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Skulls of Gymnophiona and Their Significance in the Taxonomy of the Group¹

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ABSTRACT

The skulls of 48 species and subspecies of Caecilians are reviewed and three photographs of each are presented. Significant differences are demonstrated in the skulls, which would warrant the taxonomic arrangement proposed. Four families are recognized.

INTRODUCTION

Although considerable anatomical study has been done on the skulls of certain genera of the Gymnophiona, skulls of numerous genera are as yet unknown, owing to a dearth of specimens available for such study. I have, with the help of certain museums and individuals, brought together the skulls of nearly four dozen species representing 4 families and 20 genera. For a number of years we have been wont to regard the caecilians as representing a single family and in such case perhaps committing ourselves to the premise that the evolution of the now Gymnophiona has all taken place since they arrived at their present form and habitat. With an examination of the literature descriptions of known species, and the skull studied here, one is convinced that, of the present members of the group, doubtless several had undergone a considerable evolution prior to becoming refugees in subterranean food habitats where competition for food was less severe, and where the loss of limbs and girdles was an adaptation essential to a subterranean existence. Some forms seemingly left the subterranean habitat for a completely aquatic one. It is likewise true that some anatomical studies on the skulls, though excellent, have not been directed in the immediate direction of taxonomy, since the workers were seemingly less concerned with the taxonomic implications than with other aspects.

In my study of caecilians (Taylor, 1968), having utilized such characters as were apparent from preserved specimens (such as body shape, size, folds, scales, proportions and dentition, and, to a lesser extent, reproductive organs,

gills, gill slits, eye position, character and position of the tentacle and snout projection, etc.), it became obvious to me that evolution had differentiated the Gymnophiona into several groups of greater significance than genera. Three such groups were considered as families, the Ichthyophidae, Typhlonectidae and Caeciliidae, while a fourth, still little known, likewise appeared that it might be worthy of admission to such a category.

Since this publication appeared, I have proposed that this fourth group be recognized as a new family, the Scolecomorphidae. I have also proposed that the family Caeciliidae, *sensu strictu*, be divided into two subfamilies, the Dermophinae and Caeciliinae (Taylor, 1969b).

The present study was undertaken to ascertain to what extent the gross anatomy of the skull displayed the evolution that was evident in other anatomical areas. Rather than write detailed descriptions of conditions obtaining in each of the skulls, I offer figures, which, in a way, serve as a universal language.

The following abbreviations are used for the names of various collections containing caecilians:

AMNH: American Museum of Natural History, New York, New York.

BMNH: British Museum (Natural History), London, England.

EHT-HMS: Edward H. Taylor-Hobert M. Smith Herpetological Collection, Lawrence, Kansas.

KUMNH: Kansas University Museum of Natural History, Lawrence, Kansas.

MCZ: Museum of Comparative Zoology, Harvard College, Cambridge, Massachusetts.

DSBM: Division of Systematic Biology, Museum, Stanford University, Stanford, California.

UIM: University of Illinois Museum, Urbana, Illinois.

THE BONES OF THE SKULLS OF GYMNOPTIONA

Figure 1 is a diagrammatic drawing of a representative gymnophionan skull showing the names of the bones as referred to in this paper.

The skulls of caecilians seem to have undergone a reduction in numbers of bones when compared with many other primitive amphibians, a reduction largely brought about by fusion, or in some cases perhaps by complete loss. For instance the skulls of some generic groups have certain dermal bones which in others are lacking. The usual interpretation is that the missing bones have been fused to surrounding or contiguous bones or that they have "dropped out." One may sometimes trace a bone through a series of related genera to find it diminishing in size until it no longer appears, or, as in the case of the splenial of certain salamanders, it seems as if the bone, with its numerous teeth, is resorbed or eliminated completely during the lifetime of the individual animal.

One common observation of paleontologists and others who treat of skull anatomy is that the earlier geological forms of many groups are very likely to have the greater number of bones; that later forms, usually considered more specialized, have fewer bones. By such a criterion one might consider the family Ichthyophidae as a more primitive group (i.e., retaining more of the primitive characters). However, this would not necessarily bespeak a greater age.

In the Gymnophiona one of the recognized family groups, Ichthyophidae, has pairs of separate dorsal dermal bones, the prefrontals, orbitals (or postfrontals), septomaxillae, premaxillae, and nasals. Two other groups recognized as families, Typhlonectidae and Caeciliidae, lack this series of separate bones. The first three bones are fused to neighboring elements or have dropped out completely. In the case of the nasals and premaxillae, these obviously become fused to form a pair of nasopremaxillae.

The remaining bones of the skull likewise show obvious fusions in all four recognized families. The occipital bones, the otic bones (except stapes) and the otic capsules fuse with the sphenoid bones to form a compound element which is here designated the basisphenoid and serves as the major part of the braincase.

The stapes are present in three of the recognized family groups but are absent in the fourth (Scolecomorphidae).

The maxillary bones are invariably fused to the palatines, and are here called the maxillopalatines, the palatine portion being occasionally referred to as the palatine shelf.

The family Scolecomorphidae has retained the septomaxillae, separate nasals and premaxillae but seeming invariably lacks the prefrontals, the oculars and, strangely enough, the stapes.

The pterygoids are sometimes discernible as separate elements, sometimes they seem to be more or less solidly fused to the quadrate. A tiny ectopterygoid may or may not be present. The quadrate is invariably present, sutured to the squamosal and presenting a surface for the articulation of the lower jaw, as well as a surface or a notch for contact with the stapes (except in the *Scolecophoridae*).

