ON A NEW SPECIES OF TOAD FROM SOUTHERN MOROCCO

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With 3 text-figures and 4 plates

Abstract

A new species of toad, related with *Bufo calamita* Laurenti and *B. viridis* Laurenti, is described from the southern part of Morocco. Combining the data of the available specimens with literature records it was established that the new species probably ranges from the Sous valley southwards to Cape Bojador in the Spanish Sahara. The species seems to be restricted to semi-arid habitats. Tadpoles which probably belong to this species are described. Keys for the identification of adult toads and for the tadpoles are given.

Introduction

Early in 1971 the opportunity presented itself to pay several visits to Morocco. During the first of these trips, lasting from February 20 to March 21, the coastal region between Rabat and Sidi-Akhfennir (in the province of Tarfaya in the extreme south) was visited. The second journey, lasting from April 19 to May 18, consisted of a roundtrip starting in Ceuta, from there leading via Casablanca and Agadir to Marrakech, Ouarzazate, Fès, and again back to Ceuta. During this roundtrip several excursions were made, viz., to Goulimime and to Tafraoute in the Anti-Atlas. Both trips were largely devoted to the collecting of reptiles and amphibians.

The first trip, made in collaboration with a malacologist and three entomologists, was instigated by the circumstance that the Spanish enclave Ifni in south-western Morocco in 1969 was handed over to the Moroccan government. Before that time, foreign scientists could not obtain permission from the Spanish government to collect in Ifni, but since the transfer the Moroccan government proved very cooperative for scientists wishing to work in that area. In the region south of Agadir several interesting finds were made which are the subject of the present paper.

The herpetofauna of Morocco is relatively well known as a result of the activities of Bons (1959), Bons & Girot (1962), Boulenger (1889, 1891, 1905), Doumergue (1901), Hediger (1935), Pasteur & Bons (1959, 1960) and Werner (1929, 1931), to mention only a few of the many authors that dealt with this subject. In this light it is rather surprising that a new species of pelobatid frog was described as recently as 1959 (Pasteur & Bons). From the data given by Pasteur & Bons (1959, 1960) and Klemmer (1969) it is clear

that, though not many additions to the herpetofauna of Morocco are to be expected, still much remains to be investigated concerning the exact distribution of species within Morocco and about the ecology of many species.

Results

The main result of the 1971 research in Morocco was the discovery of a new species of toad which closely resembles *Bufo viridis* Laurenti, though on closer examination a number of differences was revealed. I here describe this new species in honour of Prof. Dr. L. D. Brongersma, director of the Rijksmuseum van Natuurlijke Historie, as

Bufo brongersmai spec. nov.

Holotype. — 1 ♀, RMNH 16782, 10 km SW. of Tiznit, along road Tiznit-Mirhleft, Morocco, 2.iii.1971, leg. M. S. Hoogmoed.

Paratypes. — 2 ♂♂, RMNH 16783, Souk-el-Arba-du-Sahel, 25 km SW. of Tiznit, along road Tiznit-Mihrleft, Morocco, 8.iii.1971, leg. M. S. Hoogmoed; 2 ♂♂, RMNH 16784, Oued Seyad, 4 km E. of Fask, Morocco, 10.iii.1971, leg. M. S. Hoogmoed; 6 juvs., RMNH 16785, Tafraoute, Anti-Atlas, Morocco, 30.iv.1971, leg. M. S. Hoogmoed; 1 ♀, RMNH 16786, Vallée des Ammeln, N. of Tafraoute, Anti-Atlas, Morocco, 30.iv.1971, leg. M. S. Hoogmoed; 23 tadpoles, RMNH 16804, Oued Seyad, 4 km E. of Fask, Morocco, 10.iii.1971, leg. M. S. Hoogmoed; 1 ♀, NMW 17221, N. of Taidales, southern Morocco, 10.iv.1963, leg. H. Franz.

Diagnosis. — A small-sized *Bufo*, greyish brown with rather small green spots above. The interorbital space is always wider than the width of an upper eyelid. In adult specimens the head is more than twice as long as deep. The parotoids are small, slightly longer than wide, nearly round. The most distal subarticular tubercle under the fourth toe is double.

Description of the holotype. — It is an adult female with a snout-vent length of 48 mm. The head takes 25% of this length. The snout is broadly rounded when seen from above, in profile it is truncate, slightly projecting beyond the lower jaw. The dorsal surface of the snout is parallel to the commissure of the mouth. The head is 2.5 times as long as deep. Loreal concave, sloping steeply towards the mouth. Canthus rostralis not very distinct, rounded. Nostril oval, nearly round, in a slightly swollen area below the canthus rostralis; its distance to the tip of the snout about half the distance between the anterior corner of the eye and the nostril. The horizontal diameter of the eye is slightly less than the distance between the anterior corner of the eye and the tip of the snout; it is 2.5 times the horizontal diameter of the tympanum. Interorbital space flat, 1.3 times as wide as an upper eyelid. Tympanum very distinct, with a bony ring, its dorso-caudal margin partly hidden by the skin; its vertical diameter 1.2 times the horizontal diameter. Distance between the tympanum and the eye about 1/4 of the horizontal eye-diameter. Pupil horizontally oval with a small ventral indentation.

No maxillary or vomerine teeth. Choanae small, round. Tongue oblong, slightly wider posteriorly than anteriorly, attached with its foremost part.

Parotoid glands protuberant; small, distinct; extending from just behind the eyes to above the insertion of the forelimbs; narrower anteriorly than posteriorly; 1.4 times as long as wide; their surface distinctly pitted.

Skin on the dorsal and lateral parts of the head smooth. Skin behind the corner of the mouth with a cluster of large warts. Skin on dorsal and lateral parts of the body with irregularly scattered warts, smallest on the dorsal, largest on the lateral parts. Warts with horny tips. Ventral skin, except that of the throat, coarsely granular. Forelimbs with scattered warts, except on the dorsal surface of the lower arm. Hindlimbs with scattered warts all over.

Hand with a large central and a small inner metacarpal tubercle. Subarticular tubercles distinct, single, the distal ones tending to be divided into two. Palm with numerous rounded tubercles, smaller than the subarticular tubercles. The second finger is slightly longer than the first one. Tips of fingers not expanded. No trace of webbing between the fingers.

Foot with a small, protuberant inner metatarsal and a small, round outer metatarsal tubercle. An indistinct metatarsal fold. Subarticular tubercles distinct, single; except the distal tubercle of the third and the two distal tubercles of the fourth toe, which are double. Numerous small tubercles on the sole and the underside of the toes between the subarticular tubercles. Web between the toes rudimentary. In the following formula (cf. Schiøtz, 1967) 1, 2i, 2e etc. refer to the first toe, the inner side of the second toe, the outerside of the second toe, respectively. The numbers between brackets indicate the number of phalanges free of web. Formula of foot: 1 (1), 2i (2), 2e (1½), 3i (3), 3e (2), 4i (4), 4e (3¾), 5 (1¾). Toes distinctly depressed, not expanded into discs. Tibio-tarsal articulation reaching to the insertion of the forelimb when the hindlimb is passed forward along the body. Ankles touching when the hindlimbs are placed at a right angle to the body. Tibia without a gland.

