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Results of the Archbold Expeditions. No. 96. Relationships and Distribution of *Genyophryne thomsoni*, a Microhylid Frog of New Guinea

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ABSTRACT

The fauna of New Guinea includes representatives of two subfamilies of microhylid frogs: the Asterophryinae and Sphenophryinae. The monotypic genus *Genyophryne* was placed in the former group, but evidence developed here indicates a closer affinity with the Sphenophryinae. The partly free tongue and procoelous vertebral column are sphenophrynine characters, and other morphological features are either neutral with respect to assessing relationships or favor the Sphenophryinae. Data on the variation and distribution of *G. thomsoni* (known only in eastern New Guinea and on the D'Entrecasteaux and Louisiade islands) are presented.

INTRODUCTION

In the course of preparing a revision of the microhylid subfamily Asterophryinae, I had occasion to investigate the subfamilial relationships of the rarely collected, monotypic genus *Genyophryne*, which had been included within that subfamily by the latest reviser, Parker (1934). Because the results of my investigation indicate that *Genyophryne* is best removed from the Asterophryinae, it seems appropriate to present the findings in this separate contribution.

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FAMILY PLACEMENT OF *Genyophryne*

In the original description of *Genyophryne*, Boulenger (1890) regarded the genus "as the type of a new family of Firmisternia, Genyophrynidae, characterized by the absence of maxillary teeth and presence of mandibular teeth. In all but the latter character it agrees with the Engystomatidae [= Microhylidae]." The "mandibular teeth" given significance by Boulenger are not true teeth, but are merely serrations on the dentary, and the teeth on the palatine bones also mentioned by Boulenger are not true teeth, but are vomerine odontoids of a sort found in numerous microhylids of New Guinea.

Presumably Méhely (1901) subscribed to Boulenger's arrangement, for in his review of the New Guinea microhylids he did not mention *Genyophryne*. Alternatively, he may not have considered it a "New Guinea" species, for it was known only from the Louisiade Archipelago. Van Kampen (1919) listed the Genyophrynidae, but remarked that it might better be considered a subfamily of the Ceratobatrachidae. This is the only published suggestion that *Genyophryne* might be more closely related to ranids (*Ceratobatrachus*, of the Solomon Islands, is now considered a ranid) than to microhylids. Later, van Kampen (1923) referred *Genyophryne* to the Brevicipitidae, and all authors dealing subsequently with the genus placed it in the Microhylidae or the taxonomically equivalent Engystomatidae or Brevicipitidae.

SUBFAMILY PLACEMENT OF *Genyophryne*

Three authors (Gadow, 1901; van Kampen, 1923; Nieden, 1926) considered *Genyophryne* a microhylid belonging to a monotypic subfamily, the Genyophryninae. None of these authors offered any new information on the genus, nor did they reinterpret Boulenger's data except to reduce the taxon to subfamily status.

The modern classification of the Microhylidae dates from Parker's (1934) monograph. In this classic work, he recognized two subfamilies in the New Guinea region: the Asterophryinae and Sphenophryninae. The first of these is limited closely to the New Guinea region, ranging from the Louisiade Archipelago on the southeast throughout New Guinea to the Moluccas. The Sphenophryninae also are most diverse in New Guinea, but outlying forms occur in New Britain, northern Australia, the Lesser Sunda Islands, Celebes, and the southern Philippine Islands.

The characters Parker listed that contrast in the two subfamilies are:

Asterophryinae

Sphenophryinae

Maxillae often overlapping the premaxillae and usually in contact anteriorly.	Maxillae not overlapping the premaxillae.
Vertebral column diplasiocoelous (rarely procoelous).	Vertebral column procoelous.
Tongue subcircular, entirely adherent, often with a median furrow and posterior pouch.	Tongue oval, half-free behind, no trace of median furrow or pouch.

Several characters, including those utilized by Parker in defining the subfamilies, may now be discussed with reference to *Genyophryne*.