The bones of the various groups are fitted together by an overlapping suture or they may be narrowly separated and held together by a cartilage. Sometimes these regions of contact become still more widened by the intervention of musculature. These separations are described as diastemata. One occurs frequently between the squamosal and the parietal. Similarly, the same may happen between the basisphenoid and pterygoid with the palatine shelf of the maxillary. There may be typical sutures, overlapping or interdigitating cartilage covered openings, or there may be very wide diastemata, so that the posterior side walls of the basisphenoids are exposed and the orbitosphenoids, usually not seen, are largely exposed (*Scolecophoridae*).

Another variable element is the mesethmoid, which may be completely covered by the dorsal dermal bones or may appear on the dorsal midline of the skull, exposing little or much surface, and serving, often, to separate the frontals, or the nasopremaxillae. Occasionally the anterior part of the parietals may likewise be separated for a distance.

In making the comparisons, I have chosen only a part of the characters. Many others might be mentioned as, for instance, the blood and nerve fenestrae, shape and size of teeth, bone sculpturing, and the internal skull structures. Most of the characters I have used are visible in the cleaned skull without a dissection or dismemberment of the cranium.

Unfortunately, skulls of many of the species are unknown to me or known through only a single skull. Where several skulls of a single species were available, the variation was very meager.

In the Figures, often it is a bit difficult to follow the skull sutures. Perhaps the greatest disappointment is in the teeth. Being at different levels in the skull, rarely are all the teeth in focus at the same time with the magnification used. Moreover, in many of the skulls, many of the teeth are absent, having been lost in the preparation of the skull. Usually the numbers can be counted and their relative size discerned in the skull itself. In the Figures this is not true to the same extent. The reason for this condition is that the teeth are jointed and the distal portions may be lost.

It will be noted that I have not utilized the lower jaws of these specimens in this discussion. The jaws were photographed and studied. The material was on the whole very unsatisfactory inasmuch as the fragile jaws were almost invariably broken in the specimens that had been skeletonized. This was perhaps due to the opening of the closed jaw for the original identifica-

tion of the species of the preserved specimen. Occasionally, the specimens had been damaged before preservation. The teeth on the lower jaw were often destroyed by the opening of the jaw.

These elements do contribute characters for the differentiation of certain genera and families, but the illustrations, which are most necessary, do not show the characters adequately or at least not to the satisfaction of the author, hence the omission.

DESCRIPTIONS OF SKULLS

Family *Ichthyophidae*

The family characteristics as displayed by the skulls of *Ichthyophis* and *Caudacaecilia* examined are as follows: the number of separate bones is greater than in other known families of the Gymnophiona. Beginning dorsally on the snout tip are the large paired nasals, separated anteriorly by a small wedge formed on the upper tips of the premaxillae; a pair of frontals follow the nasals, and these in turn are followed by a pair of parietals, usually the largest dorsal bones; on each side of the median series are (anteriorly) a septomaxilla bordering the anterior nares, a prefrontal, and an ocular which may be completely free or partially fused to the squamosal; the latter is a large lateral bone. This is preceded by the maxillopalatine, that borders the mouth laterally and reaches forward to contact the premaxillaries, which border the anterior part of the mouth. The posterior part of the skull roof is formed from the sides of the posterior brain case (basisphenoid) which surrounds the large foramen magnum, but the continuity is broken dorsally by a suture in the bone between the foramen and the parietals. Behind the squamosal, and attached to it, is the quadrate. Just posterior to the quadrate is the stapes, whose base serves as part of the brain case wall and sends forward a projection that forms a suture with the quadrate.

The brain case is largely composed of a single compound bone, here designated the basisphenoid, which has incorporated the various occipital, sphenoid and otic bones and possibly certain others. It forms a large part of the floor and sides of the brain case and sometimes, in certain families, reaches forward to the prevomerine tooth series. Ventrally there is a constriction of the basisphenoid preceding the otic capsules, anterior to which the bone forms two more or less distinct lateral "wings" which are in contact with the quadrates and the pterygoids. The anterior border of the ventral surface of the skull is formed by the premaxillae and the maxillopalatines. The premaxillae are followed by paired prevomers which are relatively very large in this family, often extending farther back than the internal nares and usually if not always forming a part of their border. The major part of the

border of the nares is the palatine shelf of the maxillopalatine. Posteriorly the shelf contacts the pterygoid, which posteriorly joins the quadrate either by suture or in certain cases seemingly by fusion.

The tooth-bearing bones of the skull proper are the premaxillae, the maxillary and palatine sections of the maxillopalatines, and the prevomers. (In certain families where an ectopterygoid is present, it may also bear teeth.) The lower jaws each consist of two compound bones, the dentary, which has incorporated the splenial, and the articulare. In this family this bone bears a series of dentary teeth (usually the largest of all in size) and usually a splenial series (sometimes called the inner mandibular series). This latter may be absent completely in certain families while in other families, including the Ichthyophidae, it may be absent in only some of the genera.

Ichthyophis Fitzinger

Ichthyophis Fitzinger, Neue Classification der Reptilien. . . . Wien, 1826, pp. 36, 63. Type species *Coecilia hypocyanea* van Hasselt.

Fitzinger assigned a single species to this genus. Peters (1879) recognized three species, *Ichthyophis glutinosus* (Linnaeus), *Ichthyophis beddomei* Peters and *Epicrium monochroum* Bleeker. Boulenger, who reviewed the caecilians in 1882, as one of his maiden efforts, placed all Asiatic forms of the genus having a lateral stripe in the species *glutinosus* (Linnaeus); all lacking the stripe in the species *monochrous* (Bleeker).

The genus as now constituted has a large number of forms recognized as species which are confined to southern and southeastern Asia and adjacent island groups. The cranial skeleton is known to me from the skulls of several forms which I recognize as species. This genus differs from the *Caudacaecilia* chiefly in the absence of the splenial teeth in the adult.