Colour in life pale greyish brown above with rather small dark green spots, dotted with black. Parotoid glands, upper eyelids and dorsal warts reddish. Ventral parts white with green spots. Posterior part of belly and the underside of the thighs flesh-coloured. Iris green.

In preservative the back is grey with dark blue-green spots. Spots on the head forming a Y with the two arms on the upper eyelids. The rest of the spots is irregularly dispersed over the back. A spot extends from the anterior corner of the eye via the canthus rostralis to the tip of the snout. Upper lips with two spots, a large one below the eye and a smaller one below the nostril. The blue-green spots have a rim of black dots and numerous black dots

dispersed in the blue-green. Ventral parts dirty white with small dark blue-green spots without black dots. Parotoid glands and the outer rim of the upper eyelids with a pale reddish tinge.

For measurements see table 1.

Variation. — The paratypes agree in all essential characters with the holotype. However, there is a certain amount of variation which must be clear when consulting table 1. The maximum snout-vent length found for a female is 48 mm (the holotype), for a male it is 51 mm. The head length accounts for 25%-30% of the snout-vent length, the head is 1.7-2.6 times as long as deep. The interorbital space is 1.1-1.7 times as wide as an upper eyelid. The vertical diameter of the tympanum is 0.9-1.2 times the horizontal diameter. The parotoid glands are small and distinct in all specimens, 1.0-1.8 times as long as wide. It should be kept in mind, however, that the variation is much less when the juvenile specimens are left out of consideration. These juveniles obscure the picture, especially with regard to the dimensions of the head. Here allometric growth seems to play a part. For further details concerning measurements and ratio's I refer to table 1.

TABLE 1

Measurements of *Bufo brongersmai* spec. nov.

Reg.no.	sex	A	B	(A)	C	D	(B)	E	F	(E)	G	H	I	(H)	J	K	(J)	L	(A')
RMNH																			
16782	♀	48	12.1	(25%)	13.0	4.8	(2.5)	4.6	1.8	(2.5)	2.1	4.3	3.4-3.3	(1.3)	5.9-5.9	4.3-4.1	(1.4-1.4)	13.6	(28%)
16783a	♂	41	11.4	(28%)	12.9	5.3	(2.2)	4.3	2.3	(1.9)	2.6	3.8	3.1-2.8	(1.3)	5.1-5.1	4.2-4.1	(1.2-1.2)	14.8	(36%)
b	♂	41	11.5	(28%)	13.2	5.3	(2.2)	4.3	2.0	(2.2)	2.4	4.5	2.6-2.5	(1.7)	5.8-5.4	4.3-4.5	(1.3-1.2)	15.2	(37%)
16784a	♂	49	13.8	(28%)	15.2	6.5	(2.1)	5.8	2.8	(2.0)	3.1	4.7	4.1-4.1	(1.1)	6.3-7.1	5.4-5.2	(1.2-1.4)	17.0	(35%)
b	♂	51	14.6	(29%)	16.0	5.6	(2.6)	6.3	3.3	(1.9)	3.7	4.6	4.2-4.0	(1.1)	6.6-6.6	4.9-4.8	(1.3-1.4)	17.4	(34%)
16785a	juv.	23	6.4	(28%)	7.5	3.5	(1.8)	3.1				2.8	2.0-2.0	(1.4)	3.2-2.6	2.3-2.5	(1.4-1.0)	7.5	(31%)
b	juv.	22	6.7	(30%)	6.9	3.5	(1.9)	2.8				2.7	1.9-1.8	(1.4)	2.8-2.8	2.1-2.0	(1.3-1.4)	7.6	(29%)
c	juv.	22	6.4	(29%)	6.7	3.4	(1.9)	2.8				2.3	1.8-1.7	(1.3)	2.3-2.5	2.0-1.9	(1.2-1.3)	6.8	(32%)
d	juv.	22	6.0	(27%)	6.9	3.5	(1.7)	2.4				2.3	1.6-1.8	(1.4)	2.6-2.5	1.7-1.4	(1.5-1.8)	6.8	(32%)
e	juv.	23	6.7	(29%)	7.0	3.2	(2.1)	2.9				2.9	2.0-1.9	(1.5)	3.1-3.3	2.3-2.4	(1.3-1.4)	7.3	(32%)
f	juv.	24	6.3	(26%)	7.1	3.4	(1.9)	3.2				2.7	1.8-2.0	(1.4)	2.7-3.0	2.1-2.1	(1.3-1.4)	7.5	(32%)
16786	♀	45	11.3	(25%)	13.0	5.4	(2.1)	5.2	2.3	(2.3)	2.3	4.8	2.8-2.8	(1.7)	5.5-5.4	3.8-3.6	(1.4-1.5)	14.0	(31%)
NBM																			
17221	hgr.	33	9.3	(28%)	10.5	4.2	(2.2)	3.7	1.3	(2.8)	1.2	4.1	2.5-2.3	(1.7)	5.6-4.7	3.7-4.3	(1.5-1.1)	10.9	(32%)
Range of ratios:			25%-30%			1.7-2.6			1.9-2.8				1.1-1.7			1.1-1.8			28%-37%
Average of ratios:			28%			2.1			2.2				1.4			1.3			32%

A, snout-vent length; B, head length (distance between tip of snout and posterior margin of the tympanum); C, head width at tympanum level; D, head depth at tympanum level; E, horizontal diameter of eye; F, horizontal diameter of tympanum; G, vertical diameter of tympanum; H, interorbital width; I, width of left and right upper eyelid; J, length of left and right parotoid gland; K, width of left and right parotoid gland; L, length of tibia. All measurements are in mm.

(A) = B/A × 100; (B) = B/D; (E) = E/F; (H) = H/average of both values in I; (J) = J/K; (A') = L/A × 100.

There is sexual dimorphism in the amount of webbing of the toes. The situation in females is about as described above for the holotype. Foot formula for females (including holotype): 1 (1-1½), 2i (2), 2e (1½-1¾), 3i (3-3¼), 3e (2-2½), 4i (4), 4e (3¾-4), 5 (1¾-2). In males the web