MAXILLAE: The anterior ends of the maxillae in *Genyophryne* overlap the premaxillae (fig. 1A), but fall far short of making contact (the ends have a ligamentous connection). The condition in the Sphenophryinae is not quite as stated by Parker, for the maxillae do slightly overlap the premaxillae. The degree of overlap seen in *Sphenophryne palmipes* (fig. 1B) is similar to that in several other species of the subfamily that I examined. In the majority of asterophryine species the ends of the maxillae are closely approximated, either in a sutural contact or closely bound by a ligament. Species of the genera *Metopostira* and *Barygenys*, however, resemble *Genyophryne*.

The situation in *Genyophryne* is equivocal. The maxillae certainly are not typical of most asterophryines, but the anterior ends seem to be slightly more developed than in typical members of the Sphenophryinae. If anything, the evidence favors a closer relationship to the latter subfamily.

DENTARIES: Parker (1934, p. 5) mentioned that the dentaries form a median suture anterior to the mento-meckelian bones in the asterophryine genera *Asterophrys* and *Xenobatrachus* and later (1936) included this character in the definition of *Barygenys*. By implication, the Sphenophryinae are among those in which "normally the dentaries are separated by the full extent of the mento-meckelian bones . . ." (Parker, 1934, p. 5). The dentaries of *Genyophryne* are not in contact but overlap the mento-meckelian bones, perhaps slightly more than in several sphenophryines I examined. Because there is an asterophryine genus (*Metopostira*) in which the dentaries are not in contact the situation, as in the matter of maxillary contact, is not clear-cut, although, *Genyophryne*

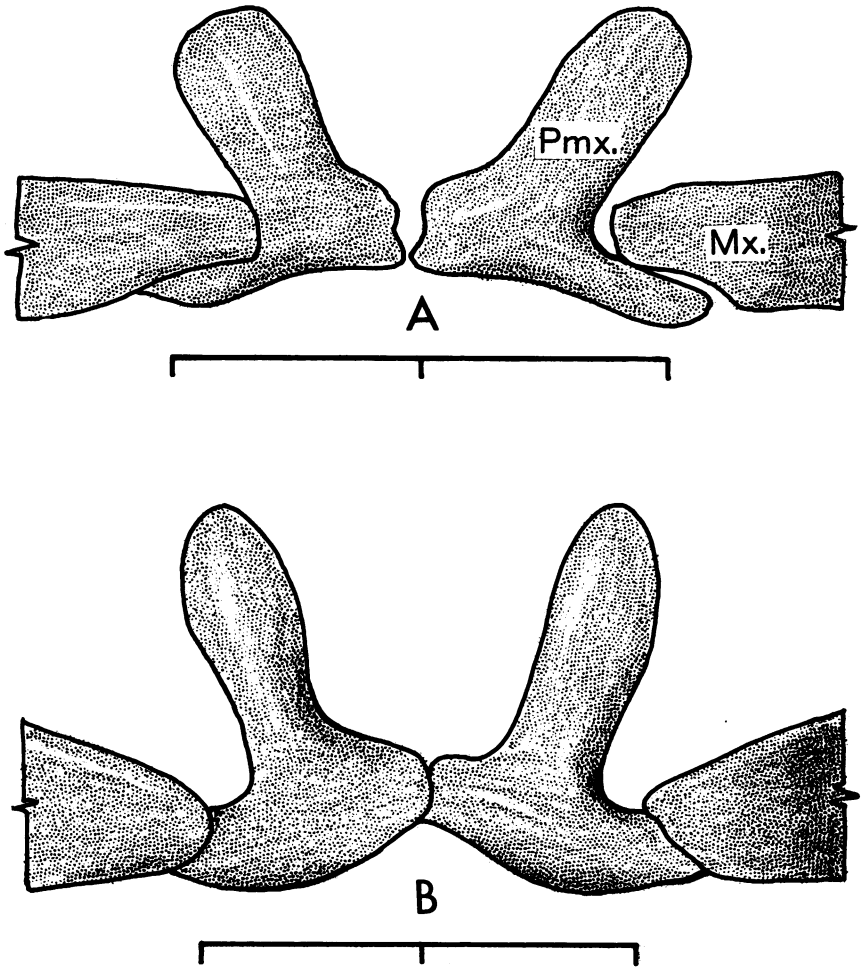


FIG. 1. *Genyophryne thomsoni* (A) and *Sphenophryne palmipes* (B) premaxillary regions in front view. Each scale line indicates 2 mm.

is somewhat more like the sphenophrynines than like the majority of asterophryines.