Ichthyophis glutinosus (Linnaeus)

(Fig. 2)

Caecilia glutinosa Linnaeus, Systema Naturae . . . , 10th Ed., vol. 2, 1758, p. 229. Type-locality "Habitat in Indiis." It appears to be most probable that the type-locality is Ceylon (see Taylor, 1965).

Data here given are from the skull of KUMNH No. 31291, Tonacumbe Estate, Numunukula, Ceylon.

The general characters agree with those listed for the family and genus. The skull bones show a rather strong overlap on the dorsal surface, the anterior elements overlap the bones behind them and the frontals have two narrowed processes pushing forward between the prefrontals and the nasals. The parietals maintain the same width until they narrow posteriorly. The parietals and squamosals have a very narrow separation, bridged by cartilage; the ocular bone is separate and complete (the bone of this skull figured is broken partially on one side). The septomaxillae border the anterior nasal

openings. The tentacular foramen is separate from the orbit but close to it, directed outward and downward rather than forward. The prevomers are not narrowed and not or scarcely separated posteriorly by the spine of the basisphenoid. The pterygoid, which is not fused to the quadrate, sends a narrow process forward that reaches to the internal nares. I do not discern an ectopterygoid and believe it normally absent. The stapes, which has a fenestra through the bone, projects forward into a notch in the quadrate. The "wings" of the basisphenoid are rather poorly developed, and the otic capsules are inflated very little. The tooth rows are subparallel. See Table 1.

Ichthyophis beddomei Peters

(Fig. 3)

Ichthyophis beddomei Peters, Monatsb. Akad. Wiss. Berlin, 1879, p. 932, fig. 4. Type-locality, Nilgherrie Hills, India.

Data given here are from the skull of EHT-HMS No. 3186, Kotegehar, India.

The skull resembles *I. glutinosus* in most characters. The tentacular aperture is somewhat farther forward or, rather, the groove continues farther forward, so that when the tentacle reaches the surface, it is distinctly farther from the eye. The stapes is fenestrated. There are two anterior fenestrae in the prevomers instead of one as in *glutinosus*. See Table 1.

Ichthyophis singaporensis Taylor

(Fig. 4)

Ichthyophis singaporensis Taylor, Univ. Kansas Sci. Bull., 1960, vol. 40, pp. 55-58, figs. 5, 6. Type-locality, Singapore Island.

Data are from the skull of the type-specimen, BMNH No. RR1959.1.2.43. (figured in Taylor, *loc. cit.*, fig. 6).

The ocular bone actually is circular, but on one side the bone tends to fuse to the maxillopalatine. The parietals are notched, constricted near their anterior end, behind which they attain their greatest width. The skull is more compact than in *I. glutinosus*, not or scarcely narrowing anteriorly. The anterior process of the pterygoid is narrower and shorter, not reaching to the level of the internal nares; the squamosals are shorter and wider than in the preceding species. See Table 1.

Ichthyophis kohtaoensis Taylor

(Figs. 5-6)

Ichthyophis kohtaoensis Taylor, Univ. Kansas Sci. Bull., 1960, vol. 40, pp. 110-113, fig. 38. Type-locality, Koh Tao Island, Gulf of Siam.

Data are from the skull of EHT-HMS No. 3935, from about 10 mi. north of Chiang Doi, N. Thailand.

The skull tends to narrow anteriorly as in *I. glutinosus*. The orbit is not completely surrounded by the ocular, and the orbit and the tentacular groove are continuous. The fenestrae, posterior to the internal nares and separating

TABLE 1. Measurements in mm and tooth counts in the skulls of *Ichthyophis*.

Species Number Museum Locality	<i>glutinosus</i> 31291 KUMNH Ceylon	<i>beddomei</i> 3186 EHT-HMS Mysore, India	<i>singaporensis</i> Type BMNH Singapore	<i>kohtaoensis</i> 3936 EHT-HMS N. of Chiang Mai, Thailand	<i>kohtaoensis</i> 3935 EHT-HMS Chiang Dao, Thailand	<i>mindanaoensis</i> 20926 DSBM Misamis, Mind. P.I.
Total length of skull	13.0	11.0	10.4	11.7	13.0	11.5
Greatest width	8.0	7.0	7.0	6.8	8.35	7.4
Width at middle of orbit	6.3	5.5	6.7	?	6.8	6.0
Jaw length	12.2	10.9	10.3	12.0	13.0	11.0
Length of basisphenoid	7.4	6.8	6.5	7.5	7.0
Width at "wings"	5.2	4.3	5.0	4.5	5.3	4.7
Width at otic capsules	5.5	5.0	5.0	5.0	5.7	4.8
Length of prevomers	4.5	4.2	3.8	4.0	3.7	4.2
Combined width, prevomers	3.5	3.2	3.7	3.4	3.5	3.0
Length from anterior border of internal nares to condyle	8.4	7.3	5.7	7.5	8.8	7.7
Total length of specimen	320	258	243	?	309	259
Premaxillary teeth	7-8	8-7	7-8	7-7	8-9	7-7
Maxillary teeth	15-15	14-15	16-17	14-17	17-17	17-18
Prevomerine teeth	9-8	11-10	8-6	10-9	9-10	10-10
Palatine teeth	14-15	14-15	13-13	13-15	18-16	16-14
Dentary teeth	?-23	14-?	20-19	24-24	24-26	21-22
Splénial teeth	?-11	14-?	3-3	16-17	17-17	12-11

the pterygoid and basisphenoid, are proportionally larger, and the prevomers are proportionally longer than in *glutinosus*. Table 1 gives data on this and one other skull.