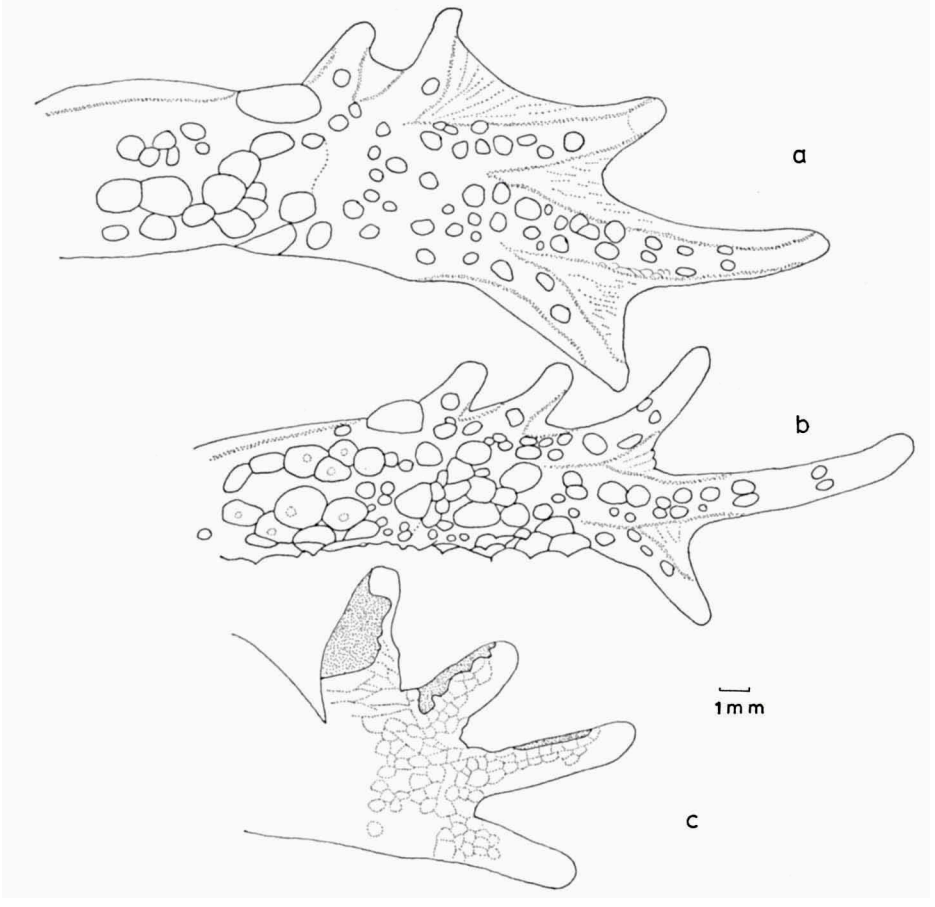

Fig. 1. *Bufo brongersmai* spec. nov. a, ventral surface of left foot, ♂ (RMNH 16784b); b, ventral surface of left foot, ♀ (RMNH 16782); c, dorsal surface of right hand, ♂ (RMNH 16784b), showing the black nuptial pads.

is nearly as large as in females, but here the web extends to the tips of the toes as a fringe, so it is impossible to give a formula. The males have nuptial pads on the first three fingers of the hands. The inner side of these fingers and the dorsal surface of the first finger are covered with small, dark brown horny warts. Another difference between the sexes is found in the condition of the warts on the dorsal part of the body. In females, the warts have opaque, rounded, horny tips; in males these tips are brown, conical and sharply pointed. Males have an internal subgular vocal sac, opening with two longitudinal slits in the floor of the mouth.

All specimens have a double distal subarticular tubercle under the fourth

toe. The distal tubercle under the third toe and the one but last distal tubercle under the fourth toe may be double.

The pattern on the head is not very variable. In all specimens a transverse spot is present on each upper eyelid, the two spots sometimes forming a transverse bar. The large spot under the eye is always present as is the spot on the canthus rostralis. Spots on the body and on the limbs are distributed haphazardly, never leaving a light stripe over the vertebral area.

In life there is some variation in the intensity and extent of the red on parotoid glands and upper eyelids. The spots on the back vary from light to dark green.

Ecology. — The specimens collected south of Tiznit were found in a hilly landscape, the holotype in a small valley with a grassy floor, scattered with larger and smaller rocks, the slopes of the hills grown with *Argania* and *Euphorbia*. The two male paratypes RMNH 16783 were found under stones in a recently ploughed field near a village. The specimens from the Anti-Atlas (RMNH 16785 and 16786) were collected in fields in sheltered valleys, with a young growth of Gramineae among which also *Argania* was present. The two males RMNH 16784 were collected along the margins of pools remaining in the valley of the Oued Seyad, in the desert. Practically no vegetation at all was present. Summarizing, we may say that this species seems to live in semi-arid conditions, in sparsely grown country with only a scanty growth of trees. It was found at an altitude varying between 171 m (Souk-el-Arba-du-Sahel) and 1000 m (Tafraoute). All specimens were found during day-time between 10.00 a.m. and 4.30 p.m. All but one were found under relatively large stones. The only specimen (a male) that was not found under a stone (RMNH 16784) was sitting in the shallow water near the margin of a pool in a river valley in the desert. Several other specimens were seen but not captured. All specimens were sitting with their heads pointing towards the shore and, when disturbed, simply let themselves slide backwards into the muddy water where they disappeard from sight. This was between 10.30 and 11.00 a.m. on March 10, 1971, when the sky was overcast and the temperature low (estimated at about 15° C). The night before there had been some rain. Together with the specimen taken from a pool, another male was collected from beneath a large stone lying at the edge of the water where I heard it croaking several times, though I do not think this was a mating call. Mating calls from other species of *Bufo* from Europe, America and Africa that I am acquainted with all have the same basic rolling sound and the sound uttered by this male of *B. brongersmai* merely consisted of some short squeaks. Perhaps it was a distress call prompted by the vibration of the soil under my footsteps. Unfortunately, the sound could not be recorded. A few days later (March 14) the same

TABLE 2

Measurements of Moroccan *Bufo viridis* Laurenti. For explanation, see table 1.

Reg.no.	sex	A	B (A)	C	D (B)	E	F (E)	G	H	I (H)	J	K (J)	L (A')
RMNH													
16780a	♀	81	19.3(24%)	24.3	12.1(1.6)	8.3	3.0(2.8)	3.4	4.8	6.5-6.5(0.7)	18.0-16.4	9.5-10.3(1.9-1.6)	23.9(30%)
b	♂	87	21.6(25%)	27.4	12.2(1.8)	8.3	3.4(2.5)	5.1	6.2	6.9-6.8(0.9)	18.5-16.7	8.7- 8.5(2.1-2.0)	29.7(34%)
16781	♂	65	18.0(28%)	21.7	10.5(1.7)	8.1	2.9(2.8)	3.6	4.3	6.4-7.1(0.6)	14.3-14.0	6.9- 6.8(2.1-2.1)	21.4(33%)
16787	♂	80	20.5(26%)	25.2	13.6(1.5)	8.1	3.3(2.5)	4.8	6.5	5.6-6.2(1.1)	15.0-16.0	8.3- 8.7(1.8-1.8)	26.8(34%)
17051	juv.	29	10.6(37%)	11.4	6.3(1.7)	3.7			3.0	2.8-2.8(1.1)	6.4- 6.7	2.7- 2.5(2.4-2.7)	10.2(35%)
SMF													
3635	♂	81	22.0(27%)	25.4	11.5(1.9)	6.8	4.3(1.6)	5.3	6.4	6.5-6.8(0.9)	16.3-15.6	7.0- 7.6(2.3-2.1)	28.7(35%)
3636	juv.	37	10.5(28%)	11.9	6.7(1.6)	4.6	1.3(3.9)	2.2	3.1	3.6-3.2(0.9)	7.9- 8.0	4.5- 4.2(1.8-1.9)	11.4(31%)
3637	juv.	36	9.5(26%)	10.9	6.2(1.5)	2.9	1.1(2.6)	1.7	3.1	3.1-3.1(1.0)	7.0- 6.3	3.2- 3.4(2.2-1.9)	9.9(27%)
3638	juv.	35	9.1(26%)	11.5	5.3(1.7)	3.5	1.0(3.5)	1.6	3.2	3.5-3.5(0.9)	6.7- 6.5	4.4- 3.3(1.5-2.0)	10.4(30%)
3639	juv.	31	8.5(27%)	9.8	5.8(1.5)	3.4			2.6	2.7-2.7(1.0)	5.8- 5.1	2.5- 2.3(2.3-2.2)	9.4(30%)
NMW													
4971.1	♀	80	20.1(25%)	25.5	11.4(1.8)	8.4	3.7(2.3)	4.8	6.8	6.2-5.8(0.9)	16.0-15.7	7.8- 7.8(2.1-2.0)	25.2(31%)
4971.2	♀	68	19.4(29%)	22.9	11.6(1.7)	7.0	2.8(2.5)	4.0	4.3	5.3-5.7(0.8)	18.0-15.7	9.3- 9.3(1.9-1.7)	22.8(34%)
Range of ratios:			24%-37%		1.5-1.9		1.6-3.9			0.6-1.1		1.5-2.7	27%-35%
Average of ratios:			27%		1.8		2.7			0.8		2.0	32%

