Scientific results of the Cambridge Expedition to the East African Lakes, 1930–1.—5. Reptiles and Amphibians.

By H. W. PARKER, B.A.

(With 10 Text-figures)

THE collections of reptiles and amphibians made by Dr. Worthington and his colleagues fall readily into two groups, those from the zoologically well-known areas of Uganda and Kenya (Lakes Bunyoni, Edward, George, Kijanebalola, Nabugabo, Nakavali, Baringo, Hannington, Naivasha, and Mt. Kenya) and those from the almost unknown Lake Rudolf region. In the first group the most noteworthy features are the really high proportion of species hitherto very incompletely known and the surprising discovery of two well-marked new species of snakes, one of them venomous and probably dangerous to man. The Lake Rudolf collection is most interesting, however, not from any super-abundance of new and rare forms (though both are present), but from the light which it sheds on the relationships of the herpetological fauna of the region. From its geographical position between Kenya, Uganda, and the Anglo-Egyptian Sudan one might expect the fauna to be essentially a Sudan-Kenya composite. But although many of the species are known to occur both in Kenya and the Sudan, the facies of the fauna is essentially that of the Somaliland sub-province. Every single species, except those endemic in the region, has been also recorded from Somaliland, whereas many are unknown elsewhere in Kenya or in the Sudan. The endemic forms, too, are more closely allied to Somali species than to any others ; the two new races described below are both local forms of species either confined to Somaliland (*Philochortus*) or scarcely known outside it (*Agama*).

In a recent discussion of the herpetology of British Somaliland (Parker, 1932) the author, in attempting an analysis of the fauna arranged the species in four groups, and application of the same principles to the Lake Rudolf collections gives the following results :—

I. ' Eremian ' species, i. e. those found in Africa north of about the 10th parallel (north), Arabia, or both and not extending S.E. into Kenya :—

(1) *Lygodactylus picturatus gutturalis.*
(2) *Echis carinatus.*

II. Species found all over Africa, except perhaps the Rain Forest, and sometimes extending into Arabia :—

(1) *Crocodilus niloticus.*
(2) *Trionyx triunguis.*
(3) *Hemidactylus brooki.*
(4) *Mabuya brevicollis.*
(5) *Naja nigricollis.*
(6) *Rana mascareniensis.*
(7) *Bufo regularis.*

III. 'Savannah' species, i.e. those found in East Africa south of about the 10th parallel (north), rarely extending further north in the Sudan or Arabia:—

(1) *Eremias spekii sextaeniata.*
(2) *Latastia longicaudata revoili.*
(3) *Varanus ocellatus.*
(4) *Lygosoma sundevallii.*
(5) *Psammophis biseriatus.*
(6) *Rhamphiophis rostratus.*
(7) *Rana delalandii.*
(8) *Chiromantis petersi.*

IV. Species endemic in the Somaliland region, sometimes extending into Kenya:—

(1) *Hemidactylus isolepis.*
(2) *Agama rueppelli occidentalis.*
(3) *Philochortus intermedius rudolfensis.*
(4) *Leptotyphlops fiechteri.*
(5) *Coluber smithi.*

Comparison of this grouping with the similar tables for Somaliland (op. cit. p. 337) shows a lower proportion of endemic species (23 per cent. compared with 45 per cent.), fewer Eremian forms, and many more in group II. There also appears to be less tendency for the species of group III to form local races; in Somaliland nearly a third of the Savannah species are modified to form distinct endemic races, but none of these are yet known to extend into the Rudolf region.

In the same paper it is suggested that the principal factor in the development of the specialized Somaliland fauna is the aridity of the climate, and a rainfall chart is given showing a mean annual rainfall in the Somali peninsula of less than 20 inches, whereas the neighbouring countries to the west and south have 40 inches or more. According to that chart the Lake Rudolf area has a relatively high annual precipitation and the present discovery of a typical Somaliland fauna in the region would appear to invalidate the hypothesis previously put forward. But the probability seems to be rather that the chart is wrong, and that Lake Rudolf lies in an isolated patch of country with a very low rainfall, comparable with Somaliland. Unfortunately, no continuous records are available, but there seems to be unanimity of opinion amongst those who know the region that it is very arid; Dr. Worthington (1932, p. 281) speaks of there being 'practically no rainfall', and assures me that the average is certainly less than 20 inches annually. It seems very probable, therefore, that the conclusions to be drawn from a study of the present collection strengthen, instead of weaken, the probability of correlation between climate and faunal change in north-east Africa.

In the following discussions of the various species, the place-names are those used in the general account of the expedition and may be found in the maps illustrating Dr. Worthington's paper earlier in this volume. Acknowledgments are due not only to Dr. Worthington and all members of the expedition for the meticulously careful way in which the material was preserved and labelled, but to the authorities of the Museum of Comparative Zoology, Harvard, the United States National Museum, and the California Academy of Sciences for the loan of much valuable comparative material.

(1) XENOPUS LAEVIS (Daudin).

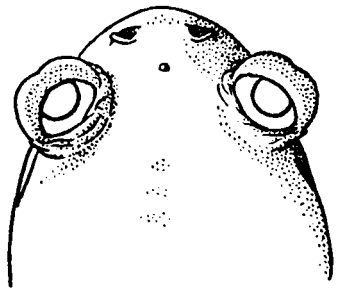
♂, 2 ♀♀. Lake Naivasha.

43 ♂♂ ♀♀, hgr. and yg. Lake Bunyoni.