Ichthyophis mindanaoensis Taylor

(Fig. 7)

Ichthyophis mindanaoensis Taylor, Univ. Kansas Sci. Bull., 1960, vol. 40, pp. 69-74, figs. 13-15. Type-locality, Todaya, Mt. Apo, Davao, Mindanao, Philippine Islands. Elev. 2800 ft.

Data are from the skull of DSBM No. 20926, from 11 km. SE of Buena Suerte, on side of Dapitan Peak, Mindanao, P.I. Elev. 3700 ft.

This is similar to the preceding *I. kohtaoensis*, but in this the ocular bone is seemingly fused to the squamosal for much of its region of contact, and the tentacular aperture is separated from the orbit. When the cartilage of the squamosal-parietal suture is removed, there is a very narrow diastema between these bones. The prevomers are shorter than in *I. kohtaoensis*. See Table 1.

Caudacaecilia Taylor

Caudacaecilia Taylor, *Cacilians of the World*, 1968, p. 165. Type of genus, *Ichthyophis nigroflavus* Taylor.

Taylor referred five species to this genus: *Ichthyophis nigroflavus*, which was designated as type, *I. paucidentulus* Taylor, *I. weberi* Taylor, *I. larutensis* Taylor and *Caudacaecilia asplenica* Taylor. The range of this series of species is spread from the western Philippine Islands through Borneo, Sumatra, and the Malay Peninsula. All differ from *Ichthyophis* in the absence of splenial teeth.

These have the general skull characters of the family Ichthyophidae; that is, the presence of prefrontals, septomaxillae, oculars and separate premaxillae and nasals. The oculars may be partially fused.

The maxillaries and palatines are fused to form the maxillopalatines, and the basisphenoid has incorporated the various occipital and otic bones and the otic capsules to form the basisphenoid that serves as the major part of the brain case. The squamosals, frontals, parietals, quadrates and stapes appear dorsally or laterally; ventrally there are prevomers and pterygoids. The mesethmoid is not visible dorsally.

Skulls are available for four of the five known species as follows:

Caudacaecilia nigroflava (Taylor)

(Fig. 8)

Ichthyophis nigroflavus Taylor, Univ. Kansas Sci. Bull., 1960, vol. 40, pp. 101-103. Type-locality, near Kuala Lumpur ("within 20 miles"), Selangor, Malaya.

The data are from the skull of EHT-HMS No. 1734, Bukit Lagong Forest Reserve, Selangor, Malaya.

The skull is relatively broad, not tapered or tapering but very little anteriorly; the premaxillae are visible dorsally between the nasal openings;

the nasals are narrowed posteriorly; the frontals are nearly as long as the parietals, which widen somewhat posterior to the squamosals. The prefrontals form relatively broad sutures with the septomaxillae. The stapes, partly hidden from above by a shelf of the dorsal part of the basisphenoid, push forward into a rather deep notch in the quadrate. The pterygoids reach to near the edge of the internal nares; no ectopterygoid is present. The orbital rim of eye and the tentacular aperture and groove are continuous. The ocular bones, if considered present, are fused to the squamosals which largely surround the eye. The diastemata following the internal nares are large. The otic capsules are not noticeably inflated. The tooth rows are subparallel, with the inner series extending farther posteriorly than the maxillae. See Table 2.

Caudacaecilia asplenica Taylor

(Fig. 9)

Ichthyophis aspleni Taylor, Univ. Kansas Sci. Bull., 1965, vol. 46, pp. 278-283, figs. 14-15. Type-locality, "Boven Mahakkam," Borneo.

Data are from the skull of EHT-HMS No. 1373, La Doo Tin Mine, Yala Province, Thailand.

This differs from the preceding species in having the orbit almost completely separated from the squamosal by a separate ocular bone, the tentacular aperture distinctly separate from the orbit, and the frontals distinctly shorter than the parietals. The maxillopalatine borders the orbit for a short distance. The skull is slenderer, narrowing more anteriorly than in *C. nigroflava*. On the left pterygoid there are two small teeth (anomaly?). See Table 2.

Caudacaecilia larutensis (Taylor)

(Fig. 10)

Ichthyophis larutensis Taylor, Univ. of Kansas Sci. Bull., 1960, vol. 40, p. 44, figs. 1, 2. Type-locality, Maxwells Hill, Larut Hills, 3380 ft. elev. Perak, Malaya.

Data are taken from the skull of EHT-HMS No. 3359, Topotype.

The ocular, if present, is fused more or less completely with the squamosal. The maxillopalatine is excluded from the orbit and the tentacular aperture is not continuous with the orbit. Dorsally the frontals are as long as or longer than the parietals, with the latter scarcely widening behind the posterior level of the squamosal. The skull tends to be narrower than that of *nigroflava*, especially anteriorly. See Table 2.

Caudacaecilia weberi (Taylor)

(Fig. 11)

Ichthyophis weberi Taylor, Philippine Jour. Sci., 1920, vol. 16, p. 227; type-locality, Malatgan River, Palawan, Philippines. (Type destroyed.)

Data are taken from the skull of DSBM No. 21764. (Paratype of neotype.)

The prevomers are slightly wider posteriorly and do not extend beyond the posterior level of the internal nares; the orbit and the tentacular aper-

TABLE 2. Measurements in mm and tooth counts in skulls of *Caudacaecilia*.

