

# American Museum Novitates

---

PUBLISHED BY THE AMERICAN MUSEUM OF NATURAL HISTORY  
CENTRAL PARK WEST AT 79TH STREET, NEW YORK, N. Y. 10024

---

NUMBER 2345

OCTOBER 4, 1968

---

## A New Species of *Bufo* from Africa, with Comments on the Toads of the *Bufo regularis* Complex

BY RONALDA KEITH<sup>1</sup>

### INTRODUCTION

The confused state of the literature dealing with the African members of the genus *Bufo* is largely attributable to the inadequacy of the diagnoses and descriptions of the species superficially resembling *Bufo regularis* Reuss (1834). Some of these species have been discussed by Poynton (1964) who admirably defined the South African forms previously considered to be subspecies of *B. regularis*. The toad described by Loveridge as *Bufo regularis kisoensis* and since reported from the Congo, Uganda, and western Kenya was elevated to specific status by Laurent (1952; see also Schmidt and Inger, 1959).

At several localities at high elevations in Kenya and Tanzania in 1962, 1963, and 1965 I collected toads that resembled *B. regularis* but differed notably in coloration and, of greater significance, in mating call as well. The purpose of this paper is to describe these toads as representatives of a new species.

The following abbreviations are used in this paper:

A.M.N.H., the American Museum of Natural History

B.M., British Museum (Natural History)

F.M.N.H., Field Museum of Natural History

---

<sup>1</sup> Associate, Department of Herpetology, the American Museum of Natural History.

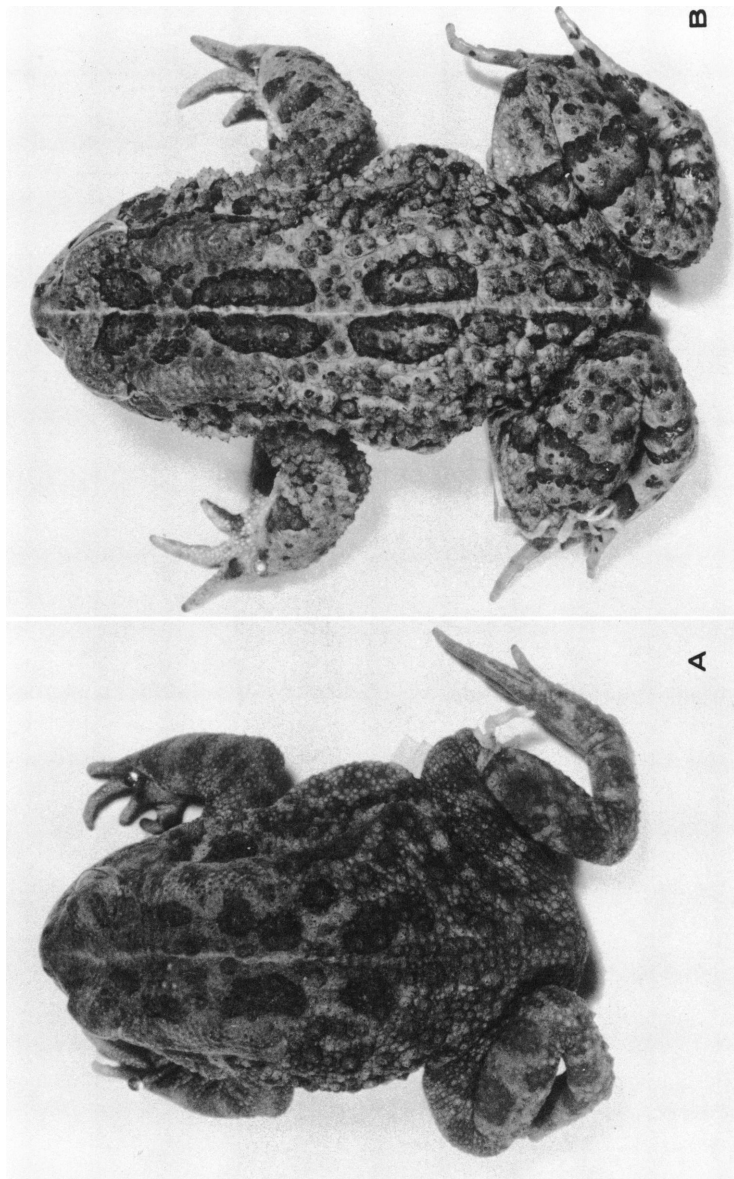


FIG. 1. A. *Bufo regularis*, A.M.N.H. No. 68462, breeding male collected March 30, 1962, at Sigor, West Pokot, Kenya, elevation 3000 feet. B. *Bufo kerryagae*, holotype, A.M.N.H. No. 75165, breeding male collected November 17, 1965, on the Nanyuki-Isiolo road, 5 miles east-northeast of Nanyuki, northwest slope of Mt. Kenya, elevation about 7000 feet, Kenya.



FIG. 2. A. *Bufo regularis*, A.M.N.H. No. 68462. B. *Bufo kerinyagae*, holotype, A.M.N.H. No. 75165.

M.C.Z., Museum of Comparative Zoology  
U.S.N.M., United States National Museum, Smithsonian Institution

Measurements of the specimens include the length from the snout to the vent; the length of the tibia, taken from the heel to the fold of the skin at the knee; the width of the head, taken at the widest part; the length of the head, measured from the posterior margin of the tympanum to the end of the snout; the hand measured from the proximal edge of the outer metatarsal tubercle to the tip of the third finger; the foot measured from the proximal edge of the outer metatarsal tubercle to the tip of the fourth toe; the horizontal diameter of the orbit; the internarial distance; the distance from the anterior corner of the eye to the naris (measurements involving the naris are taken from the center of the naris); the distance from the anterior corner of the eye to the end of the snout; and the length and the width of the paratoid glands.

The recording equipment used was a Nagra tape recorder with a Grampion microphone and an 18-inch parabolic reflector.

The name of this species is from the Kikuyu word for Mt. Kenya, the type locality.

***Bufo kerinyagae*, new species**

**HOLOTYPE:** An adult male, A.M.N.H. No. 75165 (figs. 1B, 2B), caught by R. Keith and G. H. H. Brown on the Nanyuki-Isiolo road, 5 miles east-northeast of Nanyuki, at an elevation of about 6400 feet on the northwest slope of Mt. Kenya, Kenya, on November 17, 1965.

