LIZARDS WITH NORTHERN AFFINITIES FROM THE MOUNTAINS OF OMAN

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With two plates and one map

SYNOPSIS

Oman material of four lizard species is described and discussed; it comprises specimens of a previously undescribed gecko, *Phyllodactylus gallagheri*, two lacertids — the poorly known *Lacerta jayakari* Boulenger, 1887, and *L. cyanura*, also described here for the first time, and a skink, *Ablepharus pannonicus* Lichtenstein, 1823. These species have no strong affinities with any members of the mainly Saharo-Sindian fauna now occupying much of Arabia but are closely related to forms occurring to the north of the peninsula. It is probable that they are relicts of a more temperate fauna which once entered more extensively into southeastern Arabia. As might be expected, all four species are absent from the desert areas of Oman and are confined to the disjunct mesic habitats which exist in the mountains.

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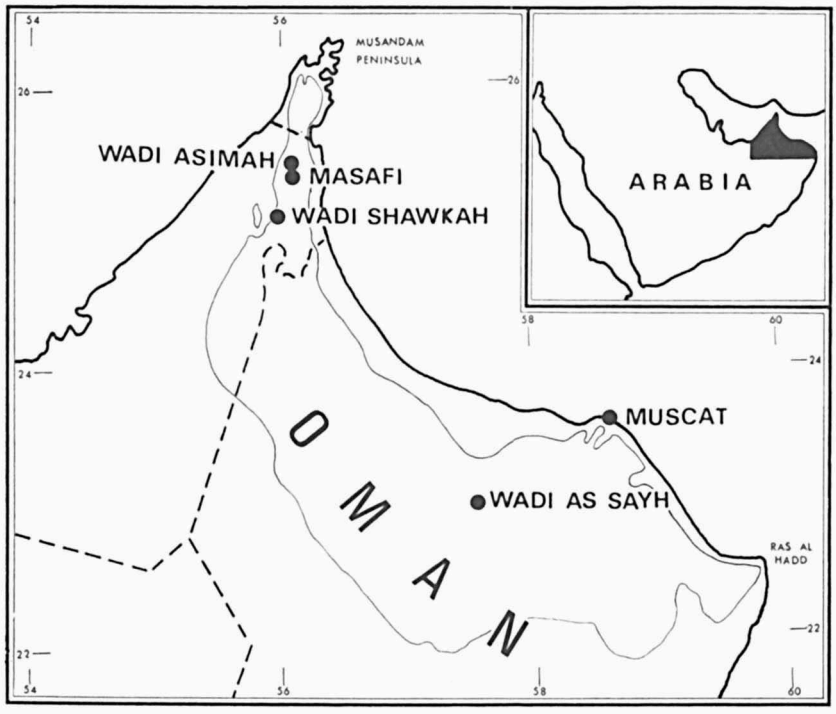
INTRODUCTION

The Oman Mountains run close to and approximately parallel with the southwest coast of the Gulf of Oman. From the Musandam Peninsula in the north to Ra's al Hadd in the southeast they are over 400 miles long and the highest section, Jebel Akhdar, rises to almost 10,000 feet. The Oman range is less arid than the rest of eastern Arabia (apart from the Dhufar littoral) and many of its wadis contain surface water for at least part of most years. Herpetologically the region is not well known and very little has been written about the reptiles of the area since Boulenger (1887, 1888) and J. Anderson (1896) described new forms from specimens obtained at

Muscat by Lieut-Col. A. S. G. Jayakar. Recently the British Museum has acquired fresh material from the mountains of Oman. Much of this was obtained by Major M. D. Gallagher who visited several localities during 1970 including Masafi (February, April) and Wadi as Sayh (July, October). In March 1971 I was fortunate enough to be able to collect with him in the Masafi area and at Wadi Shawkah (localities are shown on map). These



Localities mentioned in the text. Contour indicates land over 500 m; broken lines show approximate positions of political boundaries. Qasab is just south of the Musandam Peninsula, on the west coast.

excursions provided material of over 35 species including nine individuals of *Lacerta jayakari* Boulenger, 1887, until now known only from six specimens collected in the 1880s and one taken in 1925 or 1926, and examples of three other species (two of which were undescribed) that, like *L. jayakari*, have clear affinities with lizards occurring to the north of Arabia instead of with the Saharo-Sindian fauna now occupying much of the peninsula. This material is discussed below.

ACKNOWLEDGEMENTS

I should like to thank especially Major M. D. Gallagher who not only collected much of the material described here but also arranged and organised my collecting excursion in the Trucial States. Major-General R. C. Gibbs and Brigadier P. J. N. Ward, respectively, gave permission and support for my visit and Major J. N. Blashford-Snell also provided support. Captain W. A. C. Griffiths, Dr. P. F. S. Cornelius, and Messrs G. S. Cowles, J. George, M. C. Jennings and T. D. Rogers all helped in various ways to collect material or data. Mr A. P. Russell gave advice on the osteology of *Phyllodactylus* and Miss Dorothy Hillcoat (Botany Department, British Museum) very kindly identified plant remains from stomach samples. Miss A. G. C. Grandison read the manuscript and provided helpful comment.

Phyllodactylus gallagheri spec. nov.

Material examined. — Holotype: Trucial States, Masafi, permanent camp of Trucial Oman Scouts, 25°18.5'N, 56°10'E; in bath-house of officers' mess, collected after dark, 7.iv.1970, by M. D. Gallagher, BM 1971.42, juvenile.

It is unfortunate to have to describe a species from a single juvenile specimen. A search of the type-locality in March, 1971 failed to produce more material but there is no doubt that this lizard belongs to a distinct and previously unknown form.

Diagnosis. — A *Phyllodactylus* sharing many peculiarities with *P. elisae* Werner, 1895, of Iraq and western Iran including: absence of transverse processes on the autotomic caudal vertebrae; loss of a phalanx in each fourth digit (phalangeal formula: manus 2, 3, 4, 4, 3; pes 2, 3, 4, 4, 4); perinarial scaling (viz., internasals in contact, nostril between internasal, two postnasals, first upper labial and rostral) and arrangement of mental scutes (large triangular mental, two pairs of enlarged postmentals). *P. gallagheri* differs from *P. elisae* in almost complete absence of large trihedral tubercles on the dorsum and of enlarged, laminar and imbricate ventrals; also its subcaudal scutes are less expanded, their width being half the lateral diameter of the tail, or less, compared with three quarters or more in *P. elisae*.

Description of holotype.