The specimens from Lake Naivasha are normal *X. laevis*, but the Lake Bunyoni series is so very different that at first sight it seems as though this lake harbours a definite race. A number of differences from the normal can be detected, thus :—

(*a*) Size :—The largest specimen collected measures only 41 mm. from snout to vent, and Dr. Worthington reports that, although the frogs occur in thousands, no larger examples were seen. Normal adults of *X. laevis* measure at least 50 mm., usually much more.

TEXT-FIG. 1.



Xenopus laevis (Daudin).
Specimen from Lake Bunyoni, showing pathological eyelids.

(*b*) Colour :—All the specimens, except one, are exceedingly dark in colour and the lower surfaces are heavily spotted and dotted with black.

(*c*) The eyes are very large and prominent, the head apparently slightly broader, and the snout shorter than in specimens from other localities (text-fig. 1).

Loveridge (1932, p. 114) considers these differences to indicate that the *Xenopus* of Lake Bunyoni is at least racially distinct; but it seems quite probable that they may have a biological rather than a taxonomic significance. Considering the most noticeable size-difference first, two factors

must be borne in mind. Firstly, very few of the specimens are sexually mature; only three females have ripe pigmented ova and well-developed oviducts. These three examples measure 34, 39, and 39 mm., but other larger females measuring 40 and 41 mm. are not sexually mature. Thus it is doubtful whether any fully adult specimens have yet been captured, for the only mature examples have apparently only just reached maturity. In the second place, Worthington reports that the frogs in Bunyoni lead a pelagic existence and are plankton feeders. They possess no special adaptation for microphagy, and it is not improbable that, compelled by circumstances to subsist on prey it is ill-equipped to catch, the *Xenopus* population of Lake Bunyoni is dwarfed through malnutrition.

The differences grouped together as (*b*) and (*c*) above may have a single common cause, for the very large prominent eyes are pathological. The tissues of the lower eyelid of every specimen examined are literally packed with encysted metacercariae of an Echinostomid fluke.* The pressure set up by this heavy infection has forced the eyes outwards (text-fig. 1), and it is very probable that this pressure, operative during the early post-larval period, has materially affected the development of the whole head. In addition, it has not improbably affected the vision, either by direct inflammation of the visual apparatus or mechanically by injury to the lower eyelid, which is so much thickened as to appear opaque and non-retractile; in preserved specimens it covers the lower half of the eye completely. It has been shown experimentally that eyeless examples of *Xenopus* are much darker than the normal when kept under the same conditions (Hogben and Slome, 1931, p. 13) and very dark immature normal specimens are usually found to have liberally dark-spotted lower surfaces.

Further collecting alone can decide whether these suppositions are correct and whether the heavy parasitic infection is normal or epidemic.

(2) RANA GALAMENSIS Dum. & Bibr.

Hgr. Lake Nakavali.

(3) RANA FUSCIGULA Dum. & Bibr.

♀. Lake Bunyoni.

(4) RANA DELALANDII (Dum. & Bibr.).

Hgr. ♂. Mouth of Kaliokwell River, Lake Rudolf.

(5) RANA MASCARENIENSIS Dum. & Bibr.

Juv. Mouth of Kaliokwel River, Lake Rudolf.

(6) PHRYNOBATRACHUS NATALENSIS (A. Smith).

Juv. Stream running into Lake Hannington.

* I am indebted to my colleague Dr. Baylis for determining the family to which these flukes belong; should further identification prove possible, he will probably publish a note on the parasite.

(7) PHRYNOBATRACHUS KINANGOPENSIS (Angel).

Phrynobatrachus acridoides (non Cope), Andersson, 1911, Kungl. Svensk. Vet.-Ak. Handl. xlvii, 6, p. 28.

Arthroleptis rouxi (non Nieden), Angel, 1925, Voy. Alluaud et Jeannel Afr. Or., Rept. & Batr. p. 50.

Phrynobatrachus kinangopensis (Angel), Loveridge, 1929, Bull. U.S. Nat. Mus. cli, p. 105.

3 ♂♂, 1 ♀. 11,000 ft., Mt. Kenya (coll. L. C. Beadle).

As indicated above, no two authors have hitherto agreed as to the name to be applied to the *Phrynobatrachus* of Mt. Kenya. Andersson, indeed, realized that his specimens differed in several ways from *P. acridoides* (Cope), but ascribed these differences to individual variations. Angel, with specimens from the Aberdare Mts. and Mt. Kenya before him, concluded that the two were specifically distinct, described the former as a new species *kinangopensis*, and referred the latter to *P. rouxi* (Nieden). Loveridge (1925) identified *rouxi* (originally described from the west side of Lake Victoria) with the West African *P. ogoensis* (Boulenger) and later referred frogs from Mt. Kenya and other localities in Kenya Colony to *kinangopensis*. Comparison of seven specimens from Mt. Kenya (including three of the series reported upon by Andersson) with nine topotypes of *kinangopensis* has convinced the writer that the two are probably conspecific. This form is distinguishable from *P. acridoides* (Cope) (topotypes examined) by its smaller size, indistinct tympanum, shorter digital webbing (text-figs. 2 & 3), and slightly shorter hind limbs, a series of characters too marked and constant to be other than of specific, or at least racial, importance. If Angel is correct in identifying the Mt. Kenya frog with Nieden's *rouxi*, then the name *kinangopensis* must give way to this ; but if Loveridge is also correct, *rouxi* is a synonym of *ogoensis*. Comparison of the accompanying text-figures will, however, make it apparent that neither of these suggestions is probable, for, unless Nieden's figure is grossly inaccurate, *rouxi* differs from all the others in having the fifth toe markedly longer than the third, instead of the converse. *P. kinangopensis* is also, apparently, quite distinct from *P. ogoensis*, and appears to be a valid form confined to the Kenya highlands.

