

**THE STATUS AND RELATIONSHIPS OF SOME
EAST AFRICAN EARLESS TOADS (ANURA, BUFONIDAE)
WITH A DESCRIPTION OF A NEW SPECIES**

by

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With four plates

INTRODUCTION

In comparing some small Ethiopian *Bufo* with the descriptions, types and other examples of numerous forms from East and Central African countries I became very much aware of the confusion that exists in the taxonomy and of the need for a revision of this group of dwarf toads. Most of the earless East African toads have received little or no attention since Loveridge's papers in the 1930s and a bewildering assortment of characters of doubtful taxonomic value have been used. Two of the most misleading terms applied to these small toads are "tympanum hidden" and "paratoid obscure". Often preservation alone has rendered the outline of the tympanic annulus and the paratoid obscure or invisible and only dissection reveals the true extent of the development of the characters; yet in the past dissection has rarely if ever been carried out.

Arising from this investigation the following taxonomic changes have been made:

<i>Bufo mocquardi</i> Angel	=	<i>Bufo loennbergi</i> Andersson
<i>Bufo loennberginairobiensis</i> Loveridge	=	<i>Bufo loennbergi</i> Andersson
<i>Bufo taitanus nyikae</i> Loveridge	=	<i>Bufo loennbergi</i> Andersson
<i>Bufo taitanus uzunguensis</i> Loveridge	=	<i>Bufo uzunguensis</i> Loveridge
<i>Bufo ushoranus</i> Loveridge	=	<i>Bufo taitanus</i> Peters
<i>Bufo katanganus</i> Loveridge	=	<i>Bufo taitanus</i> Peters
<i>Bufo ushoranus</i> ; Schmidt & Inger	=	<i>Mertensophryne schmidti</i> spec. nov.

The following abbreviations are used in this paper:

A	National Museum, Nairobi
AMNH	The American Museum of Natural History, New York
BM	British Museum (Natural History), London
CAS	California Academy of Sciences, San Francisco

FMNH	Field Museum of Natural History, Chicago
IRB	Institut Royal des Sciences Naturelles de Belgique, Brussels
MCZ	Museum of Comparative Zoology, Cambridge
MHNP	Muséum National d'Histoire Naturelle, Paris
NRS	Naturhistoriska Riksmuseet, Stockholm
UMMZ	The University of Michigan, Museum of Zoology, Ann Arbor
ZMB	Zoologisches Museum der Humboldt-Universität, Berlin

Bufo loennbergi Andersson (pl. 1)

Bufo lönnbergi Andersson, 1911: 35, pl. 2 figs. 4, 6.

Bufo mocquardi Angel, 1924: 270.

Bufo loennbergi nairobiensis Loveridge, 1932: 48.

Bufo taitanus nyikae Loveridge, 1953: 339.

Material examined: 54 adults, five juveniles. KENYA: — Limuru, 7400 ft [2256 m], 1°7'S 36°37'E, A/328/1, A/329/3-6, A/97/1-3, A/826/1-19, A/594/1-2; — Mt. Kinangop, 2700 m, BM 1963.487, MHNP 1924-54, 55 (syntypes of *B. mocquardi*); — East face of Mt. Kinangop, 3000 m, MHNP 1924-51 (syntype of *B. mocquardi*); — Low forests of Mt. Kenya, 2400 m, MNHP 1924-49, 50 (syntypes of *B. mocquardi*); — Roromo, 7700 ft [2347 m], Kikuyu Forest, BM 1903.8.10.13; — Nairobi, BM 1910.10.31.19-25 (paratypes of *B. loennbergi nairobiensis*); — Mt. Kenya, 2500 m, BM 1911.7.4-5 (2 syntypes of *B. loennbergi*), NRS unnumbered (3 syntypes of *B. loennbergi*); — Mt. Kenya, 2154 m, 0°23'S 27°18'E, BM 1970.1815; — Irangi Forest, Mt. Kenya, 6500 ft [1981 m], AMNH 68481; — Nanyuki, 6000 ft [1829 m], AMNH 77291-2, AMNH 72688; — Aberdare Mts., 10,000 ft [3048 m], AMNH 73796-800. MALAWI: — Nyika plateau above Nchenachena, 7500 ft [2286 m], MCZ 27180 (holotype of *B. taitanus nyikae*), BM 1954.1.13.72-3 (paratypes of *B. t. nyikae*).

Diagnosis. — A medium-sized *Bufo* of robust proportions (body length of females up to 43.4 mm, of males up to 37.4 mm), lacking a middle ear, vocal sac, tarsal fold and tibial gland. Paratoids distinct and elevated, 2½-3 times longer than wide. Forehead sloping downwards and forwards; loreal region oblique, lips slightly flaring. First finger shorter than second. Two palmar tubercles. Subarticular tubercles under fingers and toes, paired or partially divided. Upper surfaces of head and limbs with single, very small, rounded or subconical, usually white tubercles; upper surfaces of trunk with tubercles of similar appearance but sacrum and flanks have in addition tubercles ringed by smaller tubercles. Tubercles much more developed in females; males almost smooth; sexual dichromatism present. Both sexes almost invariably with a light hair-like vertebral line and an unpigmented ventral surface.

Description. — Snout moderately pointed, the nostrils much nearer to the tip of the snout than to the eyes and on the vertical axis from the lower jaw symphysis. Canthal ridge distinct and straight; loreal region oblique, lips slightly flaring. Nostrils only very slightly swollen. Forehead sloping downwards and forwards, not swollen, without a median groove. Snout not or barely protruding, the tip rounded in profile. Tympanic annulus absent.