place was visited again but now no toads were observed. The climatic conditions were about the same as on March 10, but now a strong wind was blowing, considerably rippling the water, and the level of the water in the pools had fallen about 50 cm. During the periods March 5-March 19 and April 25-May 4, all seemingly suitable localities where *B. brongersmai* might breed were searched by night, but with no result. On March 10, a number of tadpoles were collected in the largest of the pools in the Oued Seyad, near the ford east of Fask, where the two males RMNH 16784 also were collected. These tadpoles very probably belong to the newly described species *B. brongersmai*, but as no complete series is available there remains some uncertainty. A description of the tadpoles is given below.

B. brongersmai was collected together with *B. viridis* Laurenti in the Oued Seyad, east of Fask, where a couple in copula (RMNH 16780) of the last named species was collected. The female was full of ripe eggs.

Description of the tadpoles. — In the material four stages are represented. The smallest specimen, having a body-length of 8.4 mm and a tail-length of 12.5 mm, belongs to stage 28 of Limbaugh & Volpe (1957). A medium-sized specimen has a body-length of 10.5 mm, a tail-length of 16 mm and belongs to stage 30. Two specimens belonging to stage 33 have a body-length of 15.0 and 15.2 mm and a tail-length of 23.0 and 20.1 mm, respectively. The largest specimens all belong to stages 36/37 and vary in body length from 16.0 to 17.2 and in tail-length from 21.0 to 30.0 mm.

The body is ovoid, flattened dorso-ventrally, 1 1/4 times as wide as deep, 1 2/3 times as long as wide. The tail is slightly more than 1 1/2 times as long as the body and three times as long as deep. The dorsal seam of skin is slightly wider than the ventral one and ends on the muscular base of the tail, well in front of the anus. The tip of the tail is rounded. The anus is median, the

spiraculum on the left side of the body, pointing straight backwards and sometimes pointing slightly upwards. The eyes are on the top of the head, large and invisible from below. The interorbital space is as large as the distance between the nostrils, or only slightly wider. Nostrils oval or kidney-shaped, with an elevated rim, much nearer to the eye than to the tip of the snout.

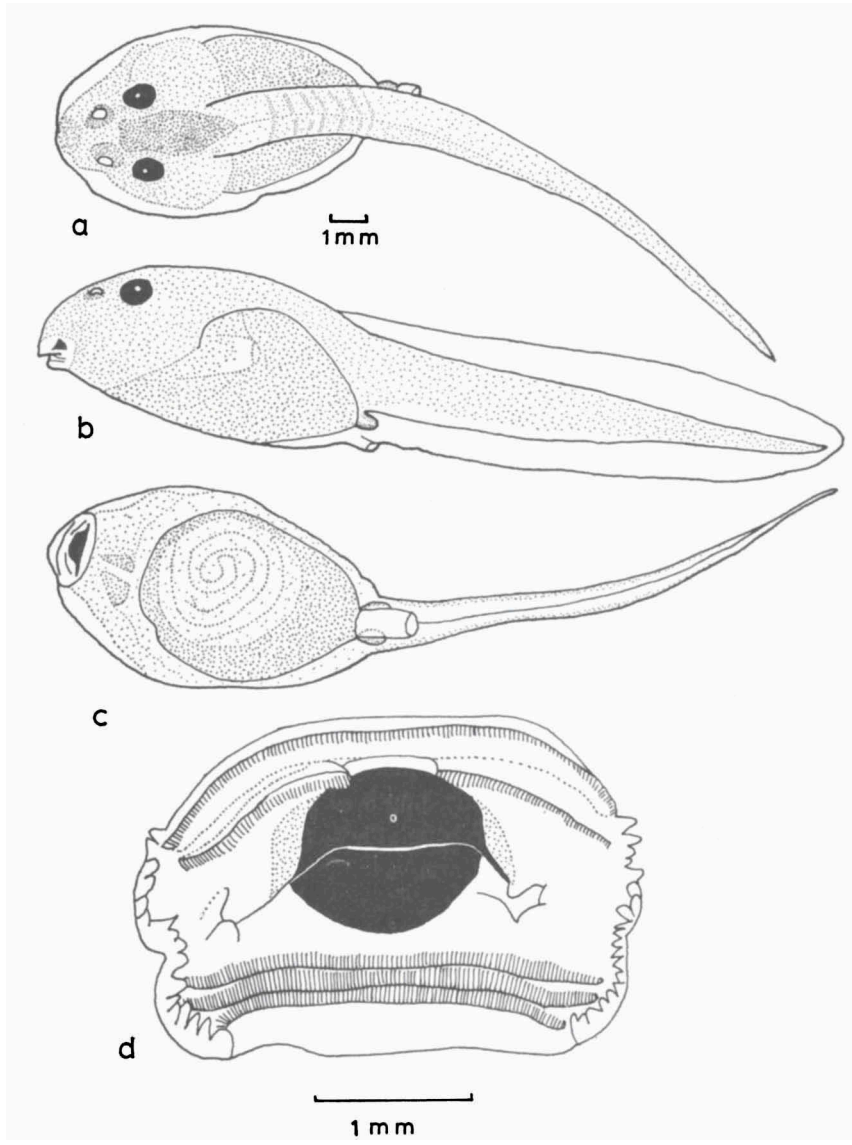

Fig. 2. *Bufo brongersmai* spec. nov. (RMNH 16804). a, b, c, dorsal, lateral and ventral view of a tadpole of stage 28; d, oral disc of tadpole of stage 36/37.

Oral disc more or less kidney-shaped with a lateral indentation. Clusters of papillae at the corners of the mouth, upper and lower lip free of papillae. Denticle formula $\frac{1}{3} + 1$. The median interruption in the upper inner denticle row is more narrow than the length of each part of the denticle row. In some specimens there occur variations on this pattern. In one specimen part of the upper outer denticle row is separated from the rest by a small gap. In another, this row is interrupted widely in the middle. In a third specimen, the upper outer denticle row is connected with the left part of the inner row, leaving the left part of the outer row isolated from the rest. Oral disc about one and a half times as wide as the interorbital space.