(8) CHIROMANTIS PETERSI Boulenger.

♂. Sukh Plains, Lake Rudolf.

It is not possible to say definitely whether this single specimen should be referred to the typical form or to the ill-defined larger Somaliland race (*kelleri*) ; it appears to be full-grown, but measures only 54 mm. from snout to vent, and the interorbital space is slightly narrower than the upper eyelid, thus resembling, rather, the typical form.

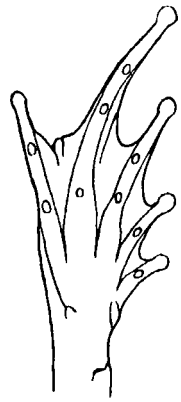
(9) HYPEROLIUS CINCTIVENTRIS Cope.

♂. Lake Bunyoni.

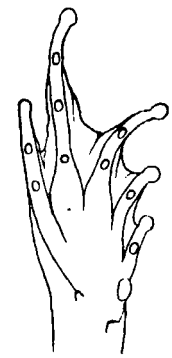
(10) HYPEROLIUS PICTURATUS Peters.

♀. Lake George.

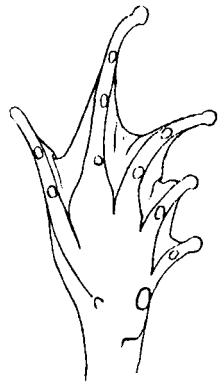
TEXT-FIG. 2.



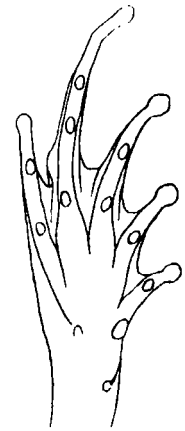
TEXT-FIG. 3.



TEXT-FIG. 4.



TEXT-FIG. 5.



TEXT-FIG. 6.

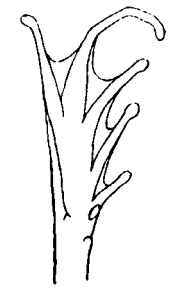


Fig. 2.—*Phrynobatrachus acridoides* (Cope). Topotype male. Right foot.
Fig. 3.- *Phrynobatrachus kinangopensis* (Angel). Topotype male. Right foot.
Fig. 4.—*Phrynobatrachus kinangopensis* (Angel). Mt. Kenya male. Right foot.
Fig. 5.— *Phrynobatrachus ogoensis* (Boulenger). Type male. Right foot.
Fig. 6.—*Phrynobatrachus rouxi* (Nieden). Type (after Nieden). Right foot.

(11) HYPEROLIUS STRIOLATUS Peters.

♀. Lake Kijanebalola.

(12) ? HYPEROLIUS STUHLMANNI Ahl.

♂. East shore of Lake Edward.

This determination and the status of the species are both open to doubt ; but if, as seems probable from the locality, the specimen is conspecific with the single female (?) described by Ahl, the following additional note on the colour may be useful. The dark dorsal vermiculations are much larger than those figured in ' Das Tierreich, Anura,' iii, fig. 271, and approach the condition of the variegated form of *H. taeniatus* Peters ; on the back there are a few small orange-tipped warts, and the concealed surfaces of the limbs are pink with orange-red spots ; smaller spots of this colour are sparsely scattered all over the venter, flanks, and chin.

(13) BUFO VITTATUS Boulenger.

Hgr. ♀. Lake Nabugabo.

(14) BUFO REGULARIS Reuss.

Juv., 3 tadpoles. Lake Baringo.

2 ♀♀. Mouth of Kaliokwell River, Lake Rudolf.

Hgr. Near Mt. El Moitat, east shore of Lake Rudolf.

♂. West shore of Lake Rudolf.

(15) LEPTOTYPHLOPS FIECHTERI (Scortecci).

♀. Mouth of Kaliokwell River, Lake Rudolf.

At the present time our knowledge of the snakes of the genus *Leptotyphlops* is in a very unsatisfactory condition. The present example is a small, hook-snouted form which agrees very closely with the description of *fiechteri*, known hitherto only from Italian Somaliland. The ratio of diameter to length is somewhat higher than in the type (79·5 *vice* 68·5) and the tail is relatively shorter (14·5 *vice* 12·5), but in other respects there is very close agreement.

(16) CHLOROPHIS HETEROLEPIDOTUS (Günther).

♂, v. 181, c. 127+1. Katunguru, Kazinga Channel, Lake Edward.

(17) CHLOROPHIS IRREGULARIS (Leach).

♀, v. 164, c. 101+1. Lake George.

(18) COLUBER SMITHI (Boulenger).

Juv. ♀, Sc. 21, v. 193, c. 93+1. Lokitaung, Northern Turkana Plains, Lake Rudolf.