Paratoid glands somewhat porous, distinctly swollen, $2\frac{1}{2}$ -3 times longer than wide, often separated from the upper eyelid by a narrow gap, their outer edges usually not extending below the level of the outer rim of the eyelids and never extending below the level of the centre of the eye. Internarial distance about $1\frac{1}{4}$ times the width of the upper eyelid, interorbital width $1\frac{1}{4}$ - $1\frac{1}{2}$ times the width of the upper eyelid. First finger a little shorter than the 2nd. Two palmar tubercles, the outer large and prominent, its width twice that of the terminal phalanx of the 3rd finger and of the inner palmar tubercle. Basal subarticular tubercles of the fingers generally only partially divided and larger and more elevated than the other subdigital tubercles which are paired. Subarticular and supernumerary tubercles of toes round, smooth and occasionally paired, more prominent in females than in males; the tubercles on the soles of the feet of a similar size and shape. Inner and outer metatarsal tubercles present, subequal in width and subconical, the inner approximately equal to the width of the proximal portion of the terminal phalanx of the 4th toe. In both sexes the tubercles are separated by a distance equal to twice the width of the inner tubercle. On the external side of the 3rd toe and on the internal side of the 5th toe the webbing extends to the bases of the penultimate phalanx while on the same aspects of the 1st and 2nd toes webbing barely extends to the distal portions of the penultimate phalanges. On the internal sides of the 2nd and 3rd toes two and three phalanges respectively are free from web. The 4th toe is almost free from web; at the most the web extends as a seam halfway along the internal side of the basal phalanx and $\frac{2}{3}$ along its external side. Thus the formula of free phalanges is:

1st	2nd	3rd	4th	5th
$1-1\frac{1}{2}$	$2 : 1-1\frac{1}{2}$	$3 : 2$	$4 : 3\frac{1}{2}-4$	2

The foot measured from the tip of the 4th toe to the base of the outer metatarsal tubercle is 0.34-0.48 times the snout to vent length.

No tarsal fold. No tibial gland.

Sexual dimorphism. — The upper surfaces of female *loennbergi* bear small, round, low, and sometimes barely visible warts each surmounted by a central, subconical tubercle the tip of which is generally white but in the gravid AMNH 73796 has a small brown deposit of melanin. The lips and sides of the snout are almost smooth. On some of the low warts of the sacrum, flanks and limbs, especially the tibias, there may be groups of tubercles and often a central tubercle surrounded by a ring of slightly smaller ones. The throat, chest and belly appear glandular but in fact each glandule has a very small central tubercle.

The males are markedly smoother than the females but usually roundish, glandular warts of low elevation are present, these being either quite smooth or bearing a single, very small, white, central tubercle. Undersurfaces of the males are smooth and the supernumerary tubercles of the digits, soles and palms are often scarcely apparent. Pattern as well as texture differ sexually. The mature males are a uniform blue gray in alcohol except for remnants of occipital and interorbital dark streaks (described later in greater detail) and a hair-like whitish vertebral line. This line, present in both sexes, occurs in all but two of the examined specimens, the exceptions being an adult female from Roromo and a male in the long series obtained at Limuru, but is barely discernible in juveniles, and in one of the syntypes of *mocquardi* the line is absent from the top of the head. In all the other specimens examined the line extends from the tip of the snout to the vent.

The pattern in the female is shown in Stewart's (1967) plate 2 but most of the adult females examined in this study have less conspicuous dark lumbar blotches. The dark canthal streak, patch on top of the 5th metatarsal, the broad, dark bands on the tibia and forearm and across the interorbital region and the longitudinal dark bar along the lower half of the paratoid gland are characteristic of the species. On the occiput, and sometimes joined to the dark interorbital streak, a light shield-shaped mark outlined in dark brown is usually visible. At its apex a pair of paravertebral, dark brown wavy streaks pass backwards but peter out on the mid-dorsal or sacral region. These streaks are occasionally broken up into two or three pairs of elliptical, dark bordered, brownish patches.

In size too the sexes differ, the females being larger than the males. Eleven adult females with enlarged, pigmented ova vary in body length from 32.5-43.4 mm (M_{38.3}) while thirty-five males with nuptial pads vary from 26.6-37.4 mm (M_{32.8}). The three males from Mt. Kinangop, 2700 m, are the smallest mature individuals that have been examined; their body sizes are 26.6-28.6 mm. However, as the female obtained at 3000 m measures 41.5 mm and is not as large as some of the females collected at 2134 m and 2256 m there seems to be no correlation between altitude and size.

Nuptial asperities on the adult male occur on the inner palmar tubercle, the entire dorsal and medial aspects of the first and second fingers and the medial aspect of the third finger. There is no vocal sac.

Breeding. — Females were spawning at Limuru at 2256 m in April and females with pigmented eggs were obtained at the same locality in March, and at 2134 m on Mt. Kenya in July and at 3048 m on the Aberdares in December.

Remarks. — *Bufo taitanus nyikae* was described by Loveridge (1953)

from 2286 m on the Nyika Plateau, Malawi, and has subsequently been recorded from between 1829 and 2286 m in other parts of the plateau where it occurs "in or near wet boggy dambos on the grassland, but never at great distances from trees" (Stewart, 1967). The type material has been examined and I believe the relationships of *nyikae* are with *loennbergi*, not with *taitanus*, and that it probably represents a disjunct population of *loennbergi* and like it is restricted to high elevations. The holotype and paratypes of *nyikae* differ from *taitanus* and resemble *loennbergi* notably in head and snout shape, toe webbing, body proportions, size (♀ holotype S-V 40.0 mm, ♂ paratypes S-V 31.3 mm and 33.5 mm) and pattern. In pattern *nyikae* is particularly similar to the syntypes of *mocquardi* and is virtually identical with plate 2 in Stewart (1967), the female *nyikae* figured by Stewart resembling closely two *mocquardi* syntypes and the female holotype of *nyikae* and Stewart's mustard yellow male *nyikae* being typical of male Kenyan *loennbergi*. However, the type series of *nyikae*, and apparently also Malawi material collected by Margaret Stewart, have very slightly less web than Kenyan *loennbergi*, although considerably less than *taitanus*. Stewart (1967) states that "toes either lack webbing or have a trace at the base of the toes" but neither the holotype nor the two paratypes are completely devoid of web and the formula of free phalanges in the types examined is:

1st	2nd	3rd	4th	5th
1½-2	2 : 1½-1¾	3 : 2-2½	4 : 3½-4	2

While a discrete hair-like vertebral line and two palmar tubercles are present in the *nyikae* type material, such features, which are diagnostic of *loennbergi*, occur also in two Malawi individuals obtained at ± 914 m that I have referred to *Bufo incertae sedis*. Characters in which the holotype and two paratypes of *nyikae* differ somewhat from Kenyan *loennbergi* are in the shape and proportions of the paratoid glands and in the development of dorsal warts. In *nyikae* the glands are close to the eyes, are less elevated and oval than in *loennbergi* and while narrow and elongated tend to be broader in their anterior halves where they are about 3½ times longer than wide. Scattered over the back, flanks and tibiae are round, raised, rather conspicuous warts many of which in the female holotype are surmounted by a rosette arrangement of very small, white tubercles but in the male paratypes are devoid of tubercles and are quite smooth. These elevated warts are rather more prominent and numerous than in Kenyan *loennbergi* and approach the texture of *taitanus*. Despite these points of difference between *nyikae* and *loennbergi* I feel it is wiser at present to regard them as conspecific.

The *mocquardi* syntypes comprise two halfgrown individuals, an adult female with enlarged, pigmented ova and two sexually mature males. Although the female appears more spinose than adult *loenbergeri*, very small spinules and scattered larger, single tubercles being present on top of the head, the "sandpaper" appearance may be merely attributable to overstrong preservative, the specimen being rather brittle and dehydrated. In all other respects the series agrees favourably with *loenbergeri* and with *l. nairobiensis* type material.

Bufo loenbergeri can be readily distinguished from *B. taitanus* by its less extensive webbing (two phalanges free from web on the 5th toe but only one in *taitanus*), broader paratoids, longer 4th toe, sloping and less prominent snout, by its having two palmar tubercles, by its hair-like white line from snout to vent and by its considerably larger body size (♀ up to 43.0 mm, *taitanus* ♀ up to 28.5 mm) as well as by its more robust proportions.

Range. — Kenya and Malawi above 1800 m.

Bufo uzunguensis Loveridge (pl. 3)

Bufo taitanus uzunguensis Loveridge, 1932: 44 (part: not MCZ 16384).

Material examined. TANZANIA MAINLAND: — Kigogo, Uzungwe Mountains [\pm 1829 m], MCZ 16383 (holotype); — Dabaga, Uzungwe Mountains [1829 m], MCZ 16380, BM 1933.I.2.1 (paratype); — Lukungu, Ubena Mountains, MCZ 16385 (paratype); — Nyamwanga, Poroto Mountains [1951 m], MCZ 16386 (paratype).

Diagnosis. — A small-sized, plump *Bufo* (body length of females up to 29.3 mm, of males up to 26.2 mm), lacking a middle ear, vocal sac, tarsal fold and tibial gland. Paratoids distinct and elevated, 3-5 times longer than wide. Forehead sloping downwards and forwards, loreal region slightly oblique, lips slightly flaring. First finger shorter than second. Two palmar tubercles. Subarticular tubercles under fingers and toes generally double. Upper surfaces of head, trunk and limbs with single, very small conical tubercles; sacrum, flanks and limbs have in addition tubercles ringed by smaller ones; all tubercles devoid of horny tips. Sexes alike in pattern and texture. A light, hair-like vertebral line present. Usually a small median brown blotch on chest visible.

Description. — Snout moderately pointed, the nostrils much nearer to the tip of the snout than to the eyes, and on the vertical axis from the lower jaw symphysis. Canthal ridge distinct and straight; loreal slightly oblique, lips slightly flaring. Nostrils barely swollen. Forehead sloping downwards and forwards, not swollen, with at the most only a very shallow median groove. Snout not protruding, the tip only slightly rounded in profile. Tympanic annulus absent. Paratoid glands distinctly swollen, 4-5 times longer than wide

in the females, 3 times longer than wide in the male and juvenile, contiguous with the upper eyelids; the outer margins of the glands not extending below the level of the outer rim of the eyelids. Internarial distance in the adults $\frac{2}{3}$ the width of the upper eyelid, in the juvenile subequal to the width of the upper eyelid; interorbital width $1\frac{1}{4}$ times the width of the upper eyelid. First finger a little shorter than the second. Two palmar tubercles, the outer large and prominent, its width $1\frac{1}{2}$ times the width of the terminal phalanx of the 3rd finger and between two and three times the width of the inner palmar tubercle. Subarticular tubercles of the fingers double, prominent, subconical, of a similar size to the largest supernumerary tubercles on the palm. (Occasionally the proximal subarticular tubercle on the 3rd finger is single or partially divided.) Additional smaller subconical tubercles under the fingers and on the palm. Subarticular and supernumerary tubercles under the toes subconical and double, except for the proximal ones which are generally single, in size equal to largest tubercles on the soles. Additional smaller tubercles under the toes and on the soles. Inner and outer metatarsal tubercles present, subconical, subequal in width or the inner very slightly larger; the width of the inner tubercle $\frac{2}{3}$ the distance separating the tubercles and approximately equal to the width of the proximal portion of the terminal phalanx of the 4th toe. The tubercles are separated by a distance $1\frac{3}{4}$ -2 times the width of the inner metatarsal tubercle. The toes have only a remnant of web and the formula of free phalanges is as follows:

1st	2nd	3rd	4th	5th
1-1 $\frac{1}{2}$	2 : 1 $\frac{1}{2}$	3 : 2-2 $\frac{1}{2}$	4 : 4	2-2 $\frac{1}{2}$

The foot measured from the tip of the 4th toe to the base of the outer metatarsal tubercle is 0.31-0.36 times the snout to vent length.