Range. — Up to now, specimens of *Bufo brongersmai* are only known from the southwestern part of Morocco, where they were found south of Tiznit, in Souk-el-Arba-du-Sahel, near Fask, in Tafraoute and surroundings, and in "Taidales, S. Morocco". This last locality could not be found on any map, but it seems possible that with Taidales is meant Taidalt or Taidalte, a small oasis south of Fask, on the road to Aouinet-Torkoz. Werner (1931) mentions a juvenile *Bufo viridis* from Tiznit, where it was found near a source in the city. This could well represent a specimen of *B. brongersmai*. Unfortunately, the specimen could not be found in the Vienna museum. Valverde (1957), in his exhaustive treatment of the birds of the Spanish Sahara, also dealt with the mammals, the reptiles and the amphibians. In this work he mentioned a "*Bufo* sp." from El Aium (also written Aaiun), Dora and Ahel Brahimat. I have good reasons to believe that most of these toads belong to the species described here (see further below). Whether the specimens from Dora really belong to *B. brongersmai* is questionable, because Valverde remarks that he saw "dos grandes sapos" (two large toads) and in this case it might very well be that *B. mauritanicus* Schlegel is meant. For completeness sake I have included Dora on the map, but provided the locality with a questionmark. Thus, the range of this new species seems to comprise the southwestern part of Morocco and the northwestern part of the Spanish Sahara. In the north the species does not seem to pass a line between Tiznit and Tafraoute, but a more probable limit seems to be the Oued Sous, which is a known northern barrier for several reptiles (*Bitis arietans* (Merrem), *Naja haje* (Linnaeus), *Malpolon moilensis* (Reuss), *Boaedon fuliginosum* (Boie)). According to Valverde (1957) the southern limit is somewhere near Cape Bojador, south of El Aium, where several other reptiles and amphibians "(*Rana, Agama bibroni, Lacerta lepida, Chamaleon*)" also seem to reach their southern limit, which coincides with a floristic border.

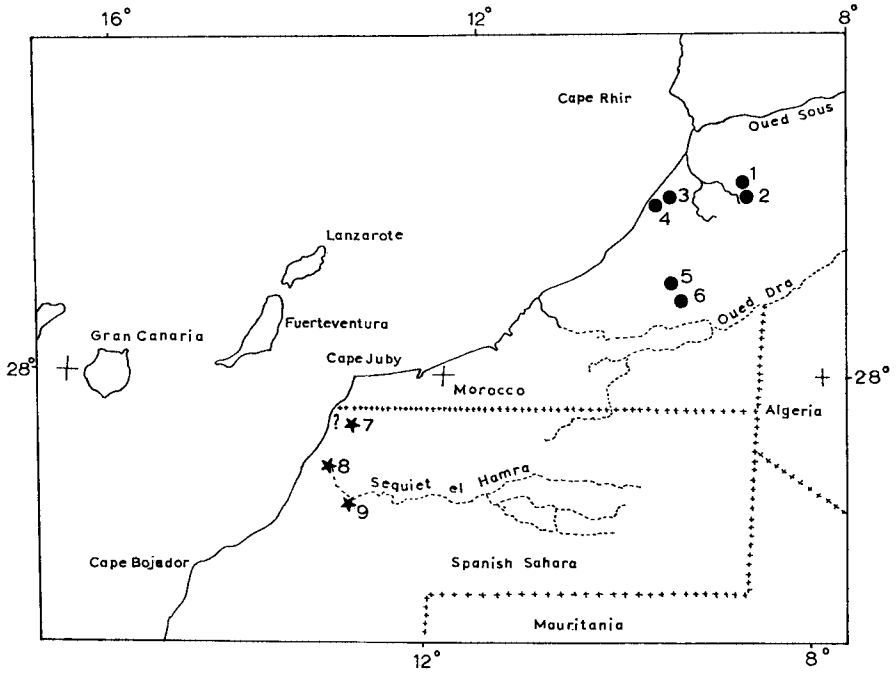

Fig. 3. Map of SW. Morocco and N. Spanish Sahara, showing the localities where *Bufo brongersmai* spec. nov. was collected (●) or from where it has been reported in literature (✱). 1, Vallée des Ammeln; 2, Tafraoute; 3, 10 km SW. of Tiznit; 4, Souk-el-Arba-du-Sahel; 5, Oued Seyad, 4 km E. of Fask; 6, Taidalte, the NMW specimens labelled "Taidales" may come from this locality; 7, Dora, as explained in the text this locality is doubtful; 8, El Aium (Aaiun); 9, Ahel Brahimat.

Discussion. — This toad at first sight resembles *Bufo viridis* Laurenti. However, it can easily be distinguished from this species by the double distal tubercle under the fourth toe, (single in *B. viridis* Laurenti (Boulenger, 1880)), the absence of a gland on the tibia (which in *B. viridis* Laurenti is smooth, without warts), the interorbital space distinctly wider than an upper eyelid, the very flat head, the absence of warts on the dorsal surface of the head, the smaller size, the absence of a light vertebral stripe (which is present in all Moroccan specimens of *B. viridis* Laurenti that were examined), the small parotoid glands and the nearly round tympanum. The total impression is that of a toad much more slender than *B. viridis* Laurenti. The tadpoles can be distinguished from those of *B. viridis* Laurenti by the interorbital space being as large as the distance between the nostrils (in *B. viridis* Laurenti 1 1/2 times this distance), the oral disc being about 1 1/2 times as wide as the interorbital space (in *B. viridis* Laurenti equal), and by their smaller size (probably not growing much beyond 50 mm, whereas for *B. viridis* Laurenti

in Morocco the maximum seems to be 62 mm). That we are dealing here with a new species, and not just a dwarf-subspecies of *B. viridis* Laurenti, was proved when both species were found within a few metres of each other in the same pool, in the Oued Seyad east of Fask.

As stated before, Valverde (1957) mentions a "*Bufo* sp." from several localities in the northwestern part of the Spanish Sahara. His description of those toads is not very extensive and only contains some data on snout-vent length, which do not give much to go by, as these data could refer both to *B. viridis* Laurenti and to *B. brongersmai*. Fortunately Valverde (1957) gives a picture of a specimen from Ahel Brahimat and from this it is clear that his "*Bufo* sp." is nothing but *B. brongersmai*. Pasteur & Bons (1959) suppose that Valverde's "*Bufo* sp." is identical with *B. mauritanicus* Schlegel, because Valverde observed the toads in thousands, which corresponds with the population density of *B. mauritanicus* Schlegel in the lower Dra valley. According to Pasteur & Bons (1959) *B. viridis* Laurenti is absent from that region, but my recent discovery of *viridis* in the neighbourhood of Fask (RMNH 16780) makes the occurrence of this species in the lower Dra valley more probable and thus weakens the arguments of Pasteur & Bons. Another point in favour of my view that Valverde's "*Bufo* sp." is *B. brongersmai* (and not *B. mauritanicus* Schlegel) is that on the picture the wide and flat interorbital region and the flat, slender body with the few, relatively small green spots of *B. brongersmai* are well recognisable. If "*Bufo* sp." should represent *B. mauritanicus* Schlegel, the concave, narrow interorbital region would have been covered with more and larger dark spots. From Valverde's (1957) publication we learn that this species is eaten by the cattle egret (*Ardeola ibis*) and that most specimens near El Aium are infested with leeches.