Species	<i>nigroflava</i>	<i>asplenia</i>	<i>larutensis</i>	<i>weberi</i>
Number	1734	1373	3359	21764
Museum	EHT-HMS	EHT-HMS	EHT-HMS	DSBM
Locality	Selangor, Malaya	Yala, Thailand	Perak Malaya	Palawan, Philippines
Total length of skull	12.0	9.5	11.0	9.0
Greatest width	8.0	6.3	6.8	5.4
Width at orbits	7.4	4.2	6.0	5.0
Length of jaws	12.4	10.5	11.1	8.0
Length of basisphenoid	7.4	6.7	6.2	5.4
Width at "wings"	5.4	4.0	4.2	3.9
Width at otic capsules	5.2	4.3	5.0	4.4
Length of prevomers	4.3	3.3	3.9	3.3
Combined width prevomers ..	4.4	3.5	3.4	3.15
Front edge of internal nares to condyle	7.9	6.2	7.0	6.0
Length of specimen	385	238	252	209
Premaxillary teeth	11-10	7-8	9-8	8-10
Maxillary teeth	17-15	16-16	19-20	17-17
Prevomerine teeth	13-12	10-10	11-10	11-11
Palatine teeth	15-15	14-15	18-18	13-13
Dentary teeth	18-?	21-21	20-20	20-21
Splenal teeth	0-0	0-0	0-0	0-0

ture are seemingly connected by a narrow groove, and the ocular if present is fused completely to the squamosal. The maxillopalatines border the orbits narrowly. The frontals are shorter than the parietals. The general skull proportions seem to be more similar to *C. nigroflava* than to the other two species. See Table 2.

Family Typhlonectidae

The general characteristics of the skull in the Typhlonectidae based on the type genus and *Potamotyphlus* are as follows: The premaxillary and nasal bones are fused and seemingly also have incorporated the septomaxilla. The frontals are largely in contact their entire length, the mesethmoid not visible. The parietals are in contact their entire length. The posterior dorsal portion of the skull is formed by the dorsal part of the basisphenoid, which is sutured above the foramen magnum.

Laterally the maxillopalatine has an anterior opening for the tentacle and posteriorly it surrounds the eye socket for about three fourths of its circumference. This is followed by the squamosal, separated from the parietal by a wide diastema, and bordered posteriorly by the quadrate. There is a small external stapes (this element has been accidentally lost on one side) on the skull of *Potamotyphlus*.

Seen from the ventral surface, the anterior portion of the skull is occupied

by the nasopremaxillae. Following this are the two prevomers, bearing the prevomerine teeth on their anterior borders, then narrowing as they extend backward between the huge internal nares, bordering them on their upper anterior edges for about one fifth to one third of their circumference or perhaps more in *Potamotyphlus*.

The lateral portion of the ventral surface is occupied by the maxillopalatine, the palatine portion largely surrounding the internal nares (choanae) and posteriorly separated by an irregular rather narrow diastema from the basisphenoid (partly cartilage covered) or without a noticeable diastema in *Potamotyphlus*. The pterygoid is at least partially fused to the quadrate. The basisphenoid is large with distinct lateral "wings" bordering the pterygoid; it runs forward, and anteriorly as a narrow point, tends to separate the prevomers for a greater or lesser distance (in *T. natans* separated nearly to the prevomerine teeth).

Typhlonectes Peters

Typhlonectes Peters, Monatsb. Akad. Wiss. Berlin, 1879, pp. 930, 940. Type of genus, *Caecilia compressicauda* Duméril and Bibron.

Peters (1879) originally referred four species to the genus: *Caecilia compressicauda* Duméril and Bibron, *Caecilia natans* Fischer, in Peters, *Siphonops syntremus* Cope, and *Caecilia dorsalis* Peters.

Of these the first two, *T. compressicauda* and *T. natans* are now recognized in the genus. *Caecilia dorsalis*, a synonym of *Caecilia kaupii* Berthold, is placed in a different genus, *Potamotyphlus*; and *Siphonops syntremus* has likewise been placed in a new genus, *Copeotyphlinus*. Formerly it had been placed in *Typhlonectes* with a ? by Peters, in *Dermophis* by Cope (1866), and treated as *incertae sedis* by Dunn (1942).

Peters recognized the most salient generic features: body lacking scales; eye in an orbit, not covered by bone; tentacular aperture opening close to nostril; splenial teeth present. Both lungs well-developed; foetus with bladder-shaped gills. Aquatic.

Certain other species have been added to the genus: *Thyphlonectes* [sic] *venzuelense* Fuhrman, *Chthonerpeton microcephalum* Miranda-Ribeiro, *Typhlonectes eiselti* Taylor, *Typhlonectes obesus* Taylor, and *Typhlonectes anguillaformis* Taylor. On the authority of Dr. Joseph Bailey, in Dunn (1942), *Chthonerpeton microcephalum* is a synonym of *Typhlonectes kaupii*=*Potamotyphlus kaupii* (Berthold).

The skulls of two species of *Typhlonectes* are known to me, *T. compressicauda* and *T. natans*.

Typhlonectes compressicaudus (Duméril and Bibron)

(Fig. 12)

Caecilia compressicauda (Duméril and Bibron), Erpétologie Générale. . . . 1841, vol. 8, p. 278 (type-locality, Cayenne).

The skull is from a specimen, EHT-HMS No. 1731, Belém, Brasil. Since the type came from a different drainage system, one cannot be absolutely certain that this Amazonian population agrees in detail with that from the Guianas.

The characters agree with those of the family: the skulls bones are reduced in number, the prefrontals, septomaxillae, and oculars do not appear, while the premaxillae and nasals are fused to form the two nasopremaxillae. As in all gymnophiones the occipitals, otics, and the otic capsule and sphenoids are fused with the basisphenoid in making the brain case. The palatine and the maxillary are fused; small stapes are present. The pterygoid may be free or fused at least partially to the quadrate. A very small ectopterygoid may be present. The orbits are cut chiefly in the maxillopalatines but are bordered posteriorly by the squamosals; the tentacular aperture notches the anterior part of the same bone, with the groove continuing along the nasopremaxilla. The external narial openings are proportionally large. A wide diastema is present between the parietal and squamosal. The internal nares are of very large size, surrounded, except anteriorly, by the palatine shelf of the maxillary. The prevomers, which border the inner anterior edge, are rather narrowed posteriorly but are separated for about a fourth of their length by the anterior point of the basisphenoid. Seemingly the pterygoid is at least partly fused to the quadrate. The wings of the basisphenoid are distinct. See Table 3.