No tarsal fold. No tibial gland.

While the five individuals examined show considerable variation in their dorsal pattern, they have the following features in common. There is a fine, light vertebral line from the tip of the snout to the urostyle, and a dark brown interorbital streak or band which is followed posteriorly by three pairs of dark brown blotches. The first pair of blotches is somewhat V-shaped and situated between the anterior halves of the paratoid glands, the second pair lies between the posterior ends of the paratoids and the third and usually the largest pair forms an inverted V over the urostyle. Adjacent pairs are separated by about the same distance. On the sides of the head and trunk, as far back as the level of the posterior border of the paratoid, are three, usually clearly visible pale areas, one forming a subocular blotch, a second

forming a broad, vertical or slightly oblique band on the temporal region and parallel to the second, a third broad band extending from the middle of the paratoid to behind the arm insertion. Limbs indistinctly crossbarred. On the midline of the chest there is either a faint dark brown smudge of irregular shape or inverted Y-shaped; on either side of this smudge, in front of the arm insertion a narrow, brown oblique line is present; remainders of ventral surfaces have very faint brown mottling. The upper surfaces have a very fine sandpaper-like texture with small scattered warts each of which bears a single central white conical tubercle; on the flanks, sacrum and on both fore and hind limbs some warts are surmounted by groups of white conical tubercles arranged in rosettes with a central one surrounded by a ring of smaller ones. Warts of slightly greater elevation and each bearing a small single tubercle are present on the temporal region and above the arm insertion. The lips have small spinules. The tubercles on the fore limbs are especially spinose. The undersurfaces are somewhat spinose with closely set warts each with a rosette of tiny tubercles. None of the tubercles is horn-tipped.

Sex dimorphism. — The material examined comprises a halfgrown individual, two males bearing nuptial pads on the dorsal surfaces of the first and second fingers, and two gravid females with pigmented eggs. There appear to be no sexual differences in skin texture or pattern and although the two females are somewhat larger than the two males (♀♀ 28.5 and 29.3 mm; ♂♂ 26.2 and 24.9 mm) only a larger series will indicate whether sex dimorphism exists in this form. The males lack vocal sacs.

Remarks. — The paratype MCZ 16384 from Ngombe, Ubena Mts., Tanganyika Territory, listed by Loveridge (1932) has a tympanum, tympanic annulus, single subarticular tubercles and a tarsal fold and is not conspecific with the holotype and other paratypes of *uzunguensis*.

The rest of the type material of *uzunguensis* not only differs in a number of characters from *taitanus* (snout shape, width of interorbital area, plumper build, less conical and prominent digital tubercles, double carpal tubercles, more reduced toe webbing, dorsal pattern, and in an absence of sexual difference in skin texture) but was collected in an area that is within both the altitudinal and geographical range of *taitanus* and there seems to be neither evidence for considering *uzunguensis* to be subspecifically related to *taitanus* nor for its having affinities with that species. There is, on the other hand, evidence of affinities with *loennbergi* which it resembles in its plump proportions and snout shape, presence of two palmar tubercles, a vertebral line and reduced webbing. However, it differs from *loennbergi* in its very much smaller size, different pattern, absence of both sexual differences in texture and of any development of horn-tipped tubercles, and in the shape. However, until further

collecting in the Uzungwe, Poroto and Ubena Mountains yields longer series of this form it seems wiser to treat *uzunguensis* as a distinct species.

Range. — Known only from the Uzungwe, Ubena and Poroto Mountains, Tanzania.

Bufo taitanus Peters (pls. 2, 4)

Bufo taitanus Peters, 1878: 208.

Bufo ushoranus Loveridge, 1932: 45.

Bufo katanganus Loveridge, 1932: 46.

Material examined. KENYA: — Taita, ZMB 9298 (syntype of *B. taitanus*), MCZ 22327 (syntype of *B. taitanus*); — Songhor, 0°03'S 35°13'E, BM 1970.1813-4. TANZANIA MAINLAND: — Ulugu, Ushora, ca 5000 ft [1524 m], MCZ 10330 (holotype of *B. ushoranus*); — Nyambita, Mwanza, ca 4400 ft [1341 m], UMMZ 61393 (paratype of *B. ushoranus*); — 13 miles S. Babati, 113 mls. S. Arusha, 4896 ft [1492 m], 4°11'S 35°46'E, CAS 85749; — Kampiza, Mpandu, 6°20'S 31°0'E, 5000 ft [1524 m], A/849/1-3; — Sitete, Kungwe Mts., Mahali Peninsula, Lake Tanganyika, 6°12'S 29°50'E, 4500 ft [1372 m], BM 1970.1812. REPUBLIC OF THE CONGO: — Lofoi, Katanga, BM 1920.5.13.2-3 (holotype and paratype of *B. katanganus*). MALAWI: 4 mls. E. Katumbi, 10°57'S 33°14'E, CAS 96977.