This specimen differs from the published descriptions of the species in having the preocular separated from the frontal, the latter shield as long as the parietals, a rather higher number of ventrals, and a characteristic colour-pattern. But another specimen in the British Museum from ' West of the Juba River ', collected by Donaldson Smith in 1895 (Boulenger, 1896, p. 216), is in some ways intermediate ; the preocular and frontal are separated, but the propor-

tions of the other head-shields and colour are almost exactly as in the type, whilst the number of ventrals is lower, 171. The separation of the frontal and preocular cannot be regarded as of specific importance, for in the male co-type they only just make contact, whilst the colour-pattern exhibited by the present example is probably the juvenile livery, which becomes obscure with age. There is a series of narrow black transverse bars on the mid-dorsal zone, a series of similar smaller vertical bars on the flanks alternating with the dorsal series and a ventro-lateral row of black spots alternating with the laterals; a broad black bar across the nape, another on the occiput, and a third, less distinct, between the eyes and extending downwards on to the upper lip.

In several respects these southern examples of *C. smithi* resemble the western *C. tchadensis* (Chabanaud).

(19) COLUBER KENIENSIS, sp. n.

Holotype a juvenile ♂ from Lake Baringo, collected by E. B. Worthington; Brit. Mus. no. 1932.5.2.7.

Snout long, obtuse. Rostral once and a half as broad as high, the portion visible from above measuring one-fourth its distance from the frontal; internasals about as long as broad, shorter than the prefrontals; frontal broader than the supra-ocular, once and a third as long as broad, a little longer than its distance from the end of the snout, and two-thirds the length of the parietals; loreal quadrangular, once and a half as long as deep; one preocular, in contact with the frontal, with two suboculars below it, and a third scale separating the fourth upper labial from the preocular and loreal; nine upper labials, the fourth and fifth entering the eye; two postoculars; temporals 2+3; four lower labials in contact with the anterior chin-shields; posterior chin-shields widely separated, about as long as the anterior.

Scales smooth, in 25 rows; ventrals obtusely angulate laterally, 204; anal entire; subcaudals 104.

Grey-brown above, with 10 longitudinal series of quincuncially arranged, small, black spots on the anterior half of the body; posterior half of body and tail immaculate; black spots on each supra-ocular, beneath the eye, and on the temple; a narrow transverse bar behind the parietals; white beneath, immaculate except anteriorly, where the lowermost rows of the black spots of the flanks lie on the outer ends of the ventrals.

Length 265 mm.; tail 66 mm.

This form appears to be most closely allied to *florulentus*, but is distinguished by the possession of more scales round the body, two suboculars, and an undivided anal shield.

(20) DASYPELTIS SCABER (Linn.).

♂, Sc. 24, v. 210, c. 71+1. Lake George.

♀, Sc. 25, v. 223, c. 52+1. Lake Naivasha.

The first-mentioned is a uniformly brown-coloured specimen of the '*palmarum*' variety and the latter a melanistic example.

(21) PSAMMOPHIS BISERIATUS Peters.

♀, juv. v. 150, 148, c. 117+1, 110+1. Near the Mouth of Kaliokwell River, Lake Rudolf.

(22) RHAMPHIOPHIS ROSTRATUS Peters.

♀, hgr. ♀, v. 180, 164, c. 94+n, 115+1. Mouth of Kaliokwell River, Lake Rudolf.

As Loveridge (in press) has pointed out, the writer was in error in proposing a new specific name for the W. African *Rhamphiophis*, though correct in regarding it as specifically distinct from the E. African form. These two specimens are normal *rostratus*, although the caudal count is higher than hitherto recorded.

(23) NAJA MELANOLEUCA Hallowell.

Head. Katunguru, Kazinga Channel, Lake Edward.

(24) NAJA NIGRICOLLIS Reinhardt.

♂, Sc. 25/25, v. 202, C. ? Mouth of Kaliokwell River, Lake Rudolf.

(25) ECHIS CARINATUS (Schneid.).

♂, Sc. 28, v. 163, c. 33+1. Mouth of Kaliokwell River, Lake Rudolf.

(26) BITIS WORTHINGTONI, sp. n.

Holotype a ♂, no. 1932.5.2.8 in the British Museum, from the shore of Lake Naivasha ; collected by E. B. Worthington.

Nostrils directed outwards, in a single nasal, which touches the rostral and the first upper labial. (Indications of a suture on the dorsal margin in front of the nostril suggest that this condition is brought about by the fusion of a rostro-nasal scale with the nasal.) Rostral small, about once and a half as broad as deep ; head covered with small, imbricate, strongly keeled scales, 12 across the vertex from eye to eye ; a compressed, erect, spine-like scale above each eye, measuring two-thirds the horizontal diameter of the eye ; two series of scales between the eye and the labials ; 18–19 scales round the eye ; two scales between the supranasals anteriorly ; 11–13 upper labials ; 5 lower labials in contact with the chin-shields. Scales in 27 rows at mid-body, all strongly keeled ; ventrals 136 ; anal entire ; subcaudals 28, entire, except the 7th and 26th, which are divided and abnormal in having two shields on the right corresponding to one on the left.

Grey-brown above, with a light yellow dorso-lateral stripe on each side on the 7th to 9th scale-rows ; bordering this light stripe above and below are a series of black semi-lunar spots, sometimes light-centred, of which the upper series are the larger and may correspond to, or alternate with, the lower. Head lighter, the dorsal dark zone of the back continuing forwards on to the occiput to form a very regular, black, narrowly light-edged arrow-head ; a small black spot behind each supraciliary spine ; upper and lower labials black, white-blotched. Belly whitish, heavily mottled and stippled with black ; tail uniform yellow beneath.

Total length 275 mm. ; tail 33 mm.