**PARATYPES:** *Kenya*: A.M.N.H. Nos. 75166–75171, 75173–75181, 75610, from Nanyuki (the type locality); A.M.N.H. No. 75609, Maji Mizuri; M.C.Z. Nos. 25053–25058, 20205, 20206, Kinangop Plateau; M.C.Z. Nos. 3468, 3470, Mt. Kenya; U.S.N.M. No. 40886, Wambugu; U.S.-N.M. No. 40921, Fort Hall; U.S.N.M. Nos. 41705, 41706, Lake Naivasha; U.S.N.M. No. 42001, Wiji River; U.S.N.M. Nos. 129782, 129823, Sabukia; F.M.N.H. No. 2426, Lake Elmentaita; U.S.N.M. No. 42506, no locality. *Tanzania*: A.M.N.H. Nos. 75611–75613, rim of the Ngorongoro Crater. *Ethiopia*: F.M.N.H. No. 12521, Mt. Arussi, Albasso.

**DIAGNOSIS:** An African toad similar to *Bufo regularis* (figs. 1A, 2A, 5) in size and habitus. It further resembles *B. regularis* in having a distinct oval tympanum with a horizontal diameter slightly more than half of the horizontal diameter of the eye, the first finger longer than the second, and a tarsal fold. Nevertheless, its mating call differs from that of *B. regularis* in being more rapidly pulsed (figs. 11A, B, 12A). Moreover, the absence of black pigment on the throat of breeding males,

the longer tibia and foot length (fig. 3), the less extensive webbing on the toes, the shape and position of the paratoid glands, the large spines on the back of the male in the breeding season (fig. 4), and its green coloration, readily distinguish *B. kerinyagae* from *B. regularis*.

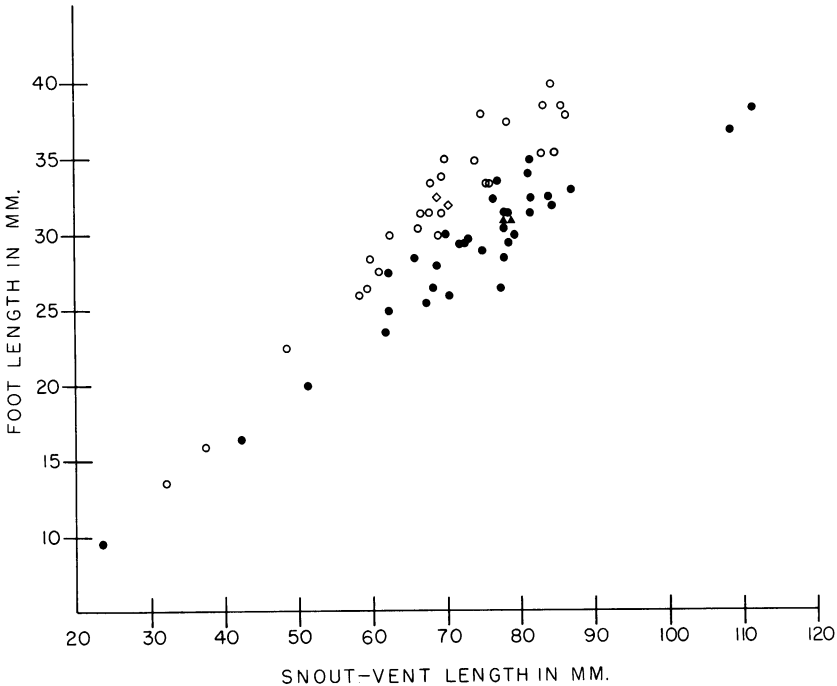


FIG. 3. Relative length of foot in *Bufo kerinyagae* (open symbols) and *Bufo regularis* (closed symbols). Each diamond and triangle indicates two specimens with same measurements.

**DESCRIPTION OF HOLOTYPE:** The specimen is an adult breeding male with measurements (in millimeters) as follows: snout-vent length, 78.3; head width, 27.6; head length, 22.4; eye-naris, 4.7; eye-snout, 11.2. The head length comprises 28.6 per cent of the distance from the snout to the vent. The snout is obtusely rounded, and the loreal region is sloping and very concave. The canthus rostralis is rounded, and the snout scarcely projects beyond the chin. The nostril is nearly halfway between the eye and the end of the snout. The interorbital distance, 5.7 mm., is 21 per cent of the head width. The tympanum is vertically oval, with a distinct border. Its horizontal diameter, 4.8 mm., is 56

per cent of the horizontal diameter of the eye (8.6 mm.). There are no cranial crests. The length of the paratoid glands is 19.5 mm. (left) and 17.7 mm. (right), and the widths, respectively, are 7.3 mm. and 7.4 mm. The paratoid glands are parallel and separated from the posterior corner of the eye by a gap of 1 mm.

The length of the hand measured from the proximal edge of the outer metatarsal tubercle to the tip of the third finger is 19 mm. The

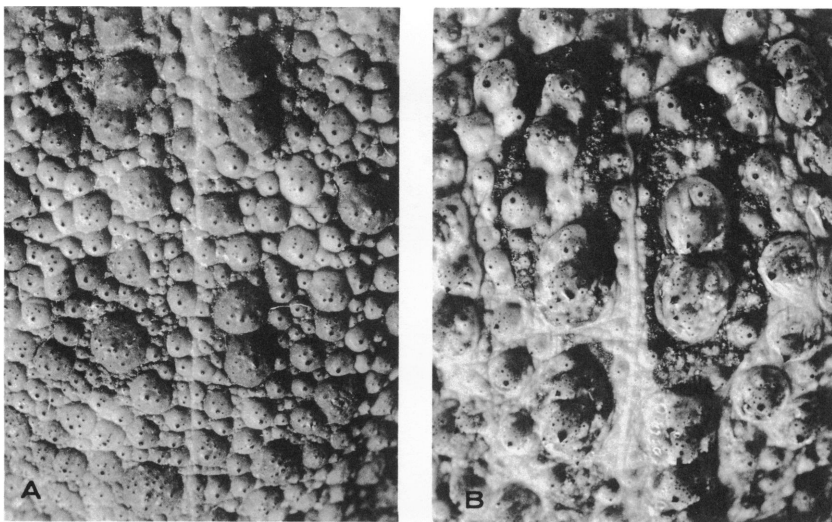


FIG. 4. Enlargement of middorsal area of *Bufo*. A. *B. regularis*, A.M.N.H. No. 68467. B. *B. kerinyagae*, holotype.

relative lengths of the fingers are  $3 > 1 > 4 > 2$ . The subarticular tubercles are prominent, and the inner two are partially cleft. A heavy, dark nuptial pad on the dorsal and median surfaces of the first finger extends from the base of the finger to the middle of the terminal phalanx. It also covers the dorsomedial surface of the second finger and the inner metacarpal tubercle.