Diagnosis. — A small-sized *Bufo* (body length of females up to 31.0 mm, of males up to 27.0 mm) of slender proportions and with spindly limbs, with a prominent acuminate snout. Middle ear, vocal sac, tarsal fold and tibial gland absent. Paratoids narrow and elongate, continuous with upper eyelids, 3½-4 times longer than wide. Forehead almost horizontal, swollen and with median groove, sloping gently downwards to snout tip which is rounded in dorsal view, slightly receding in profile. Loreal region almost vertical, lips slightly flaring. First finger shorter than second. One palmar tubercle. Sub-articular tubercles paired. Upper surfaces of head and trunk with single, small subconical tubercles lacking horn tips; back, flanks, hind limbs and belly with round warts surmounted by a rosette arrangement of white conical tubercles, the central tubercle the largest. Both sexes with a dark, median patch on chest and belly, often three-pronged in front; occasionally dark mottling on belly. Dorsum with generally a pale, median, dumb-bell shaped area between occiput and middle of back. Females more warty than males.

Description. — Snout narrow and prominent, the nostrils much nearer to the tip of the snout than to the eyes and anterior to the vertical axis from the lower jaw symphysis. Canthal ridge distinct and straight; loreal region almost vertical, lips slightly flaring. Nostrils swollen. Forehead almost horizontal but sloping gently forwards and downwards, swollen and with a median groove. Snout protruding, slightly rounded in dorsal view, slightly angular and backward sloping in profile. Tympanic annulus absent. Paratoid glands distinct, elevated, elongated and narrow, 4¼ times longer than broad

in the female syntype of *taitanus* but usually $3\frac{1}{2}$ -4 times in other examples of the species, their outer margins not extending below the level of the outer rim of the upper eyelids. Internarial distance less than (usually $\frac{2}{3}$) width of upper eyelid. Interorbital distance subequal to or a little greater than width of upper eyelid but never more than $1\frac{1}{4}$ times. First finger shorter than second. A single palmar tubercle, its width subequal to or a little wider than the width of the terminal phalanx of the 3rd finger. Double, conical sub-articular tubercles under the fingers and smaller, conical supernumerary tubercles of equal size to the supernumerary palmar tubercles. Subarticular tubercles under the toes conspicuous, double and conical in the females, double but less prominent in the males. Two conical metatarsal tubercles, subequal in width, or the inner slightly larger, the inner however with a greater surface area than the outer, its width equal to that of the distal phalanx of the 4th toe; in both sexes the distance separating the tubercles $1\frac{1}{2}$ - $2\frac{1}{2}$ times the width of the inner tubercle. Toes rather broadly webbed. On the outer aspects of the 1st and 2nd toes and on the inner aspect of the 5th toe the web reaches to the bases of the terminal phalanges. Two phalanges are free from web on the inner side of the 2nd toe. On the outer aspect of the 3rd toe the web reaches to at least halfway along the penultimate phalanx and on its inner aspect to the middle or base of the antepenultimate phalanx. On the 4th toe the web extends as a fringe only along the basal phalanx. The web has a slightly denticulate margin. The formula of free phalanges is therefore as follows:

1st	2nd	3rd	4th	5th
I	2 : I	$2\frac{1}{2}$ -3 : I- $1\frac{1}{2}$	$3\frac{1}{2}$ -4 : $3\frac{1}{2}$ -4	I

Length of foot measured from the tip of the 4th toe to the base of the outer metatarsal tubercle 0.27-0.37 times the snout to vent length. On the soles of the feet numerous single, conical tubercles of approximately the same size as the subarticular tubercles and in addition smaller single tubercles; often only the larger tubercles are discernible in the males.

No tarsal fold. No tibial gland.

Stewart (1967) records this species from four Malawi localities and gives a fairly full description as well as figures of both sexes. The description fits reasonably well the individuals that I have examined except that she states that males are rougher than females, whereas the reverse condition obtains in all the *taitanus* material examined here. The belly pattern of the Katumbi example (CAS 96977), an adult male, resembles closely the figure given by Stewart but dorsally in the Katumbi specimen the dark interorbital mark is a wide V and from each arm a narrow, longitudinal dark streak runs back-

wards as far as the posterior end of the paratoid. Between these lines is a light area which broadens on the middle of the back and is bounded posteriorly by a single, dark chevron. Behind the apex of the chevron is a light median patch. The pattern is basically the same in all the *taitanus* males examined and only in the Songhor, Kenya male is there a suggestion of a pair of dark chevrons somewhat similar to that figured by Stewart. Between the chevrons of the Songhor specimen is a conspicuous broad, light area. In pattern the females are somewhat similar to the males but a light, median patch or transverse band in the occipital region is more pronounced.

There are distinct differences in skin texture between males and females. In the female the upper surfaces of the body and limbs bear well-spaced oval or round, blister-like warts each of which has a central white subconical tubercle; some of these warts have in addition an incomplete ring of smaller tubercles. The blisters are more numerous on the flanks, middle of the back, except the midline, and on the limbs, especially on the lower leg, but in the female syntype similar blister-like warts, about nine in all, occur above the jaw commissure and each one has a central, subconical tubercle which is usually encircled by additional, smaller tubercles. On the areas of skin between the dorsal warts are single, small, well-spaced, whitish tubercles; these tubercles extend on to the top of the snout, canthal ridge, eyelids and lips where however they are usually so small that they appear as fine granules. The entire undersurfaces of the female are coarsely granular and on the chest and belly consist of closely set warts each surmounted by a rosette arrangement of tubercles, i.e. a conical tubercle which is surrounded by at least one ring of smaller tubercles. The throat skin is likewise adorned by rosettes of conical warts but these are not as prominent as those on the belly. Males are considerably smoother and apart from the undersides of hands and feet the skin is almost devoid of subconical tubercles. On the flanks, sacral region and on the limbs there are smooth, depressed, rounded warts.