This very distinct new species is akin in several ways to *B. atropos* (Linn.) and to *B. caudalis* (Smith), but differs from any known species of *Bitis* in having the nasal in contact with the rostral, and single subcaudals. These differences would, at first sight, appear to indicate that the species ought to be referred to some other genus, possibly a new one, for they are just the characters normally used to differentiate the various genera of the Viperinae. Too much stress, however, should not be placed on these two points. The subcaudal condition, for example, is very variable in some other vipers, particularly in *Trimerseurus monticola* Günther, where all may be divided or all entire, and even within the genus *Bitis* some variation is found ; females of *B. caudalis* have the normal subcaudals replaced by small keeled scales. The nasal condition may have even less significance, for, as indicated above, there may be anomalous fusion of two or more shields, and in all other ways the nostril, situated in an excavated nasal with a crescentic supranasal above it, is similar to that of all the known species of *Bitis*.

But the best indication of generic relationship is furnished by the presence of a supranasal sac, a character not hitherto recorded, but present in all the seven species of the genus examined as well as in the new form. This sac is a semi-lunar pocket, lying immediately under the supranasal scute and almost coincident with it in size and shape.

Superficially it appears as if the supranasal scute, instead of being in juxtaposition to the nasal, as is usual in the majority of snakes, imbricates it. But, although this may have been the origin of the cavity, the fact that it persists in *Pseudocerastes*, a derivative of *Bitis* in which the supranasal is wanting, suggests that it may have a deeper significance.

The cavity is lined by a horny cuticle which is continuous with the external cuticular layer and appears to be shed with it at sloughing, and microtome sections of the head of an embryo *Bitis arietans* fail to show any modification of the epidermis which would suggest that the pit has any sensory function. The dorsal side of the cavity, that is to say, the under surface of the supranasal shield, is lined by an epithelium similar to that of the lower surfaces of the other head-scales ; it is regularly beset with projecting hemispherical cells which give it a minutely granular appearance in surface-view. The lining of the ventral side of the sac, the portion of the nasal scale which is not visible from outside, differs, however, from the upper surfaces of the other head-scales in having only a very thin, not corrugated epidermis and a very delicate cuticle. No specialised nerve-endings were seen, but dissection of an adult Puff-adder's head showed that the sac receives a number of branches from the ophthalmic branch of the fifth cranial nerve, the nerve which supplies the region of the nostril.

The sac is best developed in *B. nasicornis*, where it extends under the nasal horn and is only narrowly separated from its fellow of the opposite side ; it is also present and well developed in *B. gabonicus*, *B. atropos*, *B. arietans*,

B. inornata, *B. cornuta*, *B. caudalis*, and *Pseudocerastes persicus*. An invagination in the nasal region of a viper at once suggests the possibility of relationship with the pit of the Crotalinae and it is not impossible that the two are homologous. No very definite evidence can be brought forward in support of such a view except the general situation between nostril and eye, a general similarity between the lining membranes of the two (West, 1900, pp. 49–59, pl. iv.) and the fact that the Crotaline pit, though not connected with the nostril, is also partly innervated by the ophthalmic branch of the trigeminal nerve. A comparison of the early developmental stages of both may produce evidence for or against this hypothesis.

(27) HEMIDACTYLUS ISOLEPIS Boulenger.

4 ♂♂, 5 ♀♀, 1 egg. Mouth of Kaliokwell River, Lake Rudolf.

This series shows a degree of variation not hitherto recorded. The head is never twice as long as broad (as it appears to be in the type), the subdigital lamellae of the thumb vary from 5 to 6, of the fourth finger from 7 to 8, of the inner toe from 5 to 7, and of the fourth toe from 7 to 10; the most frequent combination is 5, 7, 5, 8. The upper and lower labials vary from 7 to 8 and 5 to 7 respectively, there may be only one pair of large chin-shields, and the femoral pores vary from 6 to 8, the lesser number being the commoner. The number of scales about the middle of the body appears to vary with the sex; in males there are about 62 to 65 and in females from 67 to 77.

The egg, which contained a nearly mature embryo, is of the usual oval, hard-shelled, geckonid type, and measures about 7×5 mm.

(28) HEMIDACTYLUS BROOKII Gray.

Hgr. ♀. Mouth of Kaliokwell River, Lake Rudolf.

(29) LYGODACTYLUS PICTURATUS GUTTURALIS Bucage.

♀. Lake Baringo.

Juv. Turkana Plains, near Nepal Pass, Lake Rudolf.

(30) AGAMA RUEPPELLI Vaillant.

The five specimens collected by the expedition at the mouth of the Kaliokwell River, Lake Rudolf, differ markedly from typical examples of *A. rueppelli*, but comparison with examples from various localities in Kenya shows a more or less complete gradational series, and suggests that we are dealing with a single variable species. The Kenya specimens have previously been referred to *A. vaillanti* Boulenger, but this name is probably (Parker, 1932) a strict synonym of *A. rueppelli*. The available material can be divided into three groups, corresponding with three geographical areas, and characterized by differently proportioned heads and larger or smaller scales. These differences are sufficiently obvious when specimens are compared, but not easily expressed in words, for there are some complications. One of the standard methods of indicating scale-size is to give the number of scales round the middle of the body, but in the present instance increased scale-size is accompanied by a

stouter habitus, so that the mid-body scale-count is approximately the same for all the groups. Another method is to give the number of scales on the vertebral line between the insertion of the fore and hind limbs; this can be done with some degree of success, but as the dorsal scales are arranged in oblique series convergent towards the vertebral line, a more accurate method is to count the scales in a standard length of an oblique series. A complication which makes itself apparent in this method is that proportions change with growth, although the actual number of scales remains constant; consequently, the scale-counts obtained in this way are only comparable for individuals of approximately the same size. The variation in the shape of the head can be conveniently measured by a comparison of the length from the tip of the snout to the anterior border of the ear with the maximum width. The three recognizable forms are :—

(*a*) AGAMA RUEPPELLI RUEPPELLI Vaillant.