TABLE 3

Measurements of *Bufo viridis arabicus* Heyden. For explanation, see table 1.

Reg.no. SMF	sex	A	B (A)	C	D (B)	E	F (E)	G	H	I (H)	J	K (J)	L (A')
3630	?	59	16.8(28%)	19.3	9.2(1.8)	7.2	3.4(2.1)	3.9	5.8	4.8-3.8(1.3)	10.4-9.5	3.5-3.8(3.0-2.5)	24.2(41%)
3631	?	49	14.5(30%)	16.3	7.9(1.8)	5.4	2.9(1.9)	3.2	5.2	3.4-3.5(1.5)			19.8(41%)
3632	?	43	12.9(30%)	14.0	7.9(1.6)	5.4	2.1(2.5)	2.3	4.3	2.8-3.5(1.3)	7.5-7.8	4.1-4.0(1.8-1.9)	15.8(37%)
3633	?	35	11.2(32%)	12.3	6.3(1.8)	5.0	1.7(2.9)	2.4	3.3	3.0-2.5(1.2)	6.7-7.2	3.8-3.4(1.8-2.1)	13.4(38%)
3634	?	30	9.7(31%)	12.5	5.4(1.8)		2.1	1.9	3.2	2.7-3.0(1.1)			11.2(37%)
Range of ratios:			28%-31%		1.6-1.8		1.9-2.9			1.1-1.5		1.8-3.0	37%-41%
Average of ratios:			30%		1.8		2.4			1.3		2.2	38.8%

B. brongersmai seems to be most closely related to the *B. viridis-B. calamita* group, with which it has most characters in common.

Flindt & Hemmer (1968) compared specimens of *Bufo viridis* from the Near East with specimens from Central Europe. On the basis of their

findings they come to the conclusion that *Bufo viridis arabicus* Heyden, described in 1827 as *Bufo arabicus,* deserves recognition as a subspecies and they give a diagnosis of it. There are significant differences in the serum-proteins; the ground-colour is more yellowish olive than in *B. v. viridis* Laurenti; a vertebral stripe of the ground-colour is usually present. Characters that are only present in part of the Near East specimens are double subarticular tubercles under the fourth toe and the presence of smaller, more isolated green spots. About the specimens Flindt & Hemmer (1968) investigated (SMF 3631-34), these authors state that in three of the examples double subarticular tubercles occur; but during a reinvestigation of these specimens I could only find single tubercles. Therefore I am inclined to disregard this character in the diagnosis of Flindt & Hemmer. From their data they get the impression that on the average, the Near East specimens are larger than the Central European specimens. This is exactly the opposite of Mertens' (1957) statement. However, Mertens does not support his opinion with measurements as do Flindt & Hemmer.

A striking difference between *B. v. arabicus* Heyden and the Moroccan green toads, both *B. viridis* Laurenti and *B. brongersmai,* is the size of the tibia, which in *B. v. arabicus* Heyden has a much larger relative length in comparison with the snout-vent length than in the two Moroccan forms (see tables).

Both Flindt & Hemmer (1968) and Mertens (1971) seem to agree that the distributional area of *B. v. arabicus* Heyden reaches (in Asia) from Turkey in the west to Pakistan in the east, and to the Sinai peninsula in the south. They do not give northern or western limits. As the western border of this subspecies in North Africa was of more interest to me, I did not try to delimit the Asian distributional area towards the north. Anderson (1898) depicted *Bufo viridis* Laurenti from Alexandria and I am inclined to regard this specimen, with its elongated parotoids and smooth tibia, as a representative of *B. v. arabicus* Heyden. Marx (1968) lists a large number of specimens of *B. viridis* as *B. v. viridis* Laurenti. His localities are dispersed all over Egypt and the westernmost is on the border of Libya. I am convinced that these specimens all belong to *B. v. arabicus* Heyden. Judging by the description and photograph given by Schnurrenberger (1962), *B. v. arabicus* Heyden extends as far west as Sebha in Libya. From data in Pasteur & Bons (1959) and Doumergue (1901) it is evident that the N.W. African subspecies of *B. viridis* Laurenti extends from Morocco to Libya and meets *B. v. arabicus* Heyden in central Libya.

Mertens (1971) described *B. v. pseudoraddei* from West Pakistan, which is distinguished from *B. v. viridis* Laurenti by a dark colour, the presence of

a light vertebral stripe, a small tympanum and nearly round parotoid glands.

B. brongersmai has some characters in common with both *B. v. arabicus* Heyden and *B. v. pseudoraddei* Mertens. It agrees with *B. v. arabicus* Heyden in the size of the green spots on the back, in the ground-colour, and in the interorbital space being wider than an upper eyelid. With *B. v. pseudoraddei* Mertens it agrees in having the parotoid glands only slightly longer than wide, and in the small tympanum. From both subspecies it clearly differs in the possession of double subarticular tubercles and in a smaller snout-vent length.

It seems useful to give keys for both the adults and the tadpoles of the species of *Bufo* occurring in Morocco.

Key to adult toads of the genus *Bufo* in Morocco

1. Distal subarticular tubercle under the 4th toe single; a gland on the tibia *Bufo viridis*
   Distal subarticular tubercle under the 4th toe double; no tibial gland 2
2. Tarsal fold absent; inner metatarsal tubercle very large and protuberant; parotoid glands diverging posteriorly; uniform brown above . . . *Bufo bufo spinosus*
   Tarsal fold present; inner metatarsal tubercle not so large and protuberant; parotoid glands parallel; at least the anterior part of the head with spots of another colour than the ground-colour of the back 3
3. Interorbital region concave; parotoid glands large, distinctly elongate; most specimens have at least the anterior part of the head and body covered with large, brown, black-rimmed spots, which are frequently confluent; maximum snout-vent length about 150 mm . . . . . *Bufo mauritanicus*
   Interorbital region flat; parotoid glands small, rounded, in adults mostly 1½ times as long as wide; dorsal parts with isolated, rather small, green spots, which are either surrounded by a rim of small black dots, or without any rim; maximum snout-vent lenght recorded 51 mm . . . . . *Bufo brongersmai*

Key to the tadpoles of the genus *Bufo* in Morocco

1. Tail less than 4 times as long as deep, the upper inner denticle row narrowly interrupted, maximum length 32-62 mm 2
   Tail more than 4 times as long as deep, the upper inner denticle row widely interrupted, maximum length 30 mm . . . . . *Bufo mauritanicus*
2. Interorbital space twice as wide as the distance between the nostrils, dorsal seam of skin on the tail extending to the muscular base of the tail, maximum length 32 mm . . . . . *Bufo bufo*
   Interorbital space less than twice as wide as the distance between the nostrils, dorsal seam of skin on the tail ending posteriorly of its base, maximum length more than 40 mm 3
3. Interorbital space 1½ times as wide as the distance between the nostrils, maximum length 62 mm . . . . . *Bufo viridis*
   Interorbital space as large as the distance between the nostrils, maximum length probably not beyond 50 mm . . . . . *Bufo brongersmai*

(This key has been adapted from that given by Pasteur & Bons (1959)).