The foot, measured from the proximal edge of the outer metatarsal tubercle to the tip of the fourth toe, is 36.9 mm. The relative lengths of the toes are  $4 > 3 > 5 > 2 > 1$ . The toes are about one-third webbed, with the webbing extending as a fringe to the tips of the toes. The length of the tibia, 30.8 mm., is 39 per cent of the snout-to-vent length.

The skin of the back, sides, arms, and upper eyelids is covered with conical warts, some of which extend 4 mm. above the surface. These

warts are tipped with sharp, brown, cornified spinules (fig. 4A, B). All the warts have smaller, ancillary, cornified points scattered over the surface of the larger core. The warts on the legs, in the interorbital region and the loreal concavities, on the paratoid glands, on the sides of the head around the tympanum, and under the chin are bluntly conical. The skin of the ventral surface is coarsely granular. There is a prominent elongate gland on the posterior surface of the forearm.

The single, subgular vocal sac has a slitlike opening on the floor of the mouth on each side of the tongue.

In life the holotype was green or greenish tan dorsally, with dark brown markings and reddish tan paratoids and upper eyelids. The color of the preserved specimen is bluish gray, with dark brown markings. There is a thin, white, middorsal stripe. A brown stripe extends from the anterior corner of the eye along the canthus to the upper lip. There is a brown suborbital blotch, and a brown stripe extends below the tympanum from the eye to the angle of the mouth. There are several other brown blotches below the paratoids and on the sides. On the back four pairs of long brown blotches are symmetrically arranged along the vertebral stripe. When the legs are folded a brown blotch on the femur is continuous with a corresponding blotch on the tibia. The blotches are dark around the edges, shading to light brown inside, and, in the wider blotches, fading away in the middle, leaving a central patch of the same bluish gray as the background. The color of the under surface is dingy, yellowish white, slightly darker under the thighs. The posterior region of the throat has a faint darkish tinge.

**VARIATION IN THE PARATYPES:** The specimens examined include nine females, 23 males (in addition to the type), and six juveniles.

The snout-to-vent length of the paratypes ranges from 32.1 mm. to 85.9 mm. The tibia length varies from 11.8 to 35.5 mm. The head width varies from 11.9 mm. to 30.9 mm. The length of the smallest breeding male is 60 mm.; of the smallest breeding female, 62.5 mm. Of the specimens examined, 33 are more than 60 mm. There is no appreciable size difference between male and female. The largest breeding male is 84.6 mm. from snout to vent; and the largest female, 85.9 mm.

Slightly more than half of the paratypes closely resemble the holotype in their coloring: the dorsum pale bluish gray, with dark brown blotches, the ventral surface more or less uniform dingy yellowish or pinkish white. Fifteen of 39 specimens are darker than the holotype. Several individuals are so dark that the pattern is obscured; these are perhaps specimens preserved in stronger solutions of formalin.

Except for the few that are too dark to show any pattern, the paratypes all share the distinctive markings of the holotype. There are long narrow blotches symmetrically arranged on the back, the sides are mottled, and the ventral surface is immaculate, except for the faint shaded area on the base of the throat, present on most of the males. In about 75 per cent of the specimens the fourth and posteriormost pair of blotches above the sacrum are broken or absent. Slightly more than

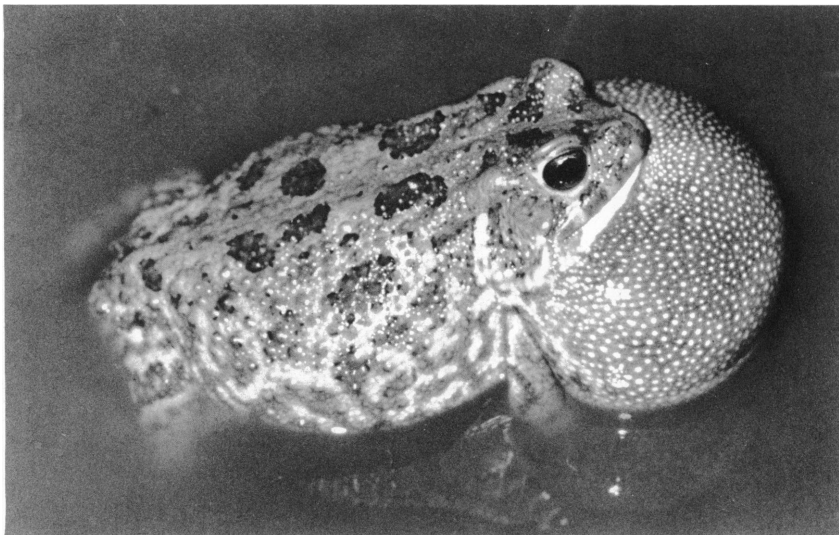


FIG. 5. *Bufo regularis* photographed near Nairobi, Kenya, at an elevation of 5900 feet, on March 17, 1963.

half of the specimens have the long prominent gland on the back of the lower arm that characterizes the holotype. On the others there is a line of smaller glands.

The paratypes resemble the holotype in having parallel, straight-sided paratoids with distinct borders that comprise a fourth of the snout-to-vent length. The paratoids are pale bluish gray as is the background color of the dorsal surface, except for the 17 specimens that have dark spots on the glands. When these spots are present there are also dark spots on the interorbital region, which is otherwise a clear bluish gray, triangular area extending from the middle of the upper eyelid to the snout.

Three of the male paratypes have paired openings to the vocal sacs, whereas four have a single opening on the right and 16 have the open-



ing only on the left. This situation is similar to that described for *Bufo regularis* by Inger and Greenberg (1956), who reported that a minority of adult males have two openings. The openings develop earlier than the nuptial pads; four males lacking nuptial pads have vocal-sac openings. The nuptial pads develop first on the first finger, then on the second, then on the metatarsal tubercle, except on one specimen that has a pad on the first finger and metatarsal tubercle only. In some

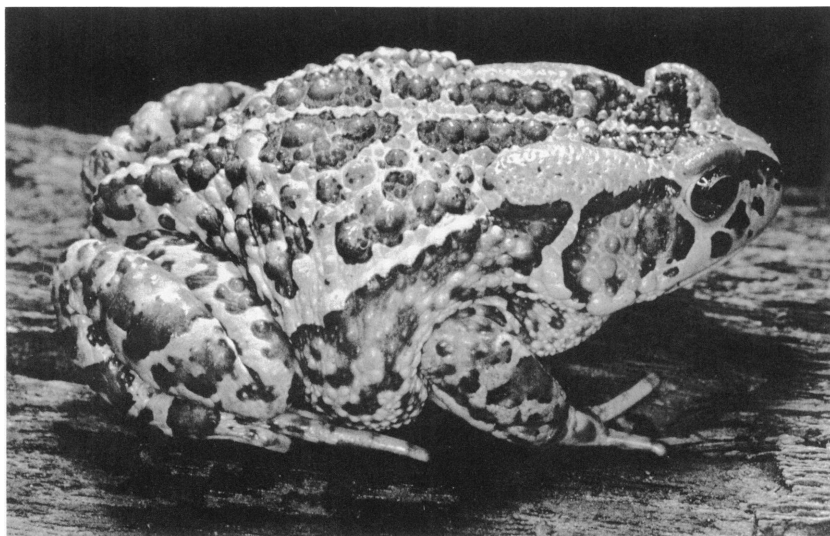


FIG. 6. *Bufo kerinyagae* from the Kinangop Plateau, Kenya, at an elevation of 10,000 feet. Photograph by George Porter.

cases the dark pigmentation does not develop until the growth of the pad is nearly complete.