Sex dimorphism. — Apart from skin texture differences, which have been discussed above, there are sexual differences in body size, females attaining a greater length and more robust proportions than males. Females with pigmented ova vary in snout to vent length from 27.4 to 31.0 mm, whereas males with nuptial asperities are 21.3 to 26.9 mm. The nuptial pads of fully mature males cover the entire dorsal and medial surfaces of the first two fingers and consist of dark, brown-tipped fine spinules. The males lack vocal sacs.

Ecology. — Only the Mahali peninsula and Songhor specimens have habitat data; they were found on recently burnt over grass and down an ant-bear hole. Friedmann & Loveridge (1937) in describing their collecting

localities state that Ushora lies in dry country in which mimosa and acacia are dominant and that along the sandy river bed (dry at the time of the visit), where collecting was carried out, many bussa palms occurred. At Nyambita, where collecting was done after heavy rains, the country is grassland with scattered trees and many manyara hedges as windbreaks.

Remarks. — The agreement between the holotype and paratype of *B. katanganus* and the syntypes of *B. taitanus* is close and I can see no reason for maintaining *katanganus* as a distinct taxon. When describing *katanganus* Loveridge (1932) claimed that its more extensive webbing and smaller size preclude the possibility of confusion with *taitanus* but in fact there is only 1 mm difference in the snout to vent length of the female holotype of *katanganus* and the female syntype of *taitanus* and there appears to be no real difference in the extent of web. Loveridge also suggested that the hind limb of *katanganus* is a little longer than that of *taitanus* and that the metatarsal tubercle of the adpressed hind limb reaches to the posterior border of the orbit, but in both the *katanganus* holotype and the *taitanus* female syntype the metatarsal tubercle reaches to between the arm insertion and the eye.

Both syntypes of *B. taitanus* are in a relatively poor state of preservation. Postmortem changes caused by long immersion in alcohol seem to have accentuated the contrast between the "smooth" areas and the warty areas on the dorsum of the female but a close examination shows that development of tubercles is the same throughout all the specimens here assigned to *taitanus*. Apart from faint crossbanding of the limbs and an obscure dark interorbital area from which runs back a pair of stripes between which are light patches, no other dorsal pattern is evident in the rather bleached female. Its belly is marbled dark brown with a concentration of pigment on the midline. The male syntype is not only faded but rather shrivelled and I am uncertain to what extent emphasis should be laid on the wavy outline and slightly different proportions of its paratoids although I am convinced that there is no question of the *taitanus* syntypes being other than conspecific. Remnants of colour pattern in the male are similar to the pattern in the female syntype and in other *taitanus*; the light patch between the paratoids and median pale streak broadening on the middle of the back, and the diffuse, central dark area on the chest and belly as well as other diagnostic features agreeing well.

The presence of middle ear elements in the holotype of *Bufo taitanus beirani* Loveridge coupled with marked differences in the shape of the paratoid glands and in skin texture suggest that this form is incorrectly considered to have affinities with *taitanus*.

The holotype and paratype of *B. ushoranus* have been examined and while the condition of the paratype is poor and some of its characters difficult to

assess both the paratype and the holotype are undoubtedly conspecific with *taitanus*. The shape and proportions of the head of the *ushoranus* type material, the narrow, elongate paratoids, the extent of the toe webbing, the flaring lips, the texture of the dorsal and ventral patterns all accord with *taitanus* and, while the paratype is flabby and so badly faded that no pattern is visible, the holotype clearly shows dorsal and ventral patterns like that in the syntype ZMB 9298. Although Loveridge (1932) described the holotype as being "above uniformly yellowish brown devoid of markings", a dark, interorbital bar is evident, as well as a light occipital patch followed behind by an inverted Y-shaped mid-dorsal light area, together forming a pale dumb-bell zone; in its dorsal markings, as well as in its chest and belly pattern, it is especially similar to CAS 85749 from Babati. The holotype is a female (S-V 25.7 mm) but at an early stage of sexual maturity with small (0.3 mm diameter) unpigmented ova. The eggs of other examples of *taitanus* at a similar stage of maturity are likewise without pigment and pigment at the poles seems to appear as the eggs ripen. Both the female syntype of *taitanus* (S-V 28.5 mm) and the Kampezi individual (A/849/1, S-V 29.3 mm) have heavily pigmented ova, some of the largest measuring 1.5 mm in diameter, but the syntype has both large pigmented and small unpigmented eggs in the ovary.

Schmidt & Inger (1959) assigned 74 Congolese individuals to *B. ushoranus* and in comparing them with the holotype drew attention to the difference in the size of the metatarsal tubercles which "in the type are subequal to the tips of the toes and are separated by a distance equal to three times the width of the outer tubercle" whereas in the Congolese series the tubercles are "one and one-half times the toe tips and are separated by less than the width of the outer tubercle". Twenty seven of the Congolese specimens have been examined by me and compared with the types of both *ushoranus* and *taitanus* and this difference is confirmed. The Congolese specimens are further distinguished from *taitanus* on a number of other characters, notably in their having no adductor longus and only seven presacral vertebrae, whereas in the type material of both *ushoranus* and *taitanus* this muscle is present and they have the typical *Bufo sensu stricto* (Tihen, 1960) complement of eight presacral vertebrae. They are therefore considered as belonging to a distinct taxon which is described later in this study.

Range. — Tanzania Mainland and Songo Songo Island, Malawi. ¹⁾

¹⁾ Although Parker et al. (1940) accept Voeltzkow's record of *B. taitanus* from Songo Songo I., I suspect that the specimens were incorrectly identified since it is unlikely that a species with an altitudinal range of 1067-1829 m (Stewart, 1967) would occur on this offshore island.

Bufo *incertae sedis* (pl. 4)

Material examined. TANZANIA MAINLAND: — Liwale District, Southern Province, BM 1951.I.2.94. MALAWI: — Tuchila, between Blantyre and Mlanje, ca 914 m (2 exs., unnumbered).