VERTEBRAL COLUMN: Parker's parenthetical "rarely procoelous" was included to accommodate *Genyophryne thomsoni*, the only procoelous species he referred to the subfamily Asterophryinae.

TONGUE: Parker (1934, p. 53) characterized the tongue of *Genyophryne* as "oval, entire, scarcely free behind and with a small median pouch

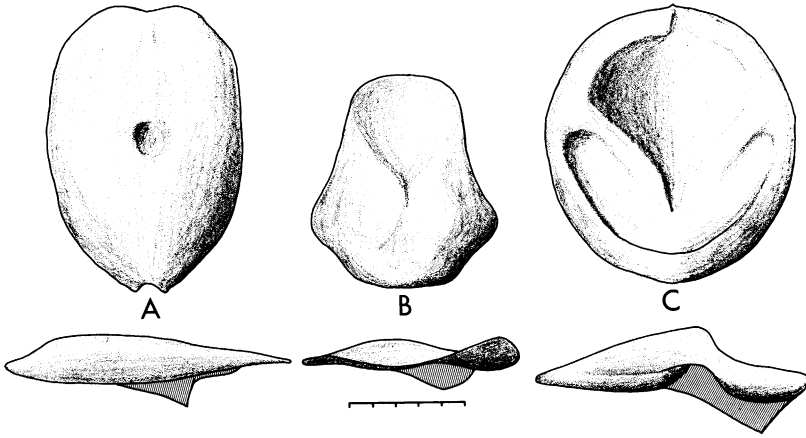


FIG. 2. *Cophixalus riparius* (A), *Genyophryne thomsoni* (B), and *Asterophrys wilhelmana* (C). Dorsal (upper row) and lateral views of tongues. Anterior is down in dorsal views and left in lateral views; basal pedicle is cross-hatched; scale line indicates 5 mm.

posteriorly." On the basis of the examination of two specimens, I regard this description as not wholly accurate. The rear of the tongue, about one-quarter of the total length, is free (fig. 2B). This is comparable to the condition in the Sphenophryinae (e.g., *Cophixalus riparius*, fig. 2A), and is quite different from the "tongue-tied" condition of an asterophryine (e.g., *Asterophrys wilhelmana*, fig. 2C). Loveridge (1948, p. 416) called the tongue "notched and free behind." The posterior part of the tongue of *Genyophryne* is thin and somewhat cupped (cupping gives the thick appearance in lateral view). This is different from the thick, pocketed tongue of *Asterophrys wilhelmana* (fig. 2C) and is more similar to the condition in *Cophixalus riparius* (fig. 2A). In being more nearly oval than subcircular, the tongue of *Genyophryne* conforms to the sphenophryine rather than the asterophryine type in Parker's terms, but I hesitate to place much significance here because the manner of killing and preservation may influence the shape. The relative freedom of the posterior edge would not be altered significantly, though, and this points to a closer relationship to the Sphenophryinae.

PECTORAL GIRDLE: Three major types of pectoral girdles exist in the Sphenophryinae: *Sphenophryne* possesses a full complement of paired ventral elements (clavicles, procoracoid cartilage, coracoids), with long, relatively straight clavicles that reach from the scapulae almost to the midline of the girdle; *Oreophryne* also has all elements, but the clavicles are

reduced to short remnants resting in the procoracoid cartilages; *Cophixalus* lacks clavicles and procoracoid cartilages. A fourth type, with procoracoids but lacking clavicles, is attributed to the genus *Microbatrachus*, but Parker (1934, p. 179) suspected that this form, described from a frog only 7 mm. long, is based on a juvenile *Oreophryne* or *Sphenophryne*. All species referred to the Asterophryinae except *Genyophryne* lack clavicles and procoracoid cartilages. In *Genyophryne* alone (if *Microbatrachus* can be set aside) are there coracoids and procoracoids but no clavicles (Parker, 1934, p. 25). Considering that the procoracoid is present in two of three well-established genera of Sphenophryinae and absent in Asterophryinae except *Genyophryne*, it appears that *Genyophryne* more closely resembles members of the first subfamily.