The specimen of *Bufo kerinyagae* from Mt. Albasso, Arussi, Ethiopia (F.M.N.H. No. 12521), may represent a subspecies, if one difference from the holotype proves to be characteristic. The snout-to-vent length is 69.4 mm.; tibia length, 26.8 mm.; and head width, 24 mm. These are the proportions of the holotype, but the foot length is 27.3 mm., which comprises 39 per cent of the snout-to-vent length, as opposed to 47 per cent in the holotype. On the foot of the holotype the distance from the edge of the webbing to the end of the fourth toe slightly exceeds the distance from the proximal edge of the outer metatarsal tubercle to the webbing. On the Ethiopian toad the length of the fourth toe comprises 57 per cent of the palm length. The webbing is also more ex-



FIG. 7. *Bufo garmani*, A.M.N.H. No. 77281, female, from the Taita Hills, Kenya, elevation 5700 feet, collected January 18, 1963.

tensive. Otherwise, judged by its spinosity (it is a breeding male), the shape of the paratoids and what can be seen of the pattern on this particularly dark specimen, it is unmistakably the same species. It was taken at an altitude of 10,200 feet.

COMPARISONS: Most of the differences between *Bufo regularis* and *B. kerinyagae* are mentioned in the diagnosis. In addition, the paratoid glands of *B. regularis* are broader than those of *B. kerinyagae*, and they are reniform rather than symmetrically elongated ovals (figs. 1-3, 6). There is less contrast between the light and dark areas on *B. regularis*, and its blotches are less regular. Although on most animals the blotches are more or less symmetrically arranged on the dorsum, *B. regularis* is subject to much variation. On this species the paired blotches, which are on the shoulders between the posterior ends of the paratoid glands, are usually distinctly reniform or placed diagonally to the median axis, with the anterior ends more widely spaced. A pale interorbital bar is present on both *B. regularis* and *B. kerinyagae*, but on the latter the pale

TABLE 1  
COMPARISON OF BODY PROPORTIONS OF *Bufo kerryngae* AND FOUR OTHER SPECIES

Species	No.	Foot/Snout-Vent Mean $\sigma_M$	Range	No.	Tibia/Snout-Vent Mean $\sigma_M$	Range	No.	Tympanum Diameter/Eye Diameter Mean $\sigma_M$	Range
<i>kerryngae</i>	27	0.435 $\pm$ 0.005	(0.40-0.50)	27	0.398 $\pm$ 0.004	(0.34-0.43)	26	0.500 $\pm$ 0.011	(0.36-0.64)
				19 ♂	0.407 $\pm$ 0.003	(0.37-0.43)	18 ♂	0.502 $\pm$ 0.015	(0.36-0.64)
				8 ♀	0.377 $\pm$ 0.008	(0.34-0.40)	8 ♀	0.499 $\pm$ 0.015	(0.44-0.53)
<i>regularis</i>	34	0.390 $\pm$ 0.004	(0.34-0.44)	34	0.378 $\pm$ 0.003	(0.33-0.42)	34	0.608 $\pm$ 0.011	(0.51-0.79)
				27 ♂	0.378 $\pm$ 0.003	(0.34-0.42)	27 ♂	0.589 $\pm$ 0.009	(0.51-0.68)
				7 ♀	0.371 $\pm$ 0.009	(0.33-0.41)			
<i>kivuloensis</i>	16	0.435 $\pm$ 0.007	(0.37-0.49)	16	0.403 $\pm$ 0.004	(0.38-0.42)	16	0.588 $\pm$ 0.018	(0.44-0.70)
				9 ♂	0.410 $\pm$ 0.003	(0.39-0.42)	9 ♂	0.593 $\pm$ 0.021	(0.52-0.69)
				7 ♀	0.394 $\pm$ 0.008	(0.38-0.42)	7 ♀	0.681 $\pm$ 0.032	(0.44-0.70)
<i>garmani</i>	11	0.403 $\pm$ 0.004	(0.38-0.43)	11	0.366 $\pm$ 0.004	(0.36-0.41)	11	0.504 $\pm$ 0.017	(0.41-0.59)
<i>garipeensis</i>	9	0.397 $\pm$ 0.008	(0.38-0.44)	9	0.349 $\pm$ 0.003	(0.34-0.36)	9	0.377 $\pm$ 0.017	(0.31-0.48)

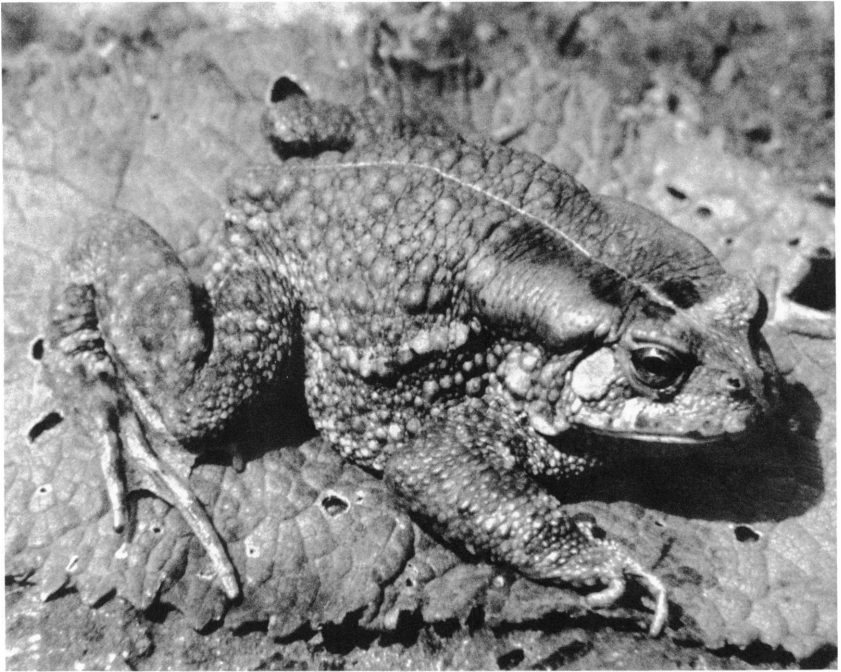


FIG. 8. *Bufo kisoensis*, A.M.N.H. No. 68484, female, from Mt. Muhavura, Uganda, elevation 10,000 feet, collected June 14, 1962.

area extends to the snout where it forms either a triangle or a T, with definite dark margins. *Bufo kerinyagae* lacks the red patch behind the thighs that in many cases is present on *B. regularis*.