External morphology. — A delicately-built gecko with rather depressed head and body; limbs and tail slender, neck well marked. Head-length one third of snout-vent distance; tail about 1¼ times head and body combined.

Rostral over twice as wide as high, entire but with a distinct medial depression. Internasals in contact behind rostral. Nostril situated between

internasal, two postnasal; first labial and rostral scutes, the last two entering broadly into the narial margin. A distinct depression present in the anterior loreal region and another, medially, just anterior to the eyes. Upper scales in posterior loreal region enlarged, over twice the diameter of the interorbitals. Twelve scales between the lower postnasal and the anterior edge of the orbit, 18 scales in a transverse row across snout at level of the third labials, 28 in transverse row just anterior to orbits; 29 scales in transverse row at level of mid-orbits. Occiput and supraorbital areas covered by more or less homogeneous juxtaposed scales, rather smaller than those on the snout. Eye large; orbital diameter almost equal to its distance from the snout-tip. Palpebral fold edged anteriorly with large scales decreasing in size posteriorly where they are separated from the edge of the supraorbital region by two rows of small granules; posteriorly a row of ciliate scales project from under the edge of the palpebral fold. Ear vertically elliptical, its longest axis just over a quarter of the horizontal orbital diameter; no denticulation of the anterior border.

12/11 upper labials (10/9 to point just below centre of eye); 9/9 lower labials (7/7 to point just below centre of eye). Mental large, wedge-shaped, its point extending backwards to the level of the suture between the second and third lower labials. Two pairs of post-mental scutes. Inner pair large; each scute elongate about twice as long as wide, anteriorly in contact with first lower labial and running backwards and inwards along posterior edge of mental to contact its fellow medially. Outer postmentals smaller, about two-thirds length of inner pair, each bordered by inner postmental and second lower labial, just touching first lower labial anteriorly. Gular scales small and granular.

Dorsum covered with uniform, rounded non-imbricate granules, about 154 in a paravertebral line from the occiput to a point above the vent. Ventral scales only slightly larger than dorsals and generally similar in shape, not flat and overlapping. Number of scales round mid-body about 105. An area of enlarged scales, each roughly twice the diameter of the other ventrals, in interfemoral region.

Forelimbs covered with small granular scales. Toes with a series of expanded scales beneath, mostly large and single but distally smaller and often divided to form a transverse series of two or three scales. Lamellar formula for manus as follows (first figure for each digit refers to number of large single scales, second to number of transverse series): 4 + 2, 5 + 1/2, 6/7 + 1/2, 7 + 2, 5/6 + 2/3. Terminal pad truncate, rather wider than long; claw distinctly exposed.

Dorsum of thigh with granular scales, those on underside slightly en-

larged but not clearly differentiated from dorsal scales posteriorly (as they are in *P. elisae*). Tibia with small overlapping scales rather enlarged beneath; a few weakly enlarged and striated tubercles present distally. Lamellar formula for pes: 4 + 2, 6 + 3, 8 + 3, 9 + 2, 8 + 2.

Tail divided externally into a series of lightly indicated segments, each equivalent to the posterior and anterior parts of two contiguous vertebrae. Tail covered above by small juxtaposed scales about equal in size to dorsal body-scales. On proximal segments there are about ten of these scales on a parasagittal line, distally they are less numerous. On the lateral posterior margins of some segments there are irregular feebly enlarged tubercles. Ventral scales of tail somewhat enlarged and overlapping on tail-base, distal to this an irregular series of expanded subcaudal scutes present; width of these scutes not more than half lateral diameter of tail; posteriorly the series becomes irregular the large scutes being interspersed by smaller scales.

Length (snout-vent): 26.5 mm. Head length: 8.5 mm. Tail: 33.5 mm. This specimen is better ossified than a juvenile *P. elisae* of similar size which may indicate that *P. gallagheri* does not grow as large as *P. elisae*.

Colour and pattern (after preservation). — Very pale tinged pinkish-brown; translucent so that viscera are discernible. A dark stripe from the posterior border of the orbit to the upper margin of the ear; a more obscure dark mark on area of enlarged scales in upper loreal region. Dorsum with a series of dark transverse bars, each less than a third the width of the intervening areas, situated as follows: one anterior to forelimbs, three between pairs of limbs and one at level of hind-legs. Tail with six bars, all more intense than those on body.

Skeletal features (based on radiographs). — Skull apparently essentially like that of other *Phyllodactylus*. Teeth in premaxilla and maxilla about 30 in all; teeth in dentary about 28. Presacral vertebrae 26; five cervical ribs, three sternals and two xiphisternals, four long free dorsal ribs and seven short ones; last two presacral vertebrae without ribs. Clavicles expanded medially, each with a large unemarginate foramen. Interclavicle cruciform, its anterior process short and its lateral arms closely bordering the posterior margins of the clavicles. Sternum without fontanelle; no inscriptional ribs. 38 caudal vertebrae, first five non-autotomic with well-developed transverse processes; remaining vertebrae autotomic with no transverse processes. Phalangeal formulae: manus 2, 3, 4, 4, 3; pes 2, 3, 4, 4, 4.

Relationships. — The genus *Phyllodactylus* has a wide but very disjunct range in the warmer parts of both the Old and New Worlds. In an attempt to assess the relationships of *P. gallagheri* members of the following species were examined radiographically: Europe, *P. europaeus* Gene, 1839; Iraq

and Iran, *P. elisae* Werner, 1895; S. E. Asia, *P. siamensis* Boulenger, 1898; Australasia, *P. marmoratus* (Gray, 1844); Socotra, *P. riebeckii* (Peters, 1882), *P. trachyrhinus* Boulenger, 1899; S. Africa, *P. ansorgii* Boulenger, 1907, *P. lineatus essex*i Hewitt, 1925, *P. porphyreus* (Daudin, 1802); W. Africa, *P. palmatus* Mocquard, 1902; Madagascar, *P. androyensis* Grandidier, 1867, *P. bastardi* Mocquard, 1900, *P. gracilis* Boulenger, 1896, *P. inunguis* (Boettger, 1878), *P. pictus* (Peters, 1854), *P. stumpfii* Boettger, 1878; Seychelles, *P. inexpectatus* (Stejneger, 1843). Of these P. *gallagheri* is most similar to its geographical neighbour *P. elisae*. Apart from a close overall skeletal resemblance, the two forms share a number of features not found in the other species examined including lack of transverse processes on the autotomic caudal vertebrae and loss of a phalanx in the fourth digit of both pes and manus. Dixon, 1964, states that several forms exhibit phalangal reduction including *elisae, europaeus, siamensis* and the American species. But in material examined during this study phalangal reduction was not found in either *europaeus* or *siamensis*. General proportions and scaling of the perinarial, mental and postmental regions are also very similar in *P. gallagheri* and *P. elisae*. These resemblances almost certainly indicate a close relationship between the two forms. *P. gallagheri* does not seem to be near the Socotran species which are superficially like it in lacking dorsal tubercles.