Agama rueppelli Vaillant in Revoil, Miss. Pays Çomalis, Rept. & Batr. p. 6, pl. i. (1882).

Agama vaillanti Boulenger, Ann. Mus. Civ. Genova, (2) xv, 1895, p. 12.

The distance from the tip of the snout to the anterior border of the ear is less than the maximum width of the head. The scales on the vertebral line vary from 22 to 29, and there are no enlarged dorso-lateral scales. The number of scales in an oblique series of the standard length (tip of snout to ear) varies in juveniles from 9 to 12, and in adults from 10 to 8.

Distribution.—British Somaliland, northern Italian Somaliland, and the Ogaden district of Ethiopia.

Specimens examined :—

Snout to vent.	Sex.	Vertebral scales.	Oblique scales.	Locality.
mm.				
24	juv.	25	12	Dagah Shabell.
29	,,	27	12	10° 32′ N., 48° 59′ E.
39	,,	27	11	Goolis Mts.
41	,,	29	11	Sol Haud.
43	,,	27	10	Goolis Mts.
46	,,	?	9	Zeila.
48	,,	29	12	Ania, Ethiopia.
49	,,	26	10	10° 42′ N., 49° E.
58	♂	26	10	Buran Distr.
63	♂	22	9	10° 42′ N., 49° E.
63	♀	26	10	Beretableh.
70	♂	25	8	10° 27′ N., 49° E.
71	♂	26	9	Berbera.
75	♀	24	8	Haud.
75	♀	29	9	Webi Shebeli.
77	♂	29	10	Sassabana, Ethiopia.
81	♀	?	8	Beretableh.
84	♀	28	8	Dagah Shabell.
86	♀	23	8	10° 32′ N., 48° 59′ E.
102	♂	26	8	'Somaliland'; cotype.

(*b*) AGAMA RUEPPELLI SEPTENTRIONALIS, subsp. n.

Agama vaillanti (*non* Boulenger) Lönnberg, Svenska Vet.-Ak. Handl. xlvii, 6, 1911, p. 6; Loveridge, Proc. Zool. Soc. London, 1920, p. 142; id. Bull. U.S. Nat. Mus. cli, 1929, p. 57 (in part).

The distance from the tip of the snout to the anterior border of the ear is equal to the maximum width of the head. There are 30–35 scales on the vertebral line, and some of the dorso-laterals may be enlarged (Lönnberg, 1911, p. 11). The number of scales in an oblique series of the standard length varies from 14 in half-grown specimens to 10 or 12 in adults. Colour as in the typical form.

Distribution.—Central and southern Kenya.

Specimens examined :—

mm.						
62	♂	35	14	Mbunji, Kenya.	M. C. Z. 18280.	Cotypes.
77	♀	34	10	Voi, Kenya.	M. C. Z. 18281.	
78	♀	33	12	Kenya Colony.	U.S. N. M. 49059.	
78	?	32	12	Madagos, Kenya.	C. A. S. 66032.	
88	♀	31	10	Mt. Njero, Kenya.	U.S. N. M. 66901.	
90	♀	33	12	Kenya Colony.	M. C. Z. 29640.	

(*c*) AGAMA RUEPPELLI OCCIDENTALIS, subsp. n.

Agama vaillanti (*non* Boulenger) Loveridge, Bull. U.S. Nat. Mus. cli, 1929, p. 57 (in part).

In juvenile specimens the head is similar to that of the preceding race, but in adults the distance from snout to ear is longer than the maximum width. There are 36–38 scales on the vertebral line and some dorso-laterals may be slightly enlarged; the number of scales in an oblique series of the standard length is 19–20 in juveniles and 15–17 in adults. The colour-pattern of immature specimens is similar to that of the typical form, but the adult is uniform light grey with a few small white dots on the sides.

Distribution.—Lake Rudolf and the country between Kenya Colony and Ethiopia.

Specimens examined :—

mm.						
47	juv.	37	20	Mouth of the Kaliokwell River, Lake Rudolf.	B.M. 1932.5.2.1.	Cotypes.
51	,,	36	19	,, ,,	B.M. 1932.5.2.2.	
55	,,	36	17	,, ,,	B.M. 1932.5.2.3.	
76	♂	38	16	,, ,,	B.M. 1932.5.2.4.	
95	♀	37	15	,, ,,	B.M. 1932.5.2.5.	
97	♀	38	16	Between Kenya Colony and Ethiopia.	U.S. N. M. 66927.	

(31) VARANUS OCELLATUS Rüppel.

Juv. ♂. Sukh Plains, near Kachel, Lake Rudolf.

(32) EREMIAS SPEKII SEXTAENIATA Stejneger.

♂. Turkana Plains, near Nepal Pass, Lake Rudolf.

(33) PHILOCHORTUS INTERMEDIUS RUDOLFENSIS, subsp. n.