Typhlonectes natans Fischer, *in* Peters

(Fig. 13)

Typhlonectes natans Fischer, *in* Peters, Monatsb. Akad. Wiss. Berlin, 1879, p. 941. Type-locality, Río Cauca, Colombia.

Data are from the skull of MCZ No. 24524 from "Cúcuta," Colombia.

Compared with the previously described skull, *T. natans* differs in having a proportionately much narrower pair of frontals and still narrower parietals which are less wide than the frontals; the very large diastema between the squamosal and the parietal is as wide as the parietal itself, the greater part of its length. The prevomers have a slight projection anterior to the prevomerine teeth, much narrowed posteriorly and terminating in points posterior to the back level of the nares. These are separated for about two thirds of their length. The pterygoid seemingly is not fused to the quadrate. See Table 3.

Potamotyphlus Taylor

Potamotyphlus Taylor, Caecilians of the World. 1968, pp. 256-257. Type of genus, *Caecilia kaupii* Berthold.

This genus comprises two known species that have the following characters: no scales, no secondaries, head relatively small with a long slender neck, a dorsal skinfold, eyes in sockets, tentacular aperture very close to large

TABLE 3. Measurements in mm and tooth counts of the skulls of *Typhlonectes* and *Potamotyphlus*.

Species	<i>T. compressicaudus</i>	<i>T. natans</i>	<i>P. kaupii</i>
Number	1731	24524	787
Museum	EHT-HMS	MCZ	UIM
Locality	Belém, Brasil	Cúcuta, Col.	(Uncertain)
Total length of skull	16.5	22.4	11.1
Greatest width	11.2	14.8	5.5
Width at middle of orbits	10	12	5.05
Length of jaw	14.2	21.5	? broken
Length of basisphenoid	11.1	15.5	7.2
Width at "wings"	7.7	8.9	3.5
Width at otic capsules	7.2	8.3	5.0
Length of prevomers	4.8	6.8	3.0
Greatest width of prevomers	4.0	5.0	1.9
Diameter of internal nares	1.8	2.0	2.5
Length of internal nares	3.2	3.2	1.3
Anterior edge of nares to condyle	11.0	15.0	7.2
Premaxillary teeth	9-10	9-9	12-10
Maxillary teeth	15-15	20-20	17-17
Prevomerine teeth	7-5	5-8	4-4
Palatine teeth	19-19	23-20	16-17
Dentary teeth	20-21	21-?	27-27
Splénial teeth	6-6	6-?	6-6
Total length of specimen	432	650	?

nostril, strongly modified body terminus in male serving as a clasper, completely aquatic.

Of the two species known, *P. kaupii* and *P. melanochrus* Taylor (1968), I have been able to study the skull of only the former.

Potamotyphlus kaupii (Berthold)

(Fig. 14)

Caecilia kaupii Berthold Nacht. Gesel. Göttingen, 1859, p. 181. Type-locality, "Angostura"= Ciudad Bolívar, Venezuela.

Data from the skull of UIM No. 787 (locality uncertain).

The diastema between the parietals and squamosals is strong, also separating the squamosal and the frontals for half the length of the latter. The eye socket is between the squamosal and the maxillopalatine, cut chiefly in the latter. The upper edge of the maxillopalatine, bordering the frontal and the nasopremaxilla, is very short, less than half its lower border. In this skull the stapes are absent as they have fallen out while the skull was being prepared, thus accounting for the large opening where the stapes would normally occur. The internal nares are enormously large proportionally, surrounded largely by the palatine shelf of the maxillary. The prevomers are greatly narrowed, with the total distance between the nares about one third of their transverse diameter. The pterygoid is moderate and the ectoptery-

goids, if present, are very small. Minute diastemata are present posterior to the nares between the palatal shelf and the basisphenoid, the latter remaining wide to near the prevomers but sending forward a spine to separate the prevomers for less than half their length. The suture separating the premaxillary area from the prevomers is transverse, anterior to the prevomerine tooth series. The basisphenoid is but little widened at the poorly developed "wings." The nostrils are large and the large tentacular aperture notches the maxillopalatine. The tentacular groove continues along the nasopre-maxilla. See Table 3.

Family *Scolecomorphidae* Taylor

This recently proposed family of the Gymnophiona comprises a single genus with six forms, recognized as species.

In studying the cranial anatomy, skulls of two species have been available, *Scolecomorphus vittatus* and *S. kirkee*. Most of the data here recorded are from the former species.

This family retains the premaxillae and the nasals as separate elements, the latter bending down between the nostrils, meeting the premaxillae on the ventral surface of the snout. Of three separate paired bones retained by the *Ichthyophidae* (prefrontals, oculars, and septomaxillae), only the latter are retained. These are short bones partly bordering the nostrils. The maxillae and palatines are fused together as in all Gymnophiona, and are visible both laterally and ventrally. The upper anterior part of the maxillopalatine has an area resembling a prefrontal, but in skulls examined, this area, while of a somewhat different color, is solidly fused with the maxillopalatine.