Ecology. — The type was taken from the waste-pipe of a bath. Although little can be based on a single specimen collected in an unnatural habitat, this may indicate that *P. gallagheri* usually occurs in fairly humid surroundings as its close relative *P. elisae* appears to do (S. C. Anderson, 1963; Reed & Marx, 1959). The type locality is a permanent military camp with brick buildings on an alluvial plain separated from the nearest hills by the precipitous banks of Wadi Ham which rises nearby. Wadi Ham is dry here except during seasonal floods. Waste water from the camp is drained into sump pits filled with large stones. Dismantling one of these produced no further geckoes, nor did investigation of the damp surroundings of a large water storage tank.

Lacerta cyanura spec. nov.

Material examined. — Holotype: Trucial States, Wadi Shawkah, 25°06'N, 56°03'E, caught 8.30 a.m., 30.iii.1971, BM 1971.1291, female. Paratypes: Sultanate of Oman (N. sector), Wadi Qidah, near Qasab, 26°14'N, 56°15'E, collected mid-day, 7.i.1971, P. F. S. Cornelius, BM 1972.710, adult male. Trucial States, Wadi Siji near Masafi Village, 24°19¼'N, 56°09¾'E, collected 11.45 a.m., 24.iii.1971, BM 1971.1292, juvenile female.

Diagnosis. — A small species of *Lacerta* assignable to Part II of the genus (Arnold, in press [1])) and differentiated from all other species by possessing a double series of carinate and bluntly spinose lamellae on the undersides of the digits. Other characters, which in combination define *L. cyanura*, are very slender limbs and tail, very depressed habitus, a series of strongly expanded plates under lower forelimb, large scales on the tibia, very strongly keeled caudal scales, hemipenis with well-developed armature (see p. 120), retracted lobes flattened and complexly folded, and micro-ornamentation of crown-shaped tubercles, and bright blue tail. *L. jayakari*, which is sympatric with *L. cyanura*, is much larger, has higher meristic counts and tubercular subdigital lamellae and a hemipenial micro-ornamentation of recurved spines.

L. cappadocica Werner of Turkey, North Iraq and N.W. Iran has carinate toes but there is only one series of subdigital lamellae and the lower eyelid has a 'window' of transparent, black-edged scales.

Description of the holotype (see pl. 1, middle and lower figure).

External morphology. — Body more depressed and limbs and tail more slender than in other species of *Lacerta*. Head strongly depressed, almost twice as long as broad; its width, in the preserved animal, about 1¾ times its depth (in lizards with cranial kinesis the depth of the skull is rather variable in life). Head-length about 26% of distance from snout to vent. Snout rather pointed, approximately as long as postocular part of head. Pileus almost 2½ times as long as broad. Neck expanded laterally, distinctly broader than head. Hind limb reaches beyond collar; foot slightly longer than head; toes strongly compressed. Tail (partly regenerated) $2^1/_3$ times as long as head and body, dorsoventrally flattened at base but tapering abruptly to become very slender and somewhat laterally compressed distally.

Paired internasal shields meet behind rostral to form a relatively long suture, about a quarter the length of the frontnasal which is slightly wider than long. Prefrontals with a short common suture. Frontal shorter than its distance from the tip of the snout, slightly over $1^2/_5$ times as long as its maximum width; anterior frontal margin formed from two obliquely intersecting curves; frontal much narrowed posteriorly, not as wide as second or third supraocular. Frontoparietals paired and in contact. Parietals each about $1^3/_5$ as long as their maximum width. Occipital slightly wider than interparietal

1) Palaearctic *Lacerta* as presently understood falls into four main species-groups two of which are quite distinct; I propose to recognise these as separate genera, viz., *Gallotia* Boulenger, 1916, and *Podarcis* Wagler, 1830. The remainder of *Lacerta* can be divided into two sections: Part I made up of the species usually referred to the subgenus *Lacerta* s. str. (*agilis, lepida, princeps, schreiberi, strigata, trilineata*, and *viridis*) and Part II containing the remaining forms.

but only $^3/_5$ as long. Four supraoculars present: first small, not in contact with frontal, second and third large, fourth small but larger than first. Supraciliaries 7/6, second largest, separated from second and third supraoculars by a complete series of granules. Lower eyelid with 4 large and about 8 moderately enlarged scales forming an opaque central disc.

Nostril bordered by internasal, two superposed postnasal, first upper labial and rostral shields, the latter entering broadly into the narial margin. Two loreals present, anterior being about two-thirds length of posterior one. 5/5 upper labials anterior to subocular and three posterior to it; subocular narrowed ventrally. A series of four narrow supratemporals diminishing posteriorly in both length and width; the first longer than the rest together. First supratemporal situated almost entirely on parietal table of skull, the others partly so. Temporal region covered by granular scales, rather smaller than dorsal body-scales; nine in a vertical line between supratemporals and rictus. Anterior temporals slightly enlarged; no masseteric shield present but tympanic shield well developed with an additional enlarged scale ventrally.

Lower labials 7/7. Five pairs of chin-shields, first two in complete contact, third pair touching anteriorly; the first three pairs slightly staggered. 27 gular scales on a straight line between collar and symphysis of chin-shields; no gular fold. Collar small, even-edged, made up of nine scales, the central one enlarged and twice as wide as any of the others.

Dorsal scales granular, non-imbricate, unkeeled, almost round anteriorly, more elongate towards tail. Scales on flanks tending towards a triangular configuration with slight imbrication of the dorsal edges. 46 dorsal scales in a transverse row at mid-body, the ones in the vertebral region larger than those flanking them. Two or three dorsals correspond to each belly-plate. Belly-plates almost rectangular with very little posterior imbrication, arranged in 26 transverse rows and six longitudinal series. Second series from mid-line the widest anteriorly, the outermost rows posteriorly. Some lateral scales bordering ventrals enlarged, up to three-quarters the length of these shields. Preanal plate of moderate size, bordered by semicircle of six large scales and an outer concentric series of small granules.