Remarks. — In his description of *B. arabicus,* Heyden dealt with one specimen only, of which he gave extensive measurements (e.g., "Länge 1 Zoll 7

Lin".). A comparison of the Frankfurt specimen indicated as holotype (SMF 3630) with the measurements provided by Heyden showed that there are several discrepancies between that specimen and Heyden's description. Whichever kind of foot I used (English, French, Berliner, Frankfurter, Rhinelandish, Viennese, or Amsterdam) to converse Heyden's measurements, none would lead to 59 mm snout-vent length, the value I found for SMF 3630. Most values thus attained centred around 43 mm, which makes it improbable that the discrepancies between SMF 3630 and Heyden's measurements are mere inaccuracies. It is far more likely that SMF 3630 is not the holotype.

In Heyden's description no paratypes were recorded. However, four other specimens (SMF 3631-34) are present in Frankfurt, with exactly the same data as SMF 3630, viz., "Arabia petraea, l. + d. E. Rüppell, 1829". It seemed possible that the real holotype might be found among these specimens. In fact, one specimen has a snout-vent length of 43 mm, but unfortunately this is the only measurement that agrees with Heyden's data, which makes it unlikely that this specimen is the holotype of *B. arabicus*.

Considering these circumstances, I only can come to the conclusion that SMF 3630 is not the holotype of *B. arabicus* Heyden. The real holotype seems to be lost. At the best SMF 3630 seems to be adequate for neotype selection.

Bufo viridis Laurenti

Material. — 1 ♀, 1 ♂, RMNH 16780, Oued Seyad, 4 km E. of Fask, Morocco, 10.iii. 1971, 1 ♂, RMNH 16781, Ouarzazate, Morocco, 10.v.1971, 1 ♂, RMNH 16787, Oualidia, Morocco, 23.ii.1971, all leg. M. S. Hoogmoed; 1 juv., RMNH 17051, between Rabat and Casablanca, Morocco, 30.vi.1971, leg. F. van der Plas; 2 ex., NMW 4971, Tafila, Morocco, 1900, leg. Steindachner; 5 ex., SMF 3635-39, between Casablanca and Essaouira, Morocco, 1881, leg. H. Simon.

The discovery of this species near Fask considerably extends the known range in Morocco to the south. Further distributional data are provided by Pasteur & Bons (1959).

Pasteur & Bons (1959) allocated the Moroccan green toads to the nominate subspecies *B. v. viridis* Laurenti. For various reasons this does not seem to be correct. In the first place, there are several morphological characters in which the Moroccan specimens differ from Central European examples, e.g., a light vertebral stripe is present in all Moroccan specimens, but absent in most Central European *B. viridis*. Also the larvae seem to reach a larger size than those in Central Europe (Pasteur & Bons, 1959). As I did not examine sufficient material of this species, I am unable to give more information on this subject, and it seems preferable to await publication of the results

obtained by Flindt & Hemmer during their study of the *B. viridis-calamita* complex. Moreover, there are zoogeographical reasons making it improbable that the N.W. African green toads would belong to the same subspecies as the Central European ones. This might have been possible if the species occurred on the Iberian peninsula, but there only *B. calamita* Laurenti is present. The nearest places where green toads occur are the Balearic Islands, Sardinia and Sicily. In other cases of a similar distribution (present in N.W. Africa, Italy; absent on the Iberian peninsula), the species have developed different subspecies in N.W. Africa and in Italy. For these reasons I refrained from using a trinomen.