Two other East African toads that might be confused with *Bufo kerinyagae* are *B. garmani* Meek (fig. 7) and *B. kisoensis* Loveridge (figs. 8, 9). *Bufo garmani* is ordinarily a savanna species, but in the vast desert areas of the Northern Province of Kenya it lives only on the isolated mountains, where the species is commonly encountered on the floor of thick montane forests. This species was well discussed and illustrated by Poynton (1964). The character he used to distinguish it from *B. regularis* in the field, "the absence of markings on the anterior half of the head," would unfortunately often serve to confuse it with *B. kerinyagae*. These two species are best distinguished by the fact that *B. garmani* lacks the spines that are present on breeding *B. kerinyagae* males and the paratoids of *B. garmani* are more widely spaced, flatter and broader than those of *B. kerinyagae*, and reniform rather than uniform in width. The relative lengths of feet and legs are similar (fig. 3).

*Bufo kisoensis* was raised to specific status by Laurent (1952), who listed many differences between it and *B. regularis*. Differences were also discussed and illustrated by Schmidt and Inger (1959).

*Bufo kerinyagae* and *B. kisoensis* are similar in size, have the same body proportions, and the breeding males of both species have a pale throat. The smooth skin of *B. kisoensis*, which becomes even smoother



FIG. 9. *Bufo kisoensis*, A.M.N.H. No. 68442, male, from 20 miles east of Kitale, Kenya, elevation 6500 feet, collected March 15, 1962.

on breeding males (fig. 9), and the more extensive webbing on its toes, readily distinguish this species. The male of *B. kisoensis* is unmarked or has very faint markings, and it may be brilliant yellow, green, or brown. Females and juveniles are more vividly marked, with a pale interorbital bar and blotches in pairs along a light median line. Unlike the situation in *B. kerinyagae*, the markings on the flanks of *B. kisoensis* tend to be in bands, rather than mottled.

I collected two juveniles of *B. kisoensis* in the forest on Mt. Kenya at 6500 feet (Irangi Forest). It is also very common in Kenya on Mt. Elgon and the Cherangani Mountains. It seems to be primarily a forest form.

Poynton (1964) believed that *Bufo gariepensis* has shifted southward, leaving behind partially differentiated disjunct populations in the southeastern Rhodesian highlands and the Drakensburg Mountains in South Africa. *Bufo kerinyagae* conceivably represents a relic montane population, but the differences in morphology and call (fig. 14) are too great to warrant placing it as a subspecies of *B. gariepensis*.

EARLIER REFERENCES TO *Bufo kerinyagae*: Perhaps the first reference to *Bufo kerinyagae* is contained in a report by Angel (1925) who described a toad collected on Mt. Kenya between 1500 and 2000 meters. Angel stated that the toad conformed to the description by Boulenger (1903) of *B. granti* (synonymized with *B. gariepensis* by Hewitt, 1911). Loveridge (1929) examined Angel's specimen and described it as resembling *B. r. regularis*. Loveridge did not distinguish between *B. regularis* and *B. kerinyagae*, however, and Boulenger described *B. granti* as "greyish or pale olive with large brown or dark olive spots or marblings," which more closely corresponds to the color in alcohol of *B. kerinyagae* than to that of *B. regularis*. Loveridge (1957, p. 311, footnote) had second thoughts about the specimen in question and, basing his action on information supplied by Dr. Jean Guibé, assigned the specimen to *Bufo latifrons*.

Loveridge's (1929) paper described a large series of "*Bufo regularis*" in the United States National Museum, mostly specimens from East Africa obtained between 1888 and 1912. My examination of this series reveals that it includes six specimens of *B. kerinyagae* (U.S.N.M. Nos. 40921, 41705, 41706, 42001, 42028, and 42506). Loveridge noted (p. 95) that "all the extremely warty toads come from the vicinity of Mt. Kenya." The same series also includes examples of *B. latifrons*, *B. garmani*, and *B. kisolensis*, as well as *B. regularis*, and a toad that Power (1927) described as *B. regularis gutturalis*, which probably deserves specific status. I hope to deal with it in a subsequent paper.

Among toads that Loveridge (1942, pp. 385-386) collected in East Africa and assigned to *Bufo regularis* are six of *B. kerinyagae* (M.C.Z. Nos. 25053-25058) from the Kinangop Plateau at 10,000 feet. Loveridge noted that they have "numerous spinose warts on the interorbital space," and that they are "bright green, their dorsal spots exceptionally elongate, thus presenting a different appearance from those seen at lower altitudes."

ECOLOGICAL NOTES: I do not know the Ethiopian locality, but in Kenya and Tanzania I found this species on the high plateaus above 6000 feet, both east and west of the Rift Valley, below the level of the forests that cover the steeper slopes of the mountains. These plateaus