Upper forelimb with series of large plates above and granular scales below. Lower limb with antero-dorsal and ventral series of strongly enlarged plates, the series separated from each other by smaller scales (4/3 on external surface, 3/2 on inner one). Digits of forelimb with two series of scales beneath except on the penultimate phalanges where only one is present. Lower surfaces of subdigital scales set at downward angle to sagittal axis of toe and bearing keels terminating as prominent, bluntly spinous processes on free distal margins of scales.

Thigh granularly scaled above and behind; anterior and ventral surfaces largely covered by two contiguous series of enlarged plates. Ventral series separated from the femoral pores by rows of smaller overlapping scales, there being two rows at mid-thigh. Femoral pores 16/17, the two series just failing to reach the knees distally and separated medially by six small scales. Tibia with two series of large plates on ventral and lateral surfaces, dorsum covered by large, pointed, obliquely keeled scales, larger than dorsal body-scales, nine in a transverse row at mid-tibia. Digits on pes generally like those of manus: two series of keeled lamellae beneath except on digit I, penultimate phalanges of digits II-V, first phalanx of digit II, and second phalanx of digit V, where there is only a single series. Fourth toe with 24/23 pairs and single lamellae beneath.

Caudal scale-whorls alternately longer and shorter, larger whorls sometimes $1^1/_3$ times as long as neighbouring short ones. Dorsal and lateral caudal scales all strongly keeled longitudinally; most ventrals also keeled but not proximal ones. Eighteen scales in fifth caudal whorl behind vent granules. Dorsal and ventral medial scale series slightly expanded.

Length (snout-vent): 49.5 mm. Head-length: 13 mm. Tail: 115 mm.

Colour and pattern (immediately after death). — Dorsum pale coffee-brown, tinged grey, vertebral area slightly paler than rest. Belly white; throat and chest (between forelimbs) pale turquoise-blue, this colour extending as a series of irregular spots onto upper labials (on left side a single additional spot on one of the lower temporal scales). Tail, except base, turquoise-blue, more intense ventrally. Iris silver-beige, tongue grey.

Skeletal features (based on radiographs). — Basic structure of skull typical of Palaearctic members of *Lacerta*, but very thin-boned with a poorly developed osteodermal layer. Second and third supraocular lamellae with a distinct common fontanelle between them (as supposedly characteristic of the subgenus *Archaeolacerta* Mertens); primary nasal chamber largely exposed dorsally. Postorbital and postfrontal elements unfused; parietal foramen present. Marginal teeth bicuspid, posterior cusp of each tooth the larger, about 25 teeth on each side of upper and of lower jaws. Pterygoid teeth apparently absent. 26 presacral vertebrae present. Five cervical, three sternal, two xiphisternal and 13 free dorsal ribs present; the latter divided into an anterior series of six long and a posterior series of seven short ribs, the last of which is very reduced. No inscriptional ribs. Clavicle strongly expanded medially with a large unemarginate foramen; interclavicle slender, cruciform, its lateral arms directed slightly forwards. Sternum with an oval fontanelle. First five caudal vertebrae non-autotomic with large, single pairs of transverse processes; caudal vertebrae six and seven have double trans-

verse processes, the anterior pair being larger than the posterior one in each case. Remaining caudal vertebrae have a diminishing series of unpaired transverse processes.

Description of paratypes.

The two paratypes are generally similar to the holotype and only the features in which they differ from this specimen will be mentioned below. In the case of the juvenile paratype, a number of differences in proportion that are apparently ontogenetic have been excluded.

Male paratype.

External morphology. — Head slightly larger than in holotype (28% of snout-vent length). Common suture between the prefrontals long. Supraciliaries 8/7; largest 2/3. Scalation of lower eyelid differs in detail from holotype. Anterior loreal scale about $^3/_7$ length of posterior one. Supratemporals $1 + 4/1 + 3$, the first slightly shorter than the rest together; eleven temporal scales on a vertical line between the supratemporals and the rictus. No enlarged scale ventral to the tympanic. Lower labials 6/6. First three pairs of chin-shields in complete contact, arranged more symmetrically than in the holotype. 29 gulars in a straight line between collar and symphysis of the chin-shields. Eight scales in the collar. 44 dorsal scales in a transverse row at mid-body. Belly-plates in 25 transverse rows; enlarged ventral scales bordering them about half the length of neighbouring ventrals. The two series of large plates on the lower forelimb separated by five rows of scales on the outer and inner surfaces of the leg. Femoral pores 21 on right side (left side damaged). Fourth hind toes with 26/26 pairs and single lamellae beneath.

Length: (snout-vent) 50.7 mm. Head-length 14.3 mm. Tail: damaged.

Colour and pattern. — Immediately after death, the specimen was very similar to the holotype in most respects, but the belly, especially the outer ventrals, was intense blue (P. F. S. Cornelius). The preserved specimen now has a general bluish tinge.

Hemipenis. — (The terms used in describing hemipenial structure are explained elsewhere — Arnold, in press.) Hemipenis symmetrically bilobed with a well-developed armature bearing short clavulae. Lobes thin-walled, flattened and complexly folded in the retracted organ, not extensively invested by the retractor magnus muscle. Lobe epithelium with a micro-ornamentation of crown-shaped tubercles.

Skeletal features (from radiograph). — 24 presacral vertebrae present and eleven free dorsal ribs (four long and seven short pairs). Foramen of

clavicle completely emarginated behind. Six non-autotomic caudal vertebrae; seventh caudal vertebra with a poorly developed second pair of transverse processes.

Juvenile paratype (see pl. 1, upper figure).

External morphology. — Prefrontals without a common suture, separated by narrow contact of frontnasal and frontal. Supraciliaries 6/7, largest 2/3. Palpebral disc with a row of 6 large scales and about 6 moderately enlarged ones. Upper labials 5/4. Supratemporals 5/5, the first not quite half as long as entire series. Tympanic shield with two smaller scales ventral to it. Lower labials 6/6; third pair of chin-shields in complete contact. 27 gulars on line between collar and chin symphysis. Dorsals not so obviously elongate posteriorly as in holotype, not overlapping dorsally on sides; 51 dorsal scales in transverse series at mid-body. Belly plates in 26 transverse and six longitudinal series, second series the widest both anteriorly and posteriorly. Dorsal and ventral series of plates on lower fore-limb separated by 4/5 smaller scales externally, 5/4 internally. Three series of small overlapping scales on underside of mid-thigh between large ventral plates and femoral pores. Femoral pores 18/18. Scales on upper surface of tibia less enlarged than in type, 11/12 on a transverse row. Fourth hind toe with 23/23 paired and single lamellae beneath. 19 scales in fifth caudal whorl.