SUMMARY OF CHARACTERS

Parker (1934, p. 53) noted that *Genyophryne* was the only procoelous genus he included in the Asterophryinae, but considered that "its other characters all point to a closer relationship with *Asterophrys*, *Metopostira*, etc., than with any member of the Sphenophryinae." My study of the same and additional "other characters" leads me to conclude that they indicate a greater affinity of *Genyophryne* to the Sphenophryinae. The procoelous vertebral column and somewhat free tongue are sphenophrynine characters; the presence of procoracoid cartilages, separation of the maxillary bones, and separation of the dentary bones are characters more like those seen in the majority of species of the Sphenophryinae than in the majority of asterophryines. Therefore, I conclude that the genus *Genyophryne* is best removed from the Asterophryinae and placed in the Sphenophryinae. The characteristics of the two subfamilies may now be compared:

Asterophryinae	Sphenophryinae
Maxillae in contact anteriorly or (genera <i>Metopostira</i> and <i>Barygenys</i>) separated but broadly overlapping premaxillae.	Maxillae not in contact, more or less overlapping premaxillae.
Dentaries in contact anteriorly (except <i>Metopostira</i>).	Dentaries not in contact.
Vertebral column diplasio-coelous.	Vertebral column procoelous.
Tongue entirely adherent, often with a median furrow and posterior pouch.	Tongue one-quarter or more free behind, furrow and pouch not or weakly developed.

Genyophryne Boulenger

Genyophryne BOULENGER, 1890, p. 326 (type-species by monotypy: *G. thomsoni* Boulenger).

GENERIC AND SPECIFIC DIAGNOSIS: This monotypic genus differs from other genera of the Sphenophryninae in having a broad sheet of bone connecting the squamosal and the maxilla. In other sphenophrynines (and in almost all asterophryines as well), a short, cartilage-tipped arm projects anteriorly from the dorsal end of the squamosal and does not reach the maxilla. In addition, *Genyophryne* differs from *Sphenophryne* and *Oreophryne* in lacking clavicles and from *Cophixalus* in possessing procoracoids.

Genyophryne thomsoni may be distinguished from all other microhylids from New Guinea without recourse to examination of the skeleton by noting the extremely broad head (head width/snout-vent length, mean 0.50), relatively wide spacing of the nostrils (internarial distance usually greater than distance from eye to naris), and small eyes (eye length/snout-vent length, mean 0.09). Only *Asterophrys turpicula* has so wide a head, and it differs from *Genyophryne* in having larger eyes (eye length/snout-vent length, mean 0.11), more closely spaced nostrils (internarial distance less than eye-naris distance), and discs on the fingers (lacking in *Genyophryne*).

Genyophryne thomsoni Boulenger

Genyophryne thomsoni BOULENGER, 1890, p. 327 (holotype: BMNH 1947.2.10.46, formerly 1889.7.1.12, collected by Basil Thomson. Type-locality, "Sudest Island [Tagula Island, Milne Bay District, Territory of Papua], between New Guinea and the Louisiade Archipelago").

DESCRIPTION: The holotype was in "very bad condition" in 1890 (Boulenger, 1890, p. 327) and has not improved in the interim. Therefore, I do not offer a redescription of the holotype but present a composite description based on all specimens examined.

This is an extremely broad-bodied frog, with the rather flattened head as wide or nearly as wide as the trunk (fig. 3). The eyes are small, with the horizontal diameter less than the distance from eye to naris. The pupil is horizontal. The interorbital space is three times the width of an upper eyelid. The internarial distance is usually (10 of 11 specimens) greater than the distance from eye to naris. The loreal region is a gentle slope, slightly concave. There is no canthal angle. The snout is rounded and projects beyond the lower jaw.