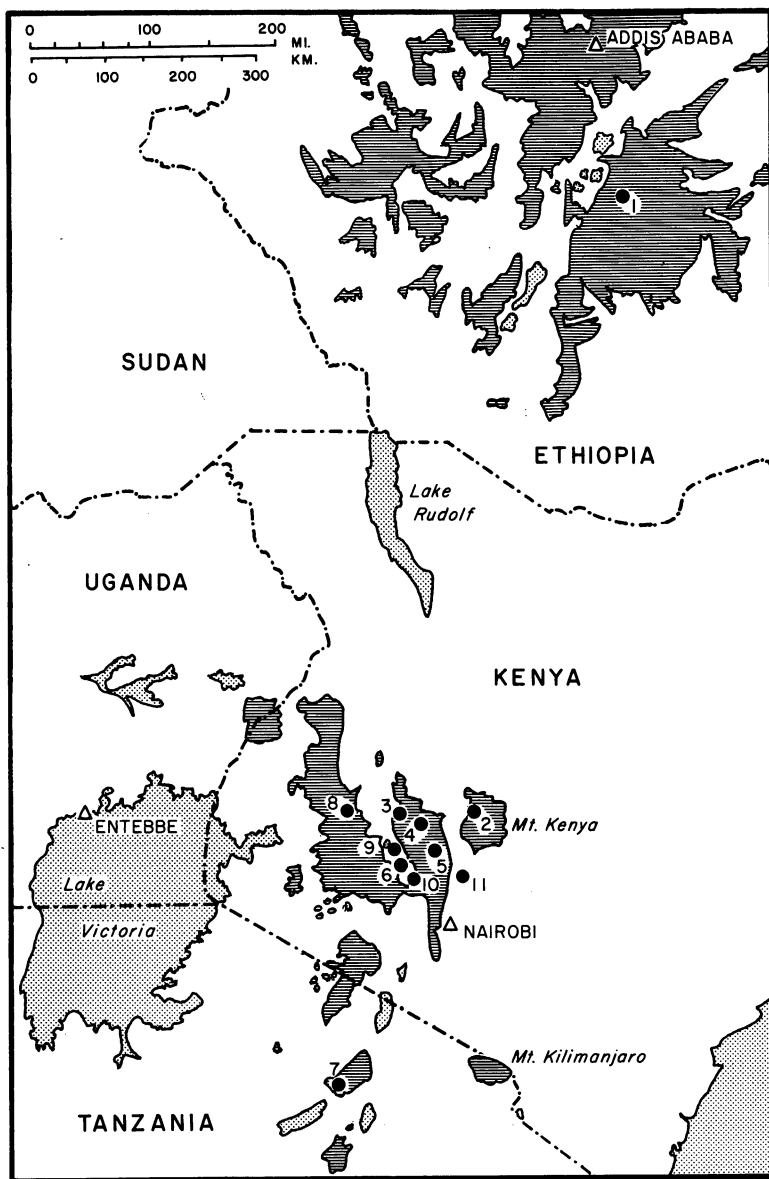


FIG. 10. Distribution of *Bufo kerinyagae*. Stippled areas represent bodies of water; cross hatching indicates upland areas (above the 6500-foot contour) where *B. kerinyagae* is known to live or may occur. Numbered localities are: 1. Mt. Albasso, Arussi. 2. Nanyuki. 3. Sabukia. 4. Lake Ol Bolossat. 5. Kinangop Plateau. 6. Eburru Hills. 7. Ngorongoro Crater. 8. Maji Mizuri. 9. Lake Naivasha.

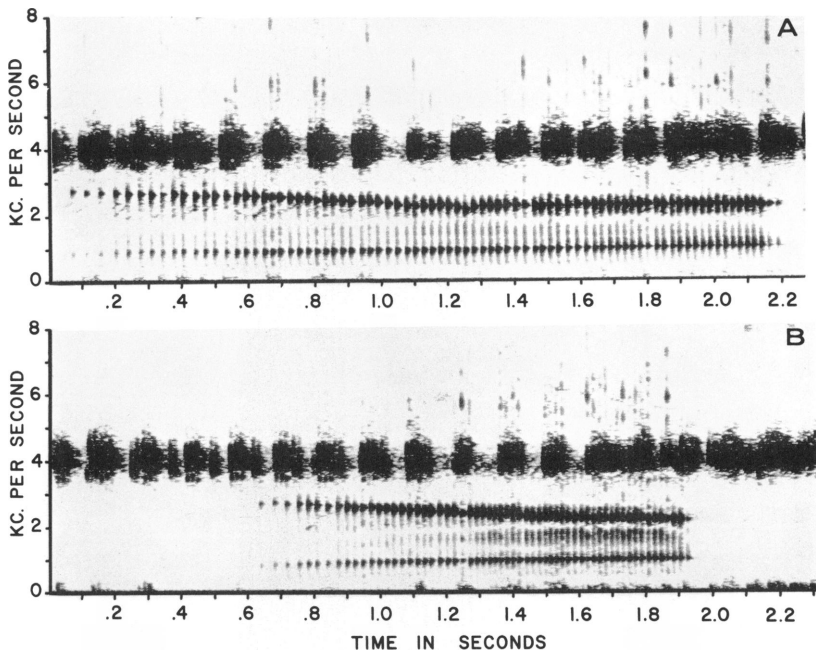


FIG. 11. A. Audiospectrogram (narrow band, 45 cycles per second) of mating call of holotype of *Bufo kerinyagae*, A.M.N.H. No. 75165, recorded on November 17, 1965, at 10:00 P.M., near Nanyuki, Kenya, elevation 6400 feet. Temperature of air, water, and toad, 16.1° C. B. Second call of same individual.

consist of flat, open grassland, where the annual rainfall is between 20 and 40 inches. The toads breed in rain pools and flooded fields at the onset of the rains. I have never found them in areas occupied by toads resembling *regularis*, although in other localities both species may occur sympatrically.

**DISTRIBUTION:** This species occurs in the highlands of East Africa in Kenya, Uganda, Tanzania, and Ethiopia (fig. 10). I have examined five specimens in addition to those listed as holotype and paratypes: Kenya: Laikipia District (B.M. No. 1912.11.8.3), and Lake Ol Bolossat, Laikipia District (B.M. Nos. 1910.10.31.17, 1910.10.31.18); Uganda: (B.M. Nos. 96.3.27.22, 96.3.27.23), and Mile 478, Uganda railway (B.M. No. 1910.3.27.9). I cannot find the last-named locality.

The localities of the specimens in the United States National Museum cited as paratypes lie beyond the areas where I am acquainted with the habitat of *B. kerinyagae*. I am unable to find "Wambugu" and Wiji