Length (snout-vent): 30 mm. Head-length: 8.2 mm. Tail: 72 mm.

Colour and pattern (from life). — Head dark grey-beige dorsally. Body with series of longitudinal stripes above: a) vertebral area dark beige with a blackish narrow medial stripe confined to nuchal region; b) from behind supraoculars a dark stripe about as wide as vertebral area which joins its fellow on tail-base, its inner margin indistinct, the outer well defined; c) a narrow pale gold-beige stripe originating from supraciliaries and running along edge of parietal to fade on tail-base; d) a dark stripe starting in post-ocular region, running over tympanum to terminate just above the thigh; e) a light stripe beginning below eye, passing through the tympanum and above the forelimb to terminate in inguinal region; f) a dark stripe starting on upper lip, crossing through the tympanum, over the forelimb and along lowest laterals to terminate on anterior surface of thigh. Venter white, throat suffused pale turquoise. Tail greenish proximally, intense turquoise above and below distally. Limbs dark beige with irregular light spots.

Skeletal features (from radiograph). — Basically like holotype but clavicles emarginated posteriorly and only one autotomic vertebra with double transverse processes.

Ecology. — The type locality, Wadi Shawkah, contained abundant surface

water when visited. There are several date-gardens in the wadi and the holotype was shot on a sloping rock-face bordering an irrigation channel leading to one of these. The dorsal body colouring of the lizard matched the rock well. Another specimen seen on a small cliff overlooking a pool retreated into a crevice. At Wadi Siji there was little surface water but the water-table was within 10 cm of the wadi floor at the place where the paratype was caught. This specimen was in a small gulley running down the precipitous side of the wadi, among scree. Once it hid in a crevice and another time disappeared under small boulders. In another part of the wadi an adult was seen three metres up a cliff-face in a crevice. Again there was no open water but the presence of oleanders and date-palms indicated that water was close to the surface. The Wadi Qidah specimen was taken in a narrow, steep-sided gorge with some vegetation on its floor. Further down, the wadi has luxuriant vegetation suggesting that it is well watered. This lizard was shot while chasing another across the sloping gorge wall. It was presumably in breeding condition; this is also suggested by the condition of the hemipenial epithelium.

Lacerta jayakari Boulenger

Lacerta jayakari Boulenger, 1887: 40, pl. 2.

Material examined. — Syntypes: Sultanate of Oman, Muscat, collected A. S. G. Jayakar, BM 85.11.7.7/1946.9.2.42, ♂, BM 85.11.7.8/1946.9.2.43, young ♂.

Other material: Sultanate of Oman, Muscat, collected A. S. G. Jayakar, BM 87.1.11.17-20 ♀, ♂, ♀, ♂. "Interior of Arabian coast of Gulf of Oman", collected winter 1925-26, J. Fernandez, BM 1971.1480, ♂; Wadi as Sayh, Jebel Akhdar, 23°04'N, 57°37'E, collected 19.vii.1970, 26.x.1970, M. D. Gallagher, BM 1971.110, 111, ♂ and ♀. Trucial States: Masafi, 25°18½'N, 56°10'E, collected 7.ii.1971, M. C. Jennings and M. D. Gallagher, BM 1971.109, ♂; Wadi Asimah, 25°22¾'N, 56°08½'E, collected 23, 24.iii.1971, BM 1971.1293-94, juvenile ♀ ♀; Wadi Shawkah, 25°06'N, 56°02½'E, collected 27.iii.1971, BM 1971.1295-96, ♂ ♂; Wadi Shawkah, collected 30.iii.1971, ♀ and half-grown ♀, alive and unregistered.

External morphology. — The following remarks are intended as a supplement to Boulenger's (1920) detailed description of the six specimens available to him. They deal with variations encountered in more recent material and minor lapses in Boulenger's description.

Head shape. — Mature males and females differ in the size and shape of the head. In males, the head is longer (3.5-3.6 times in the snout-vent distance compared with 4.0-4.2 in females) and more robust, the mandibular muscles, especially the pterygoidei, being very swollen.

Tail length. — All adult specimens available have regenerated tails; in two juveniles the intact tail is about 2¾ times the snout-vent distance.

Parietal scale. — Maximum length is between $1^3/_5$ and twice the maximum

breadth. If undamaged, the parietals may exhibit a series of concentric ridges near their margins; up to eight of these ridges may be present in adults.

Occipital scale. — In adult *L. jayakari* the occipital scale is usually broader and often longer than the interparietal but, as in other species of *Lacerta*, it is relatively small in juveniles.

Upper labial scales, anterior to eye. — Usually six of these are present on each side of the head but the unilateral count can vary from five to seven.

Temporal area. — Most temporal scales are small and granular, but those bordering the jugal arch are distinctly enlarged.

Supratemporal scales. — In all specimens examined, the most anterior temporal is large. In the young it is followed by a series (2-5) of roughly quadrilateral or rounded posterior supratemporals that diminish in size. In adults these scales become diagonally elongated so that the anterior of each is vertically above the hindmost part of the scale in front of it. This configuration does not appear to be found in other species of *Lacerta*.

Collar. — As Boulenger stated, the median scale of the collar is strongly enlarged in specimens from Muscat. But this is not usually so in the material from other localities.

Numbers of gular, dorsal and caudal scales. — Boulenger gives the ranges of these counts as follows: gulars (in a straight line from collar to chin symphysis) 45-50; dorsals (transverse series at mid-body) 85-95; caudals (in fifth scale-whorl behind perianal granules) 42-50. In fact the variation within material now available is considerably greater than this and also exhibits regional differences. Gulars: total 39-50; Muscat 45-50; Wadi as Sayh 42; Trucial States 39-44. Dorsals: total 66-92; Muscat 81-92; Wadi as Sayh 80, 87; Trucial States 66-80. Caudals: total 35-48; Muscat 38-48; Wadi as Sayh 35, 39; Trucial States 36-40.

Belly-scales. — Total range: 27-30 (27-29 in males, 29-30 in females). The scales in the second series from the mid-line are said by Boulenger to be broader than the other series but this is only true anteriorly.

Fore-limb. — The underside of the lower forelimb bears a prominent series of strongly expanded scales in all specimens examined.

Femoral pores. — Total range 23-30 (25-30 in males, 23-25 in females).