The tympanum is scarcely visible externally. There is a weak fold of

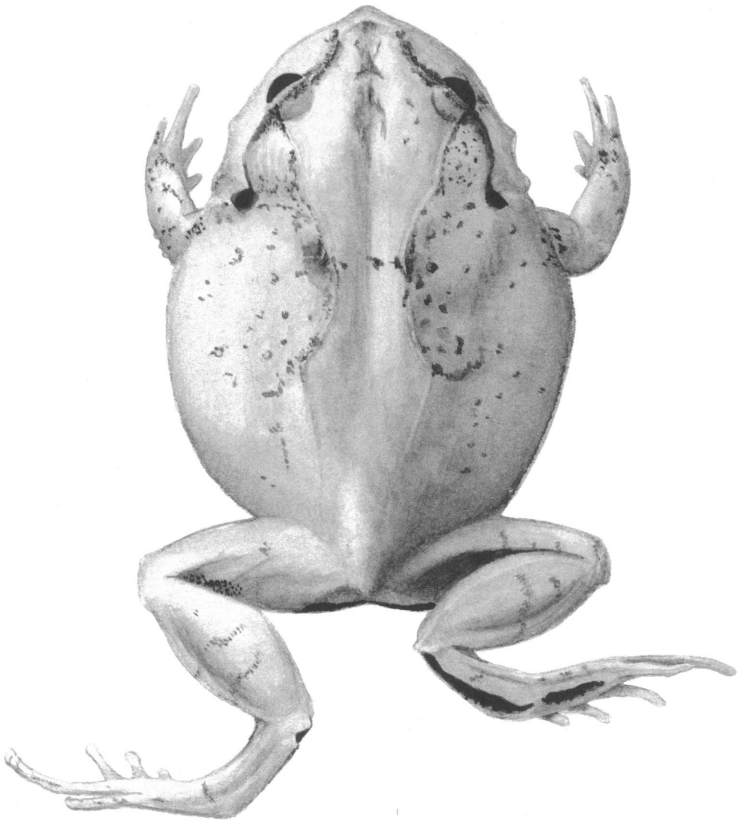


FIG. 3. *Genyophryne thomsoni*, AMNH 66956. X2.

skin above and behind the tympanum, and small warts are scattered over the dorsal surface of the body. Tiny rugosities may be present on the head. The back bears a pair of more or less distinct skin folds that begin near the eyes, converge in the scapular region and then diverge and become indistinct. The ventral surfaces are smooth. The heel has a pointed dermal projection.

The relative lengths of the short, stubby fingers are $3 > 4 > 2 > 1$ (fig. 4). They are without discs, but the third bears a faint terminal groove. The relative lengths of the toes are $4 > 3 > 5 > 2 > 1$. The first toe is extremely short and may be with or without a grooved terminal disc; the remaining toes bear small, grooved discs. Neither the fingers nor toes have subarticular elevations. The low, elongate inner metatarsal tubercle

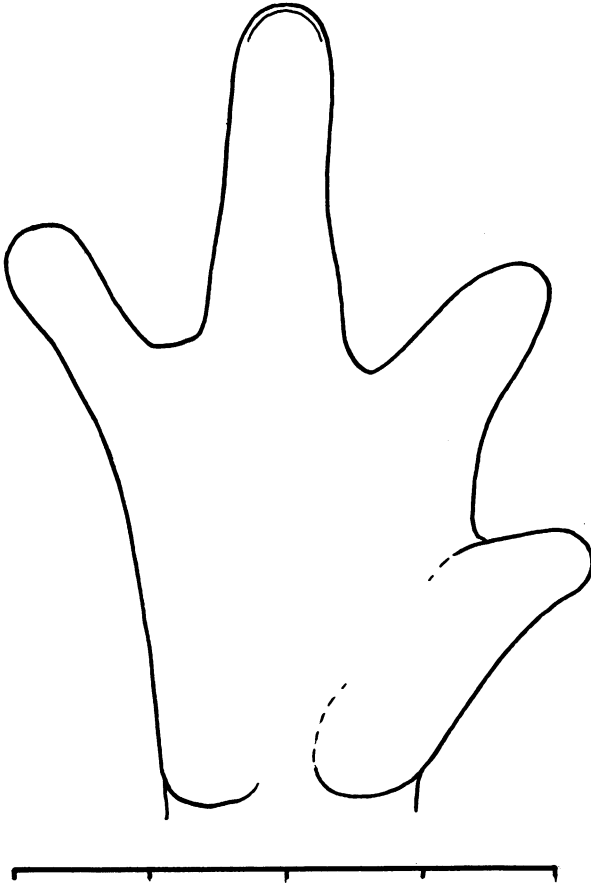


FIG. 4. *Genyophryne thomsoni*, right hand in palmar view; drawing is semidiagrammatic, but palm is virtually featureless. Scale line indicates 4 mm.

is approximately the same length as the first toe. The terminal phalanges are T-shaped.