The nasal bones are large, truncate posteriorly. The frontals form a narrow median suture while their lateral edges are 2.5 times the length of the median suture. The parietals are elongate, sloping downwards in their posterior parts and failing to enter the rim of the foramen magnum by a fraction of a millimeter (0.15 mm). The squamosal and parietal are widely separate, the squamosal attached lightly, and extending farther back than is usual. No stapes are present. The squamosals are lightly attached to the maxillopalatine.

The otic capsules are inflated and solidly fused with the basisphenoid. The prevomers are narrow, slightly widened at the prevomerine tooth series, extending a greater distance in front of the teeth than they do behind them. No eye sockets are present. The tentacular apertures are large, opening in the maxillopalatines, and extending forward, the grooves not covered by bone, widening considerably anteriorly. The internal nares are surrounded by the orbitosphenoid and partially by the palatine shelf of the maxillopalatine. This latter shelf, bearing the palatine teeth, is directed diagonally outwards so that the back part of this dental series comes to lie in a line

behind the maxillary teeth, and thus widely separated from the basisphenoid. A very wide diastema is present between the basisphenoid and the palatine shelf, thus exposing the orbitosphenoid, which tends to reach up to the dorsal skull surface. The basisphenoid forms the lateral part of the brain case. There is a wide diastema between the prevomerine teeth and the palatine teeth. I have not discerned ectopterygoids. The pterygoids seemingly are fused to the quadrates. The splenial teeth are absent.

Scolecormorphus (Boulenger)

Scolecormorphus Boulenger, Ann. Mag. Nat. Hist., ser. 5, vol. 11, 1883, p. 48. Type of genus *Scolecormorphus kirkii* by monotypy. The type-locality thought to be probably "Lake Tanganyika."

Scolecormorphus vittatus (Boulenger)

(Fig. 15)

Bdellophis vittatus Boulenger, Proc. Zool. Soc., London, 1895, p. 412, pl. 24, fig. 4. Type-locality, Usambara Mountains, Tanganyika (Tanzania).

Data are taken from the skull of EHT-HMS 4642, from Nyange, Kenya.

For the general skull description, see the preceding family description and Table 4.

The genus *Bdellophis* was erected by Boulenger for a caecilian presumably differing from *Scolecormorphus* in having the eye not covered by bone

TABLE 4. Measurements in mm and tooth counts of skulls of *Scolecormorphus*.

Species	<i>vittatus</i>	<i>kirkii</i>	<i>kirkii</i>	<i>kirkii</i>
Number	4642	27120	27106	27116
Museum	EHT-HMS	MCZ	MCZ	MCZ
Locality	Nyange, Vituri, Tanzania	Cholo Mts., Malawi	Cholo Mts., Malawi	Cholo Mts., Malawi
Greatest length of skull	7.25	7.9	7.2+	7.4
Greatest width	3.7	4.05	4.0+	?
Jaw length	5.9	6.0	6.0	?
Length of basisphenoid	4.8	5.35	broken	5.3
Width at otic capsules	2.5	3.0	3.+	3.1
Length of the prevomers	1.75	1.9	1.85	2.1
before prevomerine teeth ..	0.9	1.0	1.0	1.2
behind prevomerine teeth ..	0.55	0.7	.65	.09
Combined width, greatest	1.0	1.15	1.1	1.2
Length, anterior part of internal nares to condyle ..	4.8	5.3	?	5.3
Length of specimen, total	230±	270	?	?
Premaxillary teeth	2-3	3-3	3-2	3-3
Maxillary teeth	6-6	8-7	8-?
Prevomerine teeth	2-3	4-3	3-3	2-3
Palatine teeth	7-6	7-7
Dentary teeth	13-?	12-?	?-13
Splenial teeth	0-0	0-0	0-0	0-0

(but not in a socket). Barbour and Loveridge (1928), seemingly not examining the skull carefully, state "An examination of the skull of a topotypic specimen of *B. vittatus* shows that the character of 'eyes distinct,' which separates the genus from *Scolecormorphus* whose eyes are below the cranial bones, is a sign of youth." I have not been able to verify this statement.

I did examine the type in London and from notes taken I read "The eye is very far forward, not under bone, nor in an orbit, but carried by the tentacle from under the bone into the tentacular trough, which for much of its length is not bone-covered." In many specimens the eye may be seen dimly through the skin at the base of the tentacular aperture or just under the nostril.

Scolecormorphus kirkii Boulenger

(Fig. 16)

Scolecormorphus kirkii Boulenger, Ann. Mag. Nat. Hist., ser. 5, vol. 11, 1883, p. 48. Type-locality uncertain; thought to be presumably in the region of Lake Tanganyika (Tanzania).

Data are from the skulls of MCZ 27120, MCZ 27106 and MCZ 27116, all from the Cholo Mountains, Malawi.

The specimens of the skulls available and the photographs leave much to be desired. They are fragile and the differences between *S. vittatus* and *S. kirkii* as displayed in the Figures are not great. They seem to agree in all family characters. In two of the specimens the eyes were discovered imbedded in the tentacles in the anterior part of the tentacular grooves. A detailed description of the skulls may be found in Taylor (1969). See Table 4.

Family Caeciliidae

The prefrontals, oculars and septomaxillae are absent as separate bones while the nasals and premaxillae are fused to form the two nasopremaxillae. Usually the frontals are completely separated by the mesethmoid in the subfamily Caeciliinae (one exception may be *C. tentaculata*), but it is not generally true of the Dermophinae. Thus the genus *Dermophis* has at least one species with the frontals separated; some species with the frontals partly separated and some without an external trace of the mesethmoid. *Geotrypetes* has at least one species with the frontals completely separated and one incompletely separated. The skulls of the species seen of *Uraeotyphlus*, *Gegeneophis*, *Afrocaecilia* and *Grandisonia* have no external trace of the mesethmoid on the dorsal surface of the skull. In *Boulengerula*, *Schistometopum* and *Siphonops* the mesethmoid completely separates the frontals. (The other three families show no trace of the mesethmoid dorsally in the species here studied.)