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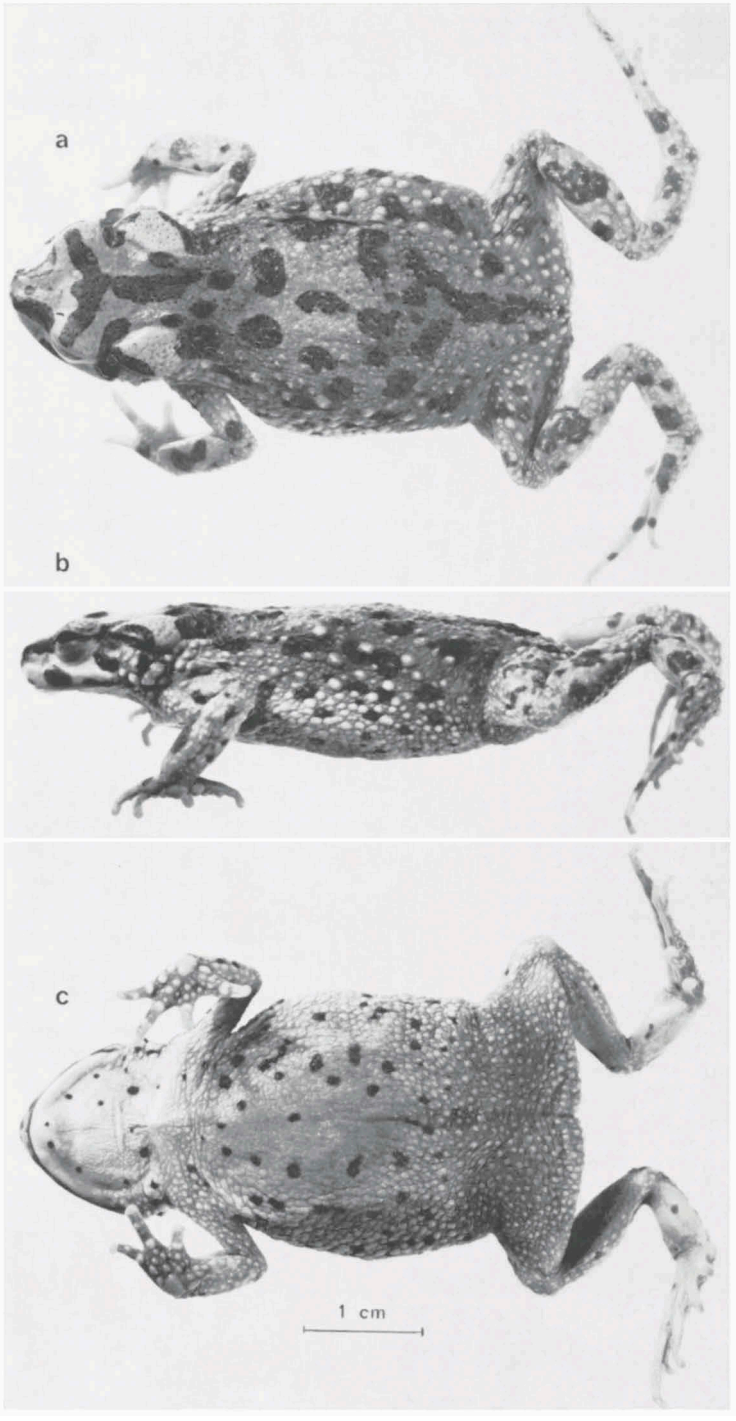
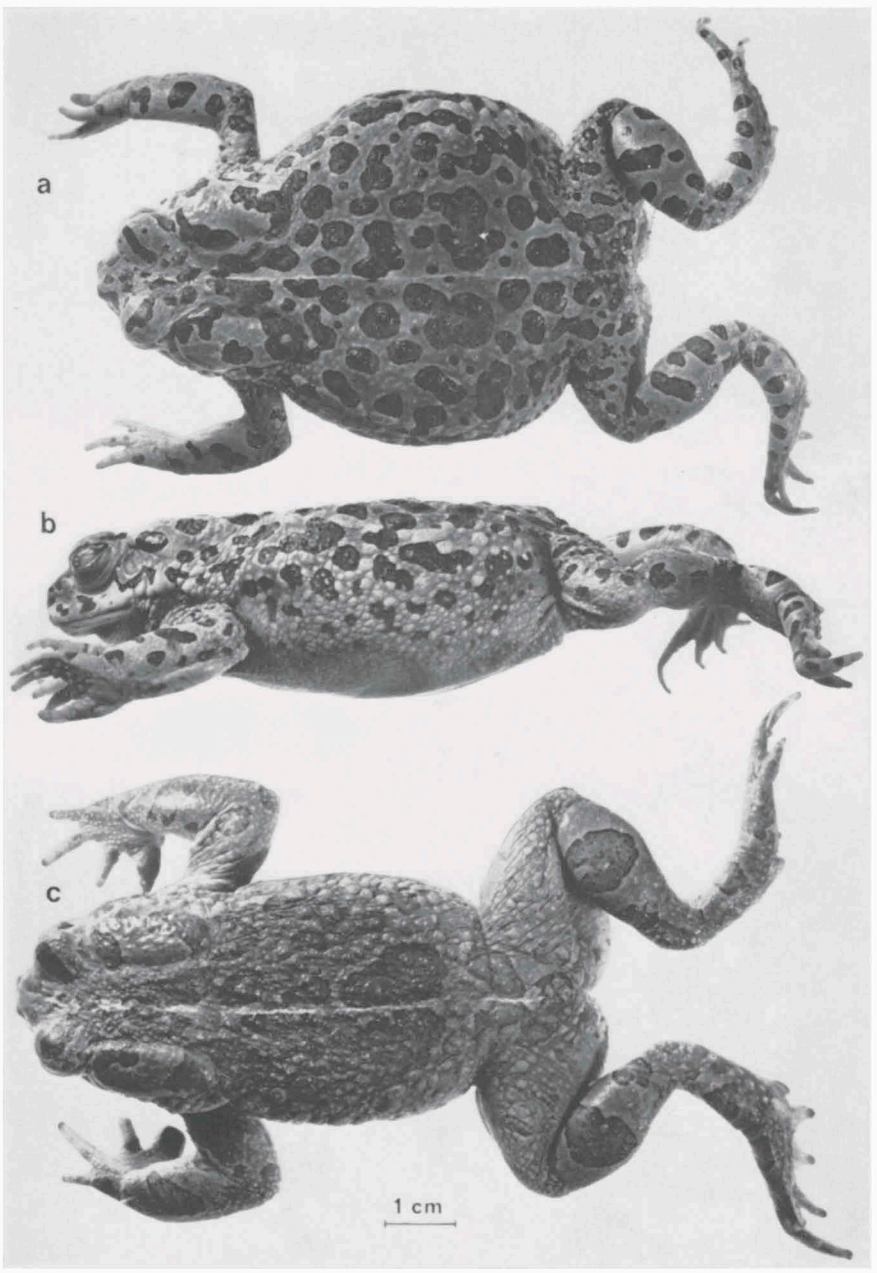
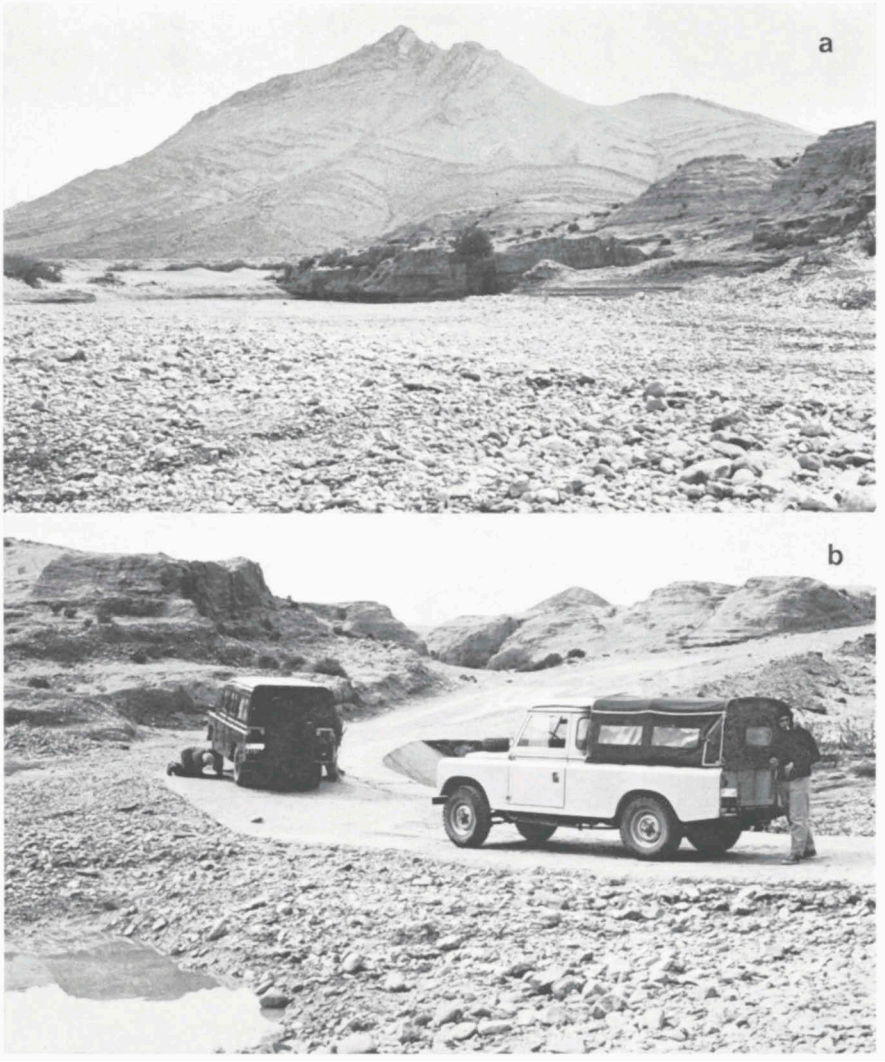


Bufo brongersmai spec. nov., holotype, ♀, RMNH 16782. a, b, c, dorsal, lateral and ventral view.

Bufo brongersmai spec. nov., dorsal view of paratypes. a, ♂, RMNH 16784 a; b, ♂ RMNH 16783 a; c, ♂, RMNH 16784 b; d, ♀, RMNH 16786.



Bufo viridis Laurenti. Moroccan specimens. a, b, dorsal and lateral view of ♀, RMNH 16780 a; c, dorsal view of ♂, RMNH 16780 b.



Oued Seyad, E. of Fask; habitat of *Bufo brongersmai* spec. nov. and *B. viridis* Laurenti. a, view to the NW, in the centre a large pool is visible in which both species were found; b, view to the SW, in the small pool in the foreground *B. brongersmai* spec. nov. was present.