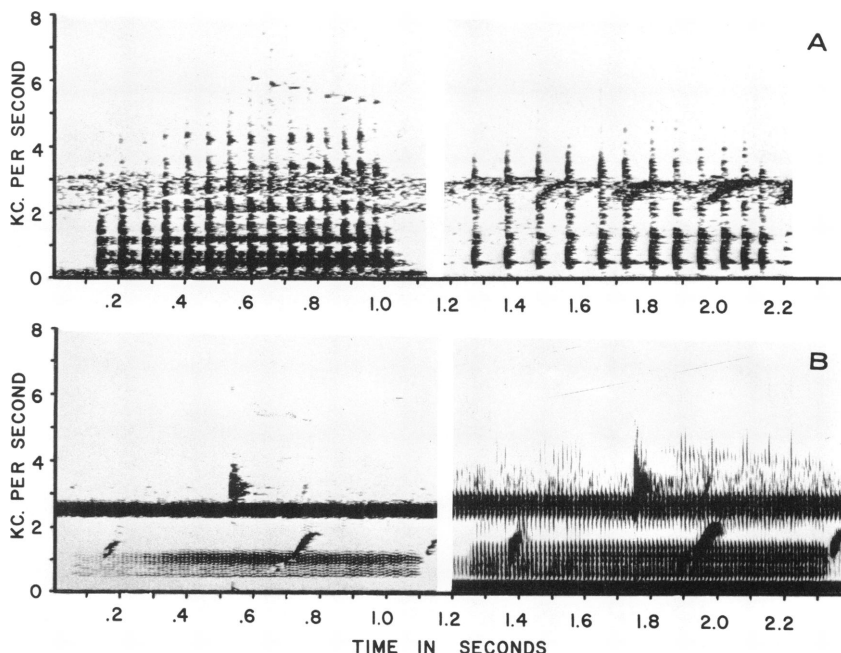


FIG. 12. Audiospectrograms of mating calls of *Bufo*. A. *Bufo regularis* (left), recorded at Amboseli, Kenya, elevation 4500 feet, on March 6, 1963; (right), recorded at Port St. Johns, South Africa, at sea level, on September 12, 1964 (both narrow band, 45 cycles per second). B. *Bufo kisoensis*, recorded at Fort Portal, Uganda, elevation 5000 feet, August 14, 1963. The same call is shown in narrow (left, 45 cycles per second) and wide band (300 cycles per second).

River on maps of Kenya. Except for the Sabukia specimens, all these were collected by the Smithsonian African Expedition in 1909, and the names then in use may since have been changed.

### MATING CALLS

Because the mating call of *Bufo kerinyagae* is distinctively different from the calls of the species that most closely resemble it in morphology, it is desirable to compare the calls objectively. Physical features of the calls are summarized in table 2, and the calls are illustrated by audiospectrograms in figures 11 to 14.

*Bufo kerinyagae*: The spectrograms (fig. 11A, B) show the structure of the calls of the holotype, which was calling in a shallow rain pool beside the road. Other toads were calling in the rain-flooded fields nearby. The temperature of the air, the water, and the individual calling was

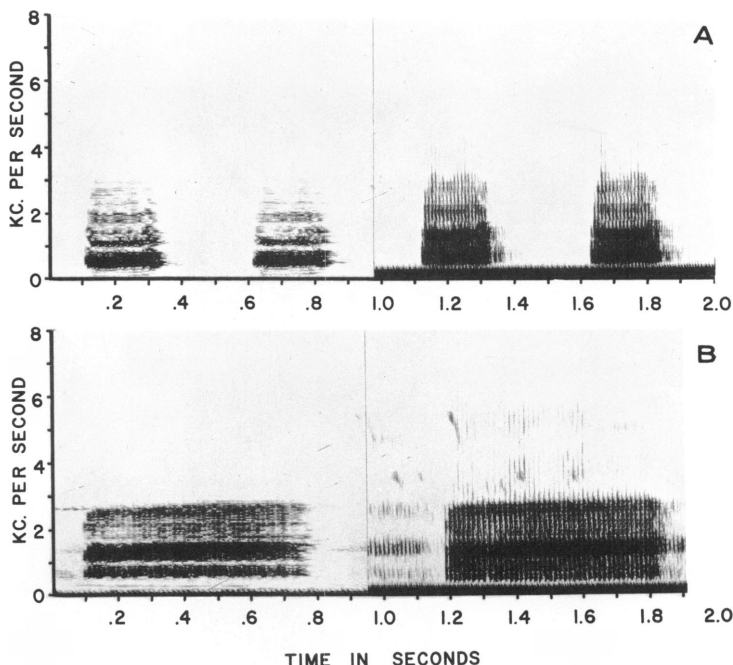


FIG. 13. Audiospectrograms of mating calls of *Bufo garmani*. A. Four calls uttered in sequence by an individual at Isiolo, Kenya, on August 18, 1961, elevation 5100 feet. Two calls at left, narrow-band display, 45 cycles per second, two at right in wide band, 300 cycles per second. B. Two consecutive calls (left, narrow band; right, wide band) recorded at Marsabit, Kenya, elevation about 3000 feet, November 11, 1962.

16.1° C. The “short rains” had started several weeks before, but the animals started breeding only in the few days previously when the water table had risen sufficiently to flood the fields. Also calling everywhere on the flooded plains were enormous numbers of *Cacosternum boettgeri*, the voices of which appear on the spectrograms at 4000 cycles per second.

The most unusual feature of the voice of *Bufo kerinyagae* revealed on the spectrograms is the steady drop in frequency of the upper emphasized band. The pulse rate is more rapid than it is in the call of *B. regularis*, but slower than in that of *B. garmani*, *B. kisaloensis*, and *B. gariepensis*.

*Bufo regularis*: The spectrograms (fig. 12A) show the structure of calls recorded at two localities 2000 miles apart. The sounds in the background of both calls represent choruses of *Hyperolius marmoratus*. The

TABLE 2  
CHARACTERISTICS OF THE CALLS OF SIXTEEN INDIVIDUALS OF FOUR SPECIES OF AFRICAN *Bufô*

Species and Locality	Call Length		Pulses per Call		Pulses per Second	
	Mean	(Range)	Mean	(Range)	Mean	(Range)
<i>kenyanae</i>						
Nanyuki, Kenya	1.4	(1.0-2.1)	62.0	(55-80)	42.9	(38- 48)
Nanyuki, Kenya	1.1	(1.0-1.3)	47.7	(42-59)	43.4	(39- 48)
<i>regularis</i>						
Port St. Johns, South Africa	0.91	(0.8-1.0)	12.4	(11-14)	13.5	(13- 14)
Amboseli, Kenya	0.85	(0.8-0.9)	14.3	(13-16)	16.6	(15- 18)
Kitale, Kenya	0.65	(0.6-0.7)	10.6	(10-11)	16.4	(16- 17)
Kitale, Kenya	0.68	(0.6-0.7)	10.8	(10-11)	16.2	(16- 17)
Kitale, Kenya	0.80	—	12.0	—	15.0	—
Lushoto, Tanzania	0.69	(0.6-0.7)	12.5	(12-13)	18.1	(17- 19)
<i>kisumuensis</i>						
Fort Portal, Uganda	1.10	(1.0-1.2)	91.2	(88-95)	81.4	(78- 83)
Kitale, Kenya	0.75	—	66.0	—	84.0	—
Kitale, Kenya	0.76	—	63.0	—	82.0	—
<i>garmani</i>						
Marsabit, Kenya	0.67	(0.5-0.9)	44.2	(34-52)	66.1	(50- 70)
Marsabit, Kenya	0.45	(0.4-0.4)	28.1	(27-30)	69.3	(65- 70)
Marsabit, Kenya	0.35	(0.3-0.4)	26.7	(26-29)	75.4	(75- 80)
Isiolo, Kenya	0.25	(0.2-0.3)	24.5	(23-27)	93.1	(90- 95)
Birchenough Bridge, Rhodesia	0.22	(0.2-0.2)	21.8	(19-24)	105.4	(105-110)