Diagnosis. — A medium-sized *Bufo* of robust body and slender limbs (body length of females 33 mm), lacking a middle ear, tarsal fold and tibial gland. Paratoids distinct and elevated, $2\frac{1}{2}$ times longer than wide, broader in anterior half, separated from upper eyelid by a gap, outer margin extending to level of at least middle of eye. Forehead almost horizontal, swollen and with median groove, sloping gently downwards to snout tip; snout protruding, truncate in dorsal view, receding in profile; loreal region almost vertical, lips slightly flaring. First finger shorter than second. Two palmar tubercles. Subarticular tubercles paired. Upper surfaces of head, trunk and undersurfaces with single, small, subconical tubercles lacking horn tips; back and flanks with numerous round warts surmounted by a rosette arrangement of white conical tubercles, the central tubercle the largest. A pale vertebral line from shoulders to sacrum or tip of urostyle.

Remarks. — While these two Malawi gravid females and the eviscerated Tanzanian individual, which is in poor condition, have many features in common with *Bufo taitanus* they differ from that species and from all known South and East African species in a number of characters and their status is uncertain.

Stewart (1967) reports that none of the Malawi examples of *taitanus* examined by her has a vertebral line but these specimens possess a light, narrow band that extends from between the anterior halves of the paratoid glands to the sacral region or to the urostyle tip. While a wide open, chevron-shaped light mark occurs immediately behind an interrupted, interorbital, dark chevron and resembles the pattern in *taitanus* it does not lead backwards to a light middorsal zone; instead a small dark brown spot marks the beginning of the vertebral line and on each side of the line are two pairs of dark brown blotches, one situated at the posterior ends of the paratoids, the other on the middle of the back. Ventrally from the base of the throat to the mid-abdominal region runs a narrow dark longitudinal band of somewhat irregular outline and approximately half the snout-vent length.

These individuals further differ from *taitanus* in having a small but clearly visible second palmar tubercle situated at the base of the thumb, in their proximal subarticular finger tubercles being a little larger than the more distal ones, in the shape and position of the paratoids which are separated from the upper eyelids by a gap and are $2\frac{1}{2}$ times longer than wide at their broadest portion, which is their anterior halves, and in the glands extending farther on to the temporal region. The tip of the snout is more squared off

in dorsal view and in profile is more backward sloping. Differences occur in texture also, for no rosettes of tubercles surrounding a central spinule are present on the undersurfaces, instead the skin has closely set glandules each bearing a single, white conical tubercle. Although the trunk has many rosettes of tubercles no such distinctive grouping of tubercles can be detected on the limbs. In snout to vent length the females, which contain pigmented ova, are beyond the upper size range of *taitanus*, being 33.2 and 33.6 mm, while the six adult females of *taitanus* that were examined vary from 27.4 to 31.0 mm (average 28.0 mm), only one being 31.0 and that individual collected near Babati, Tanzania.

Further material from Malawi and from the southern provinces of Tanzania are required before one can draw conclusions on whether these *Tuchila* individuals demonstrate some geographical variation of *taitanus* or belong to a distinct taxon.

***Mertensophryne schmidtii* spec. nov. (pl. 3)**

Bufo ushoranus; Schmidt & Inger, 1959: 33 (not Loveridge, 1932).

Mertensophryne ushoranus; Tihen, 1960: 226.

Holotype. REPUBLIC OF THE CONGO: — Kateke affluent of the Muovwe, right sub-affluent of the Lufira, 960 m, Upemba National Park, BM 1968.642, adult ♂, collected by the Mission G.-F. de Witte between 23.xi.1947 and 5.xii.1947.

Paratypes. Same locality as holotype, AMNH 79876, 1 adult ♂; IRB 4304, 10 adult ♀♀, 3 adult ♂♂; FMNH 80964-68, 80970, 80972-73, 4 adult ♀♀, 4 adult ♂♂. REPUBLIC OF THE CONGO: — Kankunda, left affluent of the Lupiala and right subaffluent of the Lufira, 1300 m, Upemba National Park, IRB 4297-4303, 9 adult ♀♀, 3 adult ♂♂.

Diagnosis. — A small-sized *Bufo* of stocky build (body length of females up to 26.1 mm, of males up to 23.5 mm) with steep-sided snout. Middle ear, vocal sac, tarsal fold, tibial gland and adductor longus absent. Only seven presacral vertebrae present. Paratoids feebly developed and consisting of, at the most, an irregular and discontinuous, longitudinal row of spinose warts. Forehead a little swollen, sloping only slightly downwards and forwards; loreal region flat and almost vertical, lips not flaring. First finger shorter than second. Single palmar tubercle. Double subarticular tubercles under fingers and toes. Two closely set, conspicuous metatarsal tubercles. Back and flanks with numerous warts surmounted by a rosette arrangement of horn-tipped conical tubercles, the central tubercle the largest; similar rosettes rarely occur on the limbs. Top and sides of head with single horn-tipped conical tubercles. Males more warty than females; no sexual dichromatism. In both sexes a somewhat obscure light patch on middle of back and a dark oblong area extends onto throat.