The tongue is described earlier in the present paper. Two pharyngeal ridges are present: the former is crenulate, the posterior serrate. There is a single, subgular vocal sac with paired, slitlike openings in the floor of the mouth.

The skull (fig. 5) is extremely broad and flattened. The large nasal bones meet on the midline and also are in contact with the frontoparietal, so that the ethmoid is not visible on the dorsal midline of the skull. The broad frontoparietal flares posteriorly over the prootic region. The most

peculiar feature of the skull (for a Papuan microhylid) is the sheet of bone that connects the squamosal with the maxilla. The vomers are in broad mesial contact and have an anterior process that almost surrounds the internal choana. Slight differences between the figure given here (fig. 5B) and that of Parker (1934, fig. 24) probably are explained by different amounts of ossification in the individual specimens. A ridge on the vomer bears several small odontoids. No true teeth are present here or on the maxillae.

The dentaries do not form a common anterior suture and are not

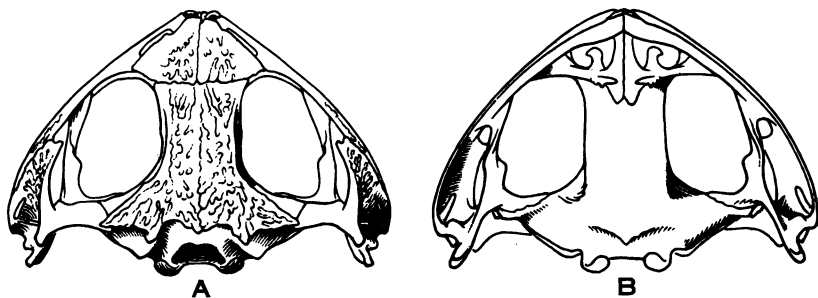


FIG. 5. *Genyophryne thomsoni* skull. (A) dorsal view. (B) ventral view. X3.

fused with the mento-meckelian bones. The anterior edge of the dentary (about 2 mm. in a large specimen) is serrate.

The bones of the dorsal surface of the skull are notably rugose. Parker (1934, p. 53) stated: "roof of the skull involved in secondary ossification with the derm." This does not appear to be the situation in the specimens I examined. The skin may be quite closely applied to the frontoparietal bones (especially if the specimen is dehydrated), but in the specimens I examined it is free of the bone.

The dorsal color in preservative ranges from gray to light tan. There is usually a dark mark above the posterior edge of the tympanum, and in some it continues anteriorly as an ill-defined postocular streak. The facial area and lips are more or less dusted with melanophores in no definite pattern. Converging skin folds on the back are accented by dark pigment, and there are symmetrically placed small dark spots elsewhere on the back. The lower posterior part of the thigh is dark brown, as is the back of the foot. The ventral surfaces are pale and immaculate. In a recently preserved specimen the brown of the ventral surfaces was darker than that of the dorsum.

The largest of 11 specimens measures 38 mm. from snout to vent.