Colour and pattern. — The young specimens from Wadi Asimah are essentially like the juvenile syntype but the dark spots on the dorsum are larger and show less tendency to form transverse bars. In life the small light dorsal spots are almost white in the vertebral region but become pale blue-green laterally and on the outer ventrals; the light patches on the upper

labials are also blue-green. Unlike the juvenile syntype, the Asimah specimens have no regular black and white barring on the temporal region although irregular and more restricted dark and pale patches are present. The tail is bronze-coloured above. In live juveniles, as in adults, the iris is silver-cream and the anterior part of the tongue grey.

Adult specimens show great variation in dorsal pattern (see pl. 2). The two individuals from Wadi as Sayh are essentially like the Muscat specimens described by Boulenger in having virtually no markings on the back, nor do they possess the dark and light temporal markings found in some Muscat specimens. The Masafi specimen was greyish green in life with very narrow, irregularly anastomising, dark transverse lines and small spots each of which involves one or two scales. On the flanks, these lines and spots tend to form ocelli, especially anteriorly. Lizards from Wadi Shawkah are a light rich olive-bronze above with numerous pale blue-green spots that are interspersed with black and form transverse bars. These specimens also have blue spots on the upper labials and irregular dark and pale marks on the temple. Similar adults were seen at Wadi Asimah.

The anterior gular region is reticulated pale grey-blue in males (and occasionally weakly so in females). Over the swollen pterygoidei muscles this reticulation changes into distinct bars.

All specimens had a white or creamy-white belly in life and in none was it brightly coloured, including the male from Wadi as Sayh which appeared to be in breeding condition when collected.

Hemipenis. — Very similar to that of *Lacerta cyanura*, but the lobe epithelium has a micro-ornamentation of simple recurved spines.

Skeletal features (based on radiographs of 9 ♂♂ and 5 ♀♀ plus the prepared skull of 1971.1480). — General features of robust skull are typical for Palaearctic *Lacerta*. Osteodermal layer, well-developed in mature specimens, includes enlarged scales in the anterior temporal region. Supraocular lamellae fully ossified in adults; primary nasal chamber almost completely roofed by nasal bones. Postorbital and postfrontal elements unfused; parietal foramen present. Marginal teeth bicuspid (posterior cusp larger): 25 or 26 on one side of the upper jaw, about 25 on lower (based on three adults). Palatal teeth present in an almost linear series of 7 to 10 teeth on each pterygoid bone. 14 scleral ossicles in each eye. 25 presacral ribs in males, 26 in females. Five cervical, three sternal, two xiphisternal and twelve or thirteen free dorsal ribs present; the latter divided into an anterior series of five or six (according to sex) long ribs and a posterior series of seven short ribs. No inscriptional ribs. Clavicle strongly expanded medially with a large foramen which is often, though not always, emarginate. Interclavicle slender,

cruciform; its lateral arms usually directed slightly forwards. Sternum with an oval fontanelle. First five or six caudal vertebrae non-autotomic with single pairs of large transverse processes; next two to four vertebrae autotomic with double processes, the anterior pair being larger than the posterior one on each vertebra. Remaining vertebrae autotomic with a diminishing series of unpaired transverse processes.

Ecology. — No habitat data are available for the Muscat specimens but field observations at other localities suggest that *Lacerta jayakari* is confined to relatively moist biotopes. The Masafi and Wadi as Sayh specimens were taken in high wadis with some surface water and some vegetation at the time of collection. At Wadi Asimah, *L. jayakari* was only seen in and around Asimah village, a well-irrigated area of dense citrus and date cultivation. Here the lizards lived in the dry-stone walls of date-gardens, on the banks of irrigation channels and on a sheer rock-face. Of the eight observed, seven were seen within 20 metres of water. The species was found in similar situations at Wadi Shawkah where again it occurred on dry-stone walls. Others were among large boulders by a pool and among rocks on the wadi floor. *L. jayakari* appears to hunt on the ground sometimes but it is also a good climber and can scale sheer rocks easily. When disturbed, it typically retreats into rock-crevices, interstices among stones and boulders, etc. The species appears to have a wide vertical range from near sea-level (Muscat) to at least 5,500 feet (Wadi as Sayh). During March, 1971, in the Trucial States, these lizards were active throughout the day but were most conspicuous in the morning.

The limited evidence available suggests that *Lacerta jayakari* is peculiar among mainland species of the genus in taking a relatively large amount of vegetable food. Of seven stomachs examined, five contained food and in four there was a high proportion of vegetable material. (Plant identifications were made by Miss Dorothy Hillcoat).

BM 85.11.7.7/1946.9.2.42 (Muscat): beetle.

BM 85.11.7.8/1946.9.2.43 (Muscat): leaf fragments.

BM 1971.109 (Masafi): 27 termites (Isoptera) 6-8 mm long; many leaves, probably of *Phragnalium viridifolium* Oliv. (Compositae).

BM 1971.111 (Wadi as Sayh): fruits of *Grewia erythraea* Schweinf. (Tiliaceae) — a hard seed surrounded by fleshy orange-red pulp.

BM 1971.1480 ('Interior of Arabian coast of Gulf of Oman'): fruits of *Solanum nigrum* L. (Solanaceae); seeds of *Sorghum* spec. (Gramineae); unidentified leaves and seeds. (The presence of *Solanum nigrum* and *Sorghum* suggests that this specimen, for which no habitat data are available, came from a mesic evironment).

A newly caught female from Wad Shawkah defaecated beetle elytra and fibrous plant remains.

In captivity, *L. jayakari* eats tomato, banana, grapes, strawberries, plantain leaves (*Plantago* spec.), mealworms (*Tenebrio*) and small locusts.

Relationships of Arabian Lacerta

Lacerta cyanura agrees with the diagnosis of *Latastia* given by Boulenger (1921). This author distinguished *Latastia* from *Lacerta* (including *Gallotia* and *Podarcis*) mainly by external toe structure, *Latastia* having bicarinate subdigital lamellae which were assumed to be absent in *Lacerta*. (Boulenger also included the unicarinate *Lacerta cappadocica* Werner in *Latastia* but subsequent authors either returned this species to *Lacerta* or placed it in a separate genus, *Apathya* Méhelÿ, 1907.) However, there seems little doubt that *L. cyanura* is much more closey related to *Lacerta* than to *Latastia*. Its general habitus is very like saxicolous members of *Lacerta* and it possesses two skeletal features confined to, although not universal in, Palaearctic members of this genus and its close relatives *Podarcis* and to the European species of *Algyroides* Bibron & Bory, 1833, viz., 1, a strongly expanded clavicle with a large medial foramen existing in both emarginated and unemarginated conditions among individuals of the same species; 2, proximal autotomic caudal vertebrae with two pairs of transverse processes, the anterior pair being larger.