Holotype a ♂, no. 1932.5.2.6 in the British Museum, from near the mouth of the Kaliokwell River, Lake Rudolf ; collected by E. B. Worthington.

Head a little depressed, about once and two-thirds as long as broad, its depth equal to the distance between the centre of the eye and the tympanum. Snout pointed, with rounded canthus rostralis. Hind limb reaching to half-way between the fore limb and the ear ; foot once and a half as long as the head. Nostril separated from the first upper labial and the postnasal by a narrow rim ; prefrontals separated by a median granule ; frontal as long as its distance from the tip of the snout, once and a half as long as broad ; parietals once and a third as long as broad ; interparietal rhomboidal, once and two-thirds as long as broad, separated from the occipital by a group of three granules ; four supraoculars, the fourth broken up into four scales ; five supraciliaries, separated from the second and third supraoculars by a row of granules. Rostral not entering the nostril ; a single postnasal ; anterior loreal shorter than the second ; five upper labials anterior to the subocular ; a long narrow temporal along almost the whole outer margin of the parietal.

Scales feebly keeled posteriorly, smooth anteriorly ; two median rows largest ; 32 dorsals and laterals across the middle of the body ; 14 enlarged, feebly keeled scales between the hind limbs. Ventrals in 6 longitudinal and 28 transverse series ; 20 gular scales in a longitudinal median series ; 7 plates in the collar ; caudal scales strongly keeled, 22 in the fourth whorl ; 10 femoral pores on each side, 27 lamellae beneath the fourth toe.

Colour as in the typical form.

Dimensions.—End of snout to vent 46 mm. ; length of head 10 ; width of head 6 ; depth of head 5 ; fore limb 15 ; hind limb 29 ; foot 15 ; tail 130.

The status of this form is very difficult to assess on the basis of a single specimen, but there are so many features in which it differs from the average of the normal form of *P. intermedius* from Somaliland that it is difficult to avoid regarding it as at least racially distinct. The most marked differences are to be seen in its more slender habitus, longer tail, differently proportioned head-shields (notably the interparietal), feebly keeled scales, the low number of scales across the body, and fewer femoral pores.

(34) LATASTIA LONGICAUDATA REVOILI (Vaill.).

2 ♂♂, ♀. Near mouth of Kaliokwell River, Lake Rudolf.
♂. Lake Baringo ?

(35) MABUYA BREVICOLLIS (Wiegmann).

♂ ♀. Near mouth of Kaliokwell River, Lake Rudolf.

(36) LYGOSOMA SUNDEVALLII (Smith).

2 hgr. Near mouth of Kaliokwell River, Lake Rudolf.
Both specimens have 26 scale-rows.

(37) CHAMAELEON BITAENIATUS SCHUBOTZI Sternfeld.

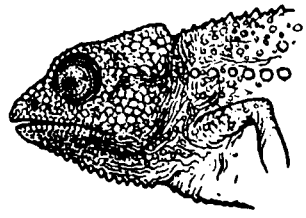
♂. 14,000 ft., Mt. Kenya (*L. C. Beadle*).

This is the first known specimen of this race for which we have a definite altitude and locality. The only previously known specimens were a juvenile from 'Mt. Kenya' and a male and female from an unknown source, but believed by their describer to have been collected on Mount Kilimanjaro. Whether or not the race actually does occur on this latter mountain must be considered doubtful, but there is no doubt that it is to be found at high altitudes on Mt. Kenya.

This fact raises a very interesting question with regard to the relationships and distribution of the various races. Sternfeld (1912) in his papers on the species has discussed some nine races, but for a clearer understanding we may reduce these nine to four principal groups, roughly characterized and distributed as follows :—

I. The *Ch. bitaeniatus bitaeniatus* group (text-fig. 7), including *bitaeniatus*, *ellioti*, *graueri*, and *tornieri*.

TEXT-FIG. 7.



Chamaeleon bitaeniatus bitaeniatus Fischer.

These are forms with a relatively low casque, low gular crest, and no rostral process ; the scaling may be more or less heterogeneous, one or two rows of enlarged flat scales are usually present on the flanks and there is some variation in the length, depth, and breadth of the head. They are found over a large area from Abyssinia to Tanganyika and from the Ituri region to western Kenya Colony ; they ascend the slopes of Ruwenzori to about 10,000 ft., but do not appear to extend so high in the mountains of Kenya Colony.

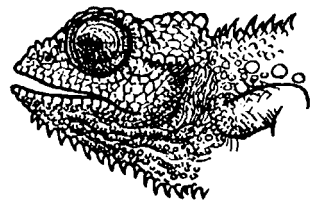
II. *Ch. bitaeniatus rudis* (text-fig. 8) has a low casque, low gular crest, no rostral process, homogeneous scaling except for two slightly enlarged scale-rows on each flank and a short, broad, deep head ; it intergrades with group I through *graueri*. It is found only on Mt. Ruwenzori between 10,000 and 12,000 ft.

III. *Ch. bitaeniatus höhneli* group (text-fig. 9) ; including *leikipiensis*, *höhneli*, and *bergeri*. This group is characterized by a very high casque, long gular crest, and a rostral process ; the scaling is heterogeneous and two well-marked rows of enlarged flat scales are usually present on each flank, the upper the better developed. These forms are found throughout the highlands of Kenya Colony from about 6,500 to 11,000 ft., and intergrade with group I through *bitaeniatus*.