VARIATION IN PROPORTIONS: Figures given are the mean, standard

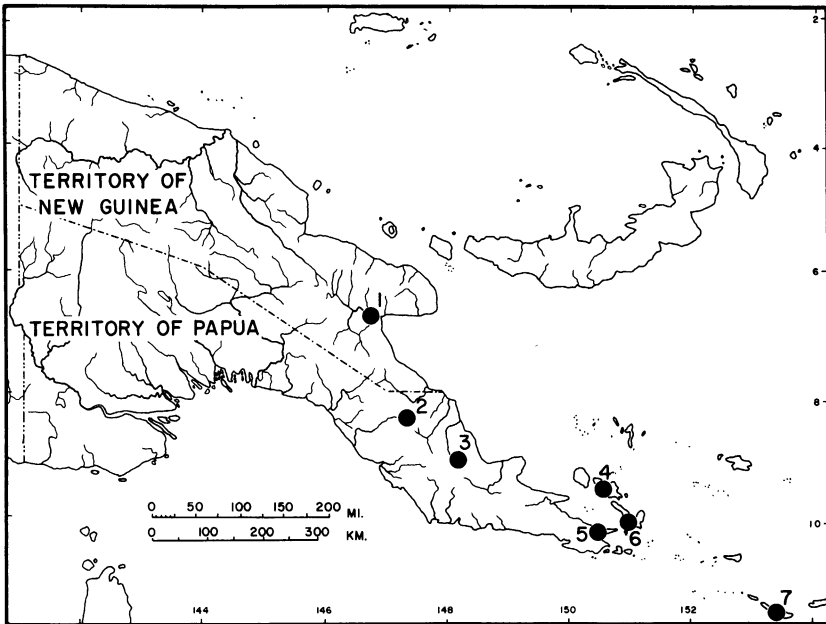


FIG. 6. Map of eastern New Guinea, showing localities for *Genyophryne thomsoni*: 1, Oomsis; 2, Mt. Albert Edward; 3, Managalase; 4, Normanby Island; 5, Alotau; 6, Fergusson Island; 7, Sudest Island (type locality).

error of the mean, and range (in parentheses); $N = 11$ in all instances: Tibia length (heel to fold of skin at knee)/snout-vent length, 0.312 ± 0.006 (0.29–0.34); head width (at angles of jaws)/snout-vent length, 0.504 ± 0.006 (0.47–0.54); eye-naris distance/internarial distance (both measured to centers of nares) 0.827 ± 0.37 (0.64–1.06); eye length (corner to corner)/snout-vent length, 0.088 ± 0.015 (0.078–0.095).

SPECIES-LEVEL TAXONOMY: Probably because this species is so distinctive morphologically and is represented in so few collections, it has remained free of synonyms. The only misidentification in the literature is that of Burt and Burt (1932, p. 483) who identified a specimen as *Asterophrys turpicula* (Zweifel, 1956, p. 3).

ECOLOGICAL NOTES: Brass (1964, p. 181) published the only information on the habitat of this species: an individual captured at Oomsis was “scratched out from the leaf litter in which it called on the forest floor.” Hobart M. Van Deusen, who collected the specimen in question and another at the same time, found them by tracing their calls at night during a light rain (personal commun.). A specimen taken by R. Pullen

at Managalase was found in rain forest floor leaf litter on a broken lava slope.

DISTRIBUTION AND SPECIMENS EXAMINED: *Genyophryne* is known to range along the northern watershed of the eastern tail of New Guinea, from the vicinity of Lae to Milne Bay, and on islands of the D'Entrecasteaux and Louisiade groups (fig. 6). Only seven definite localities of occurrence are known, and these range from about 75 to 1800 meters above sea level. The following abbreviations are used: AMNH (the American Museum of Natural History); BBM (Bernice Bishop Museum, Honolulu); BMNH (British Museum [Natural History]); MCZ (Museum of Comparative Zoology, Harvard University).

Territory of New Guinea: Morobe District: Oomsis Creek, 22 mi. W Lae, 250 ft. (75 m.) (AMNH 66986, 66987). Territory of Papua: Northern District: no specific locality (AMNH 35405); Mt. Albert Edward, 6000 ft. (1830 m.) (possibly Central District, AMNH 23822, MCZ 11646); Managalase, Pongani River, 25 mi. S Popondetta, 2000 ft. (610 m.) (AMNH 75164). Milne Bay District: Normanby Island, Mt. Pabinama, 820 m. (AMNH 60166-60169); Fergusson Island (Parker, 1934, p. 54); Sudest Island (BMNH 1947.2.10.46, holotype); near Alotau, Milne Bay, 700 m. (2300 ft.) (BBM 4123).

ACKNOWLEDGMENTS

Most of the specimens used in this study (and the first series to be collected in more than 50 years) were obtained by Leonard Brass and Hobart Van Deusen of the Archbold Expeditions, the American Museum of Natural History. Their collections added another insular record (Normanby) and extended the known range about 125 miles to the north (Oomsis). Dr. K. Paijmans generously donated the specimen from Managalase. The following persons kindly made specimens in their care available to me: Dr. A. Grandison (British Museum); Miss S. Nakata (Bernice Bishop Museum); Dr. E. E. Williams (Museum of Comparative Zoology, Harvard). I am especially grateful to Frances W. Zweifel for her careful renderings of figures 3 and 5. This study was supported in part by National Science Foundation Grant GB-2217.

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