These skeletal features are shared by *Lacerta jayakari* and are typical of Parts I and II of *Lacerta* (Arnold, in press; see also foot-note on p. 117). Part I is a uniform group in which the species are generally large, have no bright colour on the belly, strongly overlapping ventral scales, typically 27-28 presacral vertebrae (total range 26-30) and frequently at least one pair of inscriptional ribs. Part II is much more varied but the species are generally rather small, usually have bright pigmentation on the belly — at least in breeding males — and, most frequently, no strong overlap of the ventral scales; they nearly always lack sexual dichromatism in the dorsal pattern which sometimes occurs in Part I. *L. cyanura* has all the characteristics of Part II, but *L. jayakari* differs from the members presently assigned to this division in its large size and lack of bright belly colour, but although these features are typical of Part I, *L. jayakari* is unlike the members of this group in all the other Part I features listed above, so it seems best to place it in Part II.

Within Part II, *L. cyanura* and *L. jayakari* appear to be most closely related to each other. In spite of a strong superficial difference the two species are alike in many features including postcranial skeleton, close

similarity in hemipenial structure (they are the only species of Palaearctic *Lacerta* to have a very strongly developed armature), arrangement of head shields, strongly expanded scales under forearm and srongly keeled caudals. Outside Arabia, they share a number of features with their nearest geographical neighbour in Part II, *L. cappadocica* of eastern Turkey, northern Iraq and northwestern Iran. This species is skeletally similar (although more variable) and has a similar habitus. Like *L. cyanura* and *L. jayakari*, many individuals have two postnasal scales (some have three) and a rather long suture between the internasal scales is present, there is no masseteric shield, the supratemporals are situated almost entirely on the parietal table of the skull and there is some tendency for a series of expanded plates to be produced under the forearm. Finally, like *L. cyanura* and *L. jayakari*, *L. capadocica* has at least traces of a hemipenial armature, a feature that has a very limited distribution within *Lacerta*. All these characters occur only in a minority of other *Lacerta* species and then not together. *L. cyanura* is also like *L. cappadocica* in having keeled subdigital lamellae and the dorsal pattern of the juvenile paratype has some similarity to that of *L. cappadocica wolteri* (Bird, 1936). Boulenger regarded *L. laevis* Gray as the nearest ally of *L. jayakari*, but there seems to be little evidence to suggest that these two species are particularly close.

Ablepharus pannonicus Lichtenstein

Ablepharus pannonicus Lichtenstein, 1823: 145.

Material examined. — Trucial States, Asimah Village, Wadi Asimah, 25°23¾'N, 56°08½'E, collected 23-24.iii.1971, BM 1971.1297-1298, ♂, ♀. Afghanistan, Helmand, BM 86.9.21.89. Iran, Bussora, BM 74.11.23.27/1946.8.18.48 (syntype of *A. pusillus* Blanford); Naksh-i-Bahran, BM 1903.14.4; Shalgahi, BM 1969.15.31. Iraq, Amara, BM 1918.7.2.2; Basra, BM 1919.8.11.33; Suk ash Shuyuk, BM 1919.8.11.30-32. U.S.S.R., Oalyk-tau, Samarkand, BM 72.5.30.15/1946.8.18.47 (syntype of *A. brandti* Strauch).

External features. — The two Oman lizards agree quite well with *A. pannonicus* but they differ in a number of minor features from more northern specimens. In both individuals the interparietal shield is small (less than half the length of the frontal compared with well over half in other material), the number of scales round the mid-body is 18 (usually, although not always, 20 in more northern specimens), and the two mid-dorsal longitudinal scale-rows are more expanded laterally than in any other individuals examined. More Oman material will be needed to assess the significance of these differences.

Ecology. — Both specimens were collected in the fertile part of Wadi Asimah from under a pile of discarded palm-fibre on an moist sand slope

near the side of the Wadi; the fibre was under a sparse bush. Other specimens were seen among discarded palm-fibre in the irrigated date-gardens of Asimah Village.

Discussion

The four species discussed are the only representatives of their respective genera known from Arabia. All have obvious affinities with lizards from more northern regions. This is not altogether unexpected as the size, relative humidity and position of the Oman Mountains makes them a potential refuge for relict species surviving from a more pluvial era when temperate forms would have extended much further south. The Oman Mountains are separated from the Iran Highlands only by the shallow Strait of Hormuz and there may have been a previous land connexion between the two areas (Anderson, 1968) so that elements of a temperature fauna could have reached Oman by this route. It is unknown how long the Oman relictual forms have been isolated from their relations in the north but the period has been long enough for three of them (the two *Lacerta* species and *Phyllodactylus gallagheri*) to become quite distinct at the species level. As might be expected all four species are restricted to isolated mesic habitats in mountain wadis and are absent from intervening desert areas. It is probable that more reptiles with northern affinities will be discovered when the Oman Mountains are more fully investigated.