Description of holotype. — Snout narrow, obtusely pointed, the nostrils much nearer to the tip of the snout than to the eyes and anterior to the

vertical axis from the lower jaw symphysis. Canthal ridge indistinct and straight; loreal region flat and almost vertical, lips not flaring. Nostrils barely swollen. Forehead almost horizontal but sloping forwards and downwards, a little swollen and with a shallow, median groove. Snout protruding, rounded in profile. Tympanic annulus and adductor longus absent. Seven presacral vertebrae. Paratoid glands barely discernible but consisting of a narrow, longitudinal series of discontinuous spinose warts of slightly higher elevation and greater area than other warts on trunk; outer margin of paratoids not or barely extending below outer rim of upper eyelid. Internarial distance subequal to width of upper eyelid. Interorbital distance about $1\frac{1}{4}$ times width of upper eyelid. First finger shorter than second. A single, round, conspicuous, subconical palmar tubercle, its width considerably greater than width of terminal phalanx of 3rd finger. Subarticular tubercles under fingers and toes conical and double, subequal to supernumerary phalangeal tubercles and to supernumerary tubercles on palms and on soles of feet. Inner and outer metatarsal tubercles present, subconical, inner slightly larger than outer, its width $1\frac{1}{4}$ times width of terminal phalanx of 4th toe, distance separating tubercles $\frac{2}{3}$ width of inner tubercle. Toes with much reduced and deeply emarginate web. On outer aspects of 1st and 2nd toes web reaches to halfway along basal phalanges and on inner aspect of 5th toe it extends to base of terminal phalanx. 4th toe and inner aspects of 2nd and 3rd toes free from web. On outer aspect of 3rd toe web reaches base of penultimate phalanx. The formula of free phalanges is therefore as follows:

1st	2nd	3rd	4th	5th
$1\frac{1}{2}$	$2 : 1\frac{1}{2}$	$3 : 2$	$4 : 4$	1

Length of foot, measured from tip of 4th toe to base of outer metatarsal tubercle 0.31 times snout to vent length.

No tarsal fold. No tibial gland.

Upper parts of head and body mid-brown except for a faint semicircular pale fawn area on middle of back and a similarly indistinct light zone between the paratoids which narrows and extends forwards to interorbital area. Limbs a little paler than trunk and with faint dark crossbanding. Undersurfaces cream except for a broad greyish-brown longitudinal band that runs from the midabdominal region forwards to the pectoral region where it broadens a little and passes on to the throat.

Top and sides of head and upper surfaces of limbs with numerous small, subconical warts, each surmounted by a single, conspicuous, central, conical horn-tipped spine, head spines with a particularly heavy deposit of horn. Tip of snout and upper lips with many brown spinules. Trunk warts of greater

elevation and area than those on head and having more than one horn-tipped conical spine, especially so on sacral region and flanks where spines are arranged in distinctive rosettes, the central spine being more prominent than any of the smaller spines surrounding it. Ventral skin entirely spinose, the spinules often brown-tipped and usually arranged in rosettes. No vocal sac. Nuptial pads present on dorsomedial surface of basal portion of first finger and on dorsal surface of all but terminal phalanx of second finger. Brown-tipped clusters of fine spinules present on first finger pad.

Variation in paratypes. — Apart from sexual differences in ventral pattern, texture and size (see below) the series is remarkably uniform but some minor variation in dorsal pattern exists. The large, pale middorsal area varies in shape from triangular, with the apex anteriorly, to chevron-shaped or even squarish and while it is present in all individuals it is rarely clearly visible. The light patch extending from occiput to interorbital area in the holotype is in the paratypes either restricted to a small light occipital patch or is entirely absent.

Sexual dimorphism. — At sexual maturity males are a little smaller than females. The snout to vent length varies in 23 ♀♀ from 22.7-26.1 mm and in 12 ♂♂ from 20.9-23.5 mm. Sexes are alike in dorsal pattern but ventrally females lack a dark throat although they are similar to males in having the broad dark median band from the chest to the middle of the abdomen. In texture males are more rugose and bear heavier deposits of horn on the dorsal spinules and these spines "are consequently higher and broader in mature males than in females and young males" (Schmidt & Inger, 1959). Except for the terminal phalanges, nuptial asperities cover the dorsomedial surface of the first finger and the dorsal surface of the second finger and consist of clusters of very small horn-tipped spinules. No vocal sacs present.

Remarks. — Schmidt & Inger (1959, figs. 13-14) give a very accurate representation of the head shape and texture of this species but it should be pointed out that the rosette arrangement of spinules which they figure and describe is a feature not peculiar to this species but one that is found in other East African Bufos, for example *Bufo parkeri* Loveridge (flanks), *B. loennbergi* (back of females), *B. uzunguensis* (back and limbs) and *B. taitanus*; however, of those species rosettes are a striking feature only of *B. taitanus* where they occur not only on the upper and lower surfaces of the body but also on the legs, especially the tibial portion. Although in *M. schmidti* rosettes of spinules also occur on the back, flanks and underparts, compared with *B. taitanus* the rosettes are generally more numerous and more closely set, the spinules are more conical and they bear deposits of horn and the tibiae rarely have spinules arranged in rosettes.

An examination of the 23 gravid female paratypes confirms Schmidt & Inger's (1959) statement on the size of the ova and their absence of pigmentation.

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LEGENDS FOR PLATES

Plate 1

Bufo loennbergi Andersson. Above, adult female, A/826/19; below, adult male, A/826/9. Both specimens from Kamirithu Pond, Limuru, Kenya.

Plate 2

Bufo taitanus Peters, adult females. Above, CAS 85749, from 113 miles S. Arusha, Tanzania; below, A/849/1, from Kampiza, Mpandu, Tanzania.

Plate 3

Above, *Mertensophryne schmidti* spec. nov., holotype, BM 1968.642. Below, *Bufo uzunguensis* Loveridge, MCZ 16385, from Lukungu, Ubena Mts., Tanzania (paratype of *B. taitanus uzunguensis*).

Plate 4

Above, *Bufo taitanus* Peters, adult male, BM 1970.1814, from Songhor, Kenya. Below, *Bufo incertae sedis*, adult female, unregistered (Andrew Stevens' private collection), from Tuchila, S. Malawi.