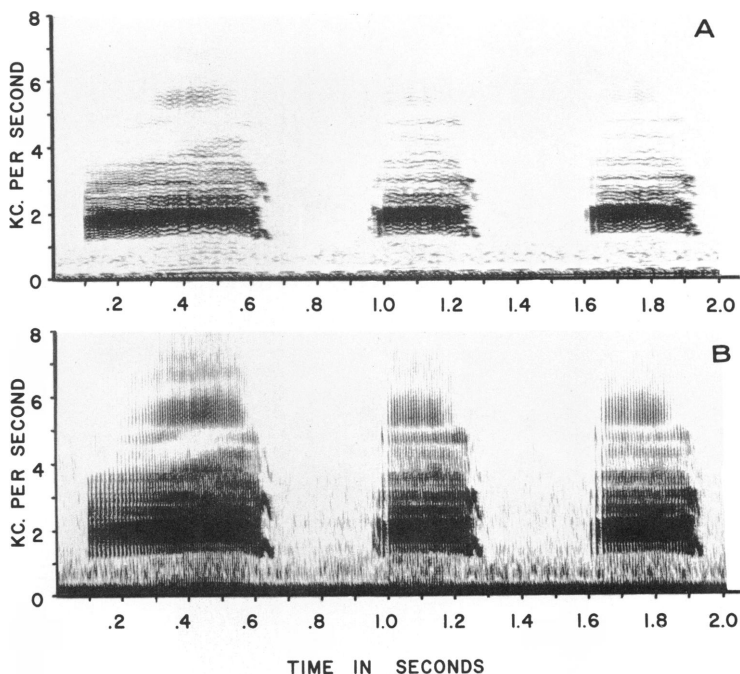


FIG. 14. Audiospectrograms of mating call of *Bufo gariiepensis* recorded at Vioolsdrif, South Africa, elevation 2000 feet, August 21, 1964. A. Narrow-band display (45 cycles per second). B. Same call in wide-band display (300 cycles per second).

individual recorded at Amboseli was calling near a fishpond in a garden, after several heavy rainstorms that heralded the start of the "long rains." The toad recorded in Port St. Johns was one of a mixed chorus of *B. regularis* and *B. rangeri* calling in a swamp by the edge of the sea.

*Bufo kisoloensis*: Toads of this species were found breeding in a pond by the edge of the Mpanga Forest. They appeared following several thunderstorms at the time of year ordinarily considered to be the dry season. The noise that appears on the spectrogram (fig. 12B) at 2500 cycles per second is produced by insects. Among the sounds represented on the spectrogram below that of the insects is the call of *Kassina senegalensis*, and above the insects is the call of an unidentified species of *Hyperolius*.

*Bufo garmani*: I recorded the call of one individual at an irrigation ditch (fig. 13A) in Kenya at Isiolo. The other recording (fig. 13B), made at Marsabit, represents one of several toads calling on the rocky edges

of a waterhole in dry, open country. I found this species breeding only during the dry season, and the animals called near water, rather than in it.

*Bufo gariiepensis*: I recorded toads of this species in an irrigation ditch on the northern edge of Little Namaqualand, where at 12:00 P.M. the air temperature was 6.1° C. and the water was 8.9° C. The toad was in extremely dry, open terrain.

The peculiarity of the call of this species is that each call consists of a series of three, and occasionally four, short bursts of different lengths, the first of which is the longest and the second the shortest. The spectrograms (fig. 14A, B) represent one complete call.

### ACKNOWLEDGMENTS

For permission to examine specimens in their charge or for other courtesies extended, I am deeply grateful to Dr. Robert F. Inger of the Field Museum of Natural History, Dr. James A. Peters of the United States National Museum of the Smithsonian Institution, Dr. Ernest E. Williams of the Museum of Comparative Zoology, and Miss Alice G. C. Grandison of the British Museum (Natural History).

### LITERATURE CITED

- ANGEL, F.  
1925. Reptiles et Batraciens. In Voyage de Ch. Alluaud et R. Jeannel en Afrique orientale (1911-1912). Résultats scientifiques. Vertebrata. Paris, vol. 2, pp. 1-63, 6 figs., pls. 1-3.
- BOULENGER, G. A.  
1903. On a collection of batrachians and reptiles from the interior of Cape Colony. Ann. Mag. Nat. Hist., ser. 7, vol. 12, pp. 215-217, pls. 16-17.
- HEWITT, JOHN  
1911. A key to the species of the South African Batrachia together with some notes on the specific characters and a synopsis of the known facts of their distribution. Rec. Albany Mus., vol. 2, pp. 189-228.
- INGER, ROBERT F., AND BERNARD GREENBERG  
1956. Morphology and seasonal development of sex characters in two sympatric African toads. Jour. Morph., vol. 99, pp. 549-574, figs. 1-11, tables 1-11.
- LAURENT, R. F.  
1952. *Bufo kisoensis* [sic] Loveridge and *Chamaeleo ituriensis* Schmidt revived. Herpetologica, vol. 8, pp. 53-55.
- LOVERIDGE, ARTHUR  
1929. East African reptiles and amphibians in the United States National Museum. U. S. Natl. Mus. Bull. 151, pp. i-v, 1-135, pl. 1.

1942. Scientific results of a fourth expedition to forested areas in East and Central Africa. V. Amphibians. Bull. Mus. Comp. Zool., vol. 91, pp. 377-436, pls. 1-4
1957. Check list of the reptiles and amphibians of East Africa (Uganda; Kenya; Tanganyika; Zanzibar). *Ibid.*, vol. 117, pp. 151-362, i-xxxvi.
- POWER, J. H.
1927. On the herpetological fauna of the Lobatsi-Linokana area. Trans. Roy. Soc. South Africa, vol. 14, pp. 405-422, fig. 1, pls. 18-22, 1 map.
- POYNTON, J. C.
1964. The Amphibia of southern Africa. Ann. Natal Mus., vol. 17, pp. 1-334, figs. 1-123, tables 1-3, maps 1-73.
- REUSS, ADOLPH
1834. Zoologische Miscellen, Reptilian. Saurier. Batrachier. Mus. Senckenbergianum, Abhandl. Gebiete beschreibenden Naturgesch., vol. 1, pp. 27-62, pl. 3.
- SCHMIDT, KARL P., AND ROBERT F. INGER
1959. Amphibians exclusive of the genera *Afrivalus* and *Hyperolius*. In Exploration du Parc National de l'Upemba, Mission G. F. de Witte. Brussels, no. 56, pp. 1-264, figs. 1-75, pls. 1-9, tables 1-46, map.