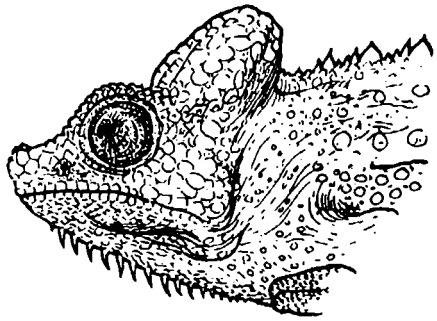
IV. *Ch. bitaeniatus schubotzi* (text-fig. 10) has a low casque, low gular crest, no rostral process, heterogeneous scaling, with two well-developed rows of enlarged scales on each flank, the lower the larger; the head is short, broad, and deep. Mt. Kenya above 11,000 ft.; ? Kilimanjaro.

It is thus seen that in the west the main stock (group I) gives rise at higher altitudes to group II, with complete intergradation between the two. In the east with increasing altitude differentiation has proceeded in quite a different direction, culminating in group III. But group IV, at a still higher altitude in the east, has the scalation of group III combined with the head-characters

TEXT-FIG. 8.



TEXT-FIG. 9.



TEXT-FIG. 10.

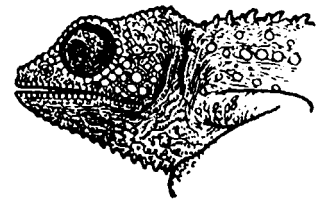


Fig. 8.—*Chamaeleon bitaeniatus rudis* Boulenger.
Fig. 9.—*Chamaeleon bitaeniatus höhneli* Steindachner.
Fig. 10.—*Chamaeleon bitaeniatus schubotzi* Sternfeld.

of group II, and no definite intergradation with any of the other forms can be traced. It is true that Sternfeld records an intermediate with *graueri* from the Kilimanjaro region, but as the occurrence of *schubotzi* on this mountain is doubtful, the status of the 'intermediate' is decidedly questionable.

At first sight it would seem that *rudis* and *schubotzi* are the results of convergent evolution in response to similar environmental conditions, for both occur at very high altitudes. But if this were the case it would not be unreasonable to expect to find analogous forms at intermediate heights on the two mountains which they inhabit. This expectation is not fulfilled, for between about 6,500 and 11,000 feet on Kenya only the high-casqued rostral-horned *höhneli*

is known, whereas on Ruwenzori *graueri* occupies the same zone. In fact, *schubotzi*, although apparently most closely allied to the forms of group I (probably *bitaeniatus*), is entirely separated from it geographically by the *höhneli* group, whereas *rudis* is in direct geographical contact with its nearest relatives. This peculiar situation of *schubotzi* only seems susceptible of explanation in one of two ways :—Either (*a*) it has arisen as an atavistic mutation of *höhneli* or (*b*) *höhneli* is the product of a secondary evolutionary outburst of the stem-form, which has cut off *schubotzi* from its nearest allies and has possibly supplanted a previously existing intermediate.

Which of these explanations is the more probable cannot be gauged except by previously conceived ideas of the methods of evolution. But should it be found that there is on Kilimanjaro a third form analogous with *rudis* and *schubotzi*, and that this is linked with the stem-form by Sternfeld's 'intermediates' mentioned above, a greater degree of probability will be given to the second hypothesis.

(38) TRIONYX TRIUNGUIS (Forsk.).

Juv. Mouth of Kaliokwell River, Lake Rudolf.

(39) CROCODILUS NILOTICUS Laur.

Juv. Mouth of Kaliokwell River, Lake Rudolf.

REFERENCES.

BOULENGER, G. A. 1896. Second Report on the Reptiles and Batrachians collected by Dr. A. Donaldson Smith during his Expedition to Lake Rudolf. Proc. Zool. Soc. London, 1896, p. 216.

HOGBEN & SLOME. 1931. The Pigmentary Effector System.—VI. The Dual Character of Endocrine Co-ordination in Amphibian Colour Change. Proc. Roy. Soc. London, B, cviii, B. 755, pp. 10–53.

LÖNNBERG, E. 1925. Reptiles, Batrachians, and Fishes collected by the Swedish Zoological Expedition to British East Africa, 1911. Reptiles and Fishes. Svenska Vet.-Akad. Handl. xlvii, 6, pp. 3–24.

LOVERIDGE, A. 1925. Notes on East African Batrachians collected 1920–3 with the Descriptions of four new Species. Proc. Zool. Soc. London, 1925, pp. 763–91.

——. 1932. New races of a Skink (*Siaphas*) and a Frog (*Xenopus*) from the Uganda Protectorate. Proc. Biol. Soc. Washington, xlv, pp. 113–16.

PARKER, H. W. 1932. Two Collections of Reptiles and Amphibians from British Somaliland. Proc. Zool. Soc. London, 1932, xxii, pp. 335–67.

STERNFELD, R. 1912. Der Formenkreis des *Chamaeleon bitaeniatus*. SitzBer. Ges. Naturf. Fr. Berlin, 1912, vii, p. 379.

——. 1912. Wiss. Ergeb. Deutsch. Z. Afr. Exp. iv, Zool. ii, 9, pp. 197–279.

WEST, G. S. 1900. On the Sensory Pit of the Crotalinae. Quart. Journ. Micr. Sci. xliii, pp. 49–59, pl. iv.

WORTHINGTON, E. B. 1932. The Lakes of Kenya and Uganda, investigated by the Cambridge Expedition, 1930–1. Geogr. Journ. lxxix, pp. 275–97.