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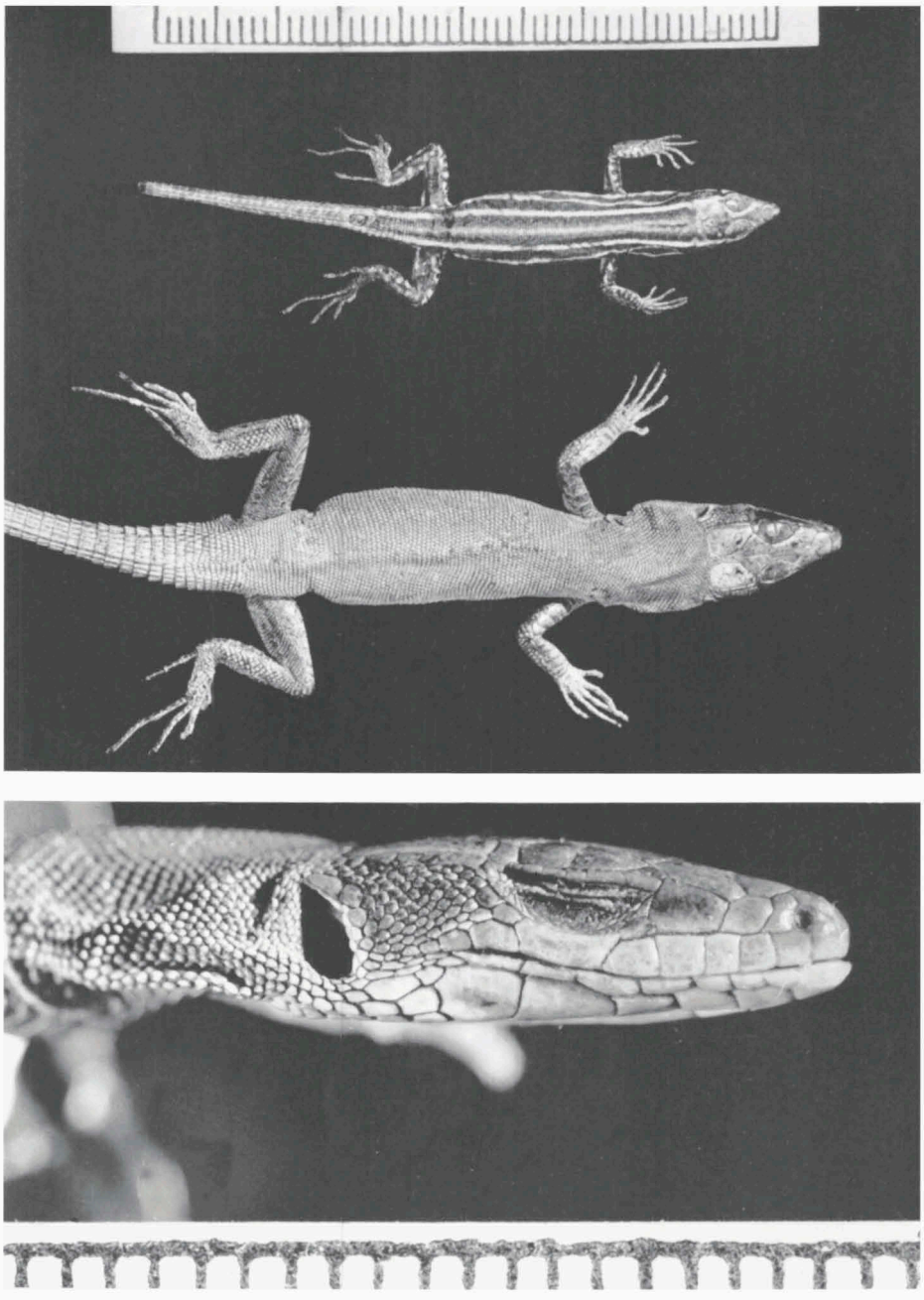
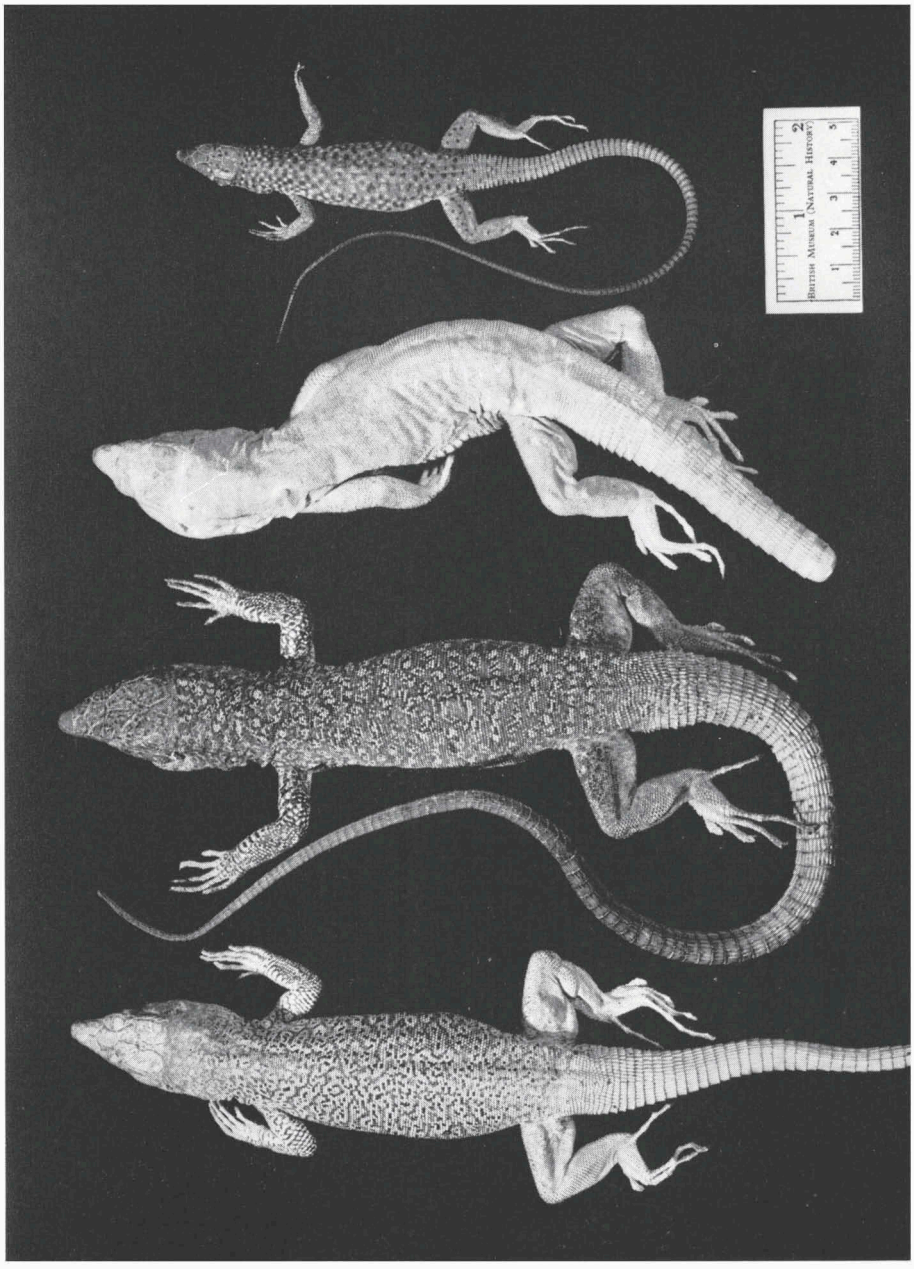


Lacerta cyanura spec. nov. From top to bottom: paratype (BM 1971.1292), holotype (BM 1971.1291), and lateral view of head of holotype. Scale in mm.



Lacerta jayakari Boulenger, 1887: variation in dorsal pattern. 1, ♂, Masafi, BM 1971.109; 2, ♂, Wadi Shawkah, BM 1971.1295; 3, ♂, Muscat, BM 1887.1.11.18 (specimen somewhat faded); 4, juvenile ♀, Wadi Asimah, BM 1971.1293.