This family is treated under the two subfamilies, Caeciliinae and Dermophinae.

Subfamily **Caeciliinae**

The significant characters of the two genera included in this subfamily are the longer and heavier teeth, and the anterior processes on the prevomers notching the nasopremaxillaries. Also, one group of species has a well-defined eye socket, the other group has the eye solidly roofed over with bone.

In this subfamily the tentacular opening appears almost directly below the nostril, usually about the same distance from the nostril and edge of the lip and concealed by the snout so as not to be visible from above.

Caecilia Linnaeus

Caecilia Linnaeus, *Systema Naturae*, 1758, Ed. 10, vol. 1, p. 229. Type of genus, *Caecilia tentaculata* Linnaeus (by monotypy).

This genus now has a large number of species all confined to southern Central America and South America.

Skulls of seven species have been available. The skull characters are given in greater detail for the species *C. nigricans*, than for the others. This is one of the largest members of the genus and in fact of all Gymnophiona.

Caecilia nigricans Boulenger

(Fig. 17)

Caecilia nigricans Boulenger, *Ann. Mag. Nat. Hist.*, ser. 7, 1902, vol. 9, p. 51. Type-locality, Río Lita, N. W. Ecuador or southwest Colombia (3000 feet).

Data here recorded are chiefly from the skull of KUMNH No. 94377 from Darién, Panamá.

Two other forms, described by Boulenger (1913), *Caecilia intermedia* and *Caecilia palmeri*, from Ecuador and Colombia respectively, have been placed as synonyms of this species.

This skull displays the family characters of the reduced number of dorsal dermal bones with the usual fusions. The parietals are sharply declivous posteriorly, while anteriorly two median processes push forward separating the posterior parts of the frontals and contacting the narrow mesethmoid which is between the frontals. The very small orbits of the eyes are cut in the maxillopalatines anterior to the squamosal border; the squamosal bones are wider but shorter than the maxillopalatines; the tentacular aperture is at the anterior end of the maxillopalatine, with the groove extending along the side of the nasopremaxilla for some distance. No diastemata are present between the parietals and squamosals and the stapes are seemingly more posterior than is usual.

On the ventral surface of the skull the prevomers, which have flattened projections anterior to the prevomerine tooth series, are longer than their combined width, and are separated posterior to the tooth series for four fifths of their length by a narrow pointed spine of the basisphenoid. The premaxillary tooth series is widely separated from the prevomerine teeth.

The internal nares are bordered on their inner edges by the prevomers, elsewhere by the palatine shelf of the maxillopalatine. A diastema exists between the basisphenoid, pterygoid process, and the palatine shelf, the opening being about double the size of a naris. The "wings" of the basisphenoid are prominent, tending to bend down, leaving the basisphenoid somewhat domed as seen from below; the otic capsules are not or are scarcely inflated; no ectopterygoid is discernible, and the pterygoids do not reach to the internal nares. The transverse bosses below the otic capsules are prominent. See Table 5.

Caecilia tentaculata Linnaeus

(Fig. 18)

Caecilia tentaculata Linnaeus, Systema Naturae, Ed. 10, vol. 1, 1758, p. 229. Type-locality "America"—Surinam (see the earlier description by Linnaeus which preceded the 10th edition).

Data are chiefly from the skull of KUMNH No. 104438, Santa Cecilia, Napo-Pastaza, Ecuador.

Caecilia ithmica, described by Cope (1887) from Darién, appears to be a synonym of this species. *Amphiumophis andicola* Werner from Chanchamayo, Perú has been referred to this species also, but of this I am not certain, not having yet been able to examine the type. *Caecilia albiventris* Daudin also has been synonymized with *C. tentaculata*, but after examination of a skull I regard this as a legitimate species (see later discussion).

Although this specimen is about 200 mm shorter than the *C. nigricans* described, the skull is higher, longer and tapers more toward the snout. The eye is cut into the maxillopalatine farther from its posterior end. The parietals are shaped much the same but are more narrowed at the posterior end and the mesethmoid does not complete the separation of the frontals and consequently does not separate the posterior parts of the nasopremaxillae. The pterygoid (seemingly fused to the quadrate) is shorter and wider than that in *C. nigricans*. See Table 5.

Caecilia degenerata Dunn

(Fig. 19)

Caecilia degenerata Dunn, Bull. Mus. Comp. Zool., Harvard College, 1942, vol. 91, pp. 505-508. Type-locality, Garagoa, Cundinamarca, Colombia.

Data are from the skull of a paratype, AMNH No. 23354, "Colombia," without a specific locality.

All the bones of this specimen are greenish, not impossibly caused by the method of preservation. This is a much smaller species than *tentaculata* but the arrangement of the dorsal bones of the skull are much the same. The orbit is proportionally even larger; the maxillopalatine is slightly longer proportionally. See Table 5.

TABLE 5. Measurements in mm and tooth counts of the skulls of *Caecilia*.

Species	<i>nigricans</i>	<i>tentaculata</i>	<i>degenerata</i>	<i>disossea</i>	<i>volcani</i>	<i>orientalis</i>	<i>albiventris</i>
Number	94377	104438	23354	1808	4696	4677	49960
Museum	KUMNH	KUMNH	AMNH	EHT-HMS	EHT-HMS	EHT-HMS	AMNH
Locality	Cana, Darién	Santa Cecilia, Napo-Pastaza	Colombia	Río Cararay, Ecuador	Antón, Panamá	"Ecuador"	Bogotá, Colombia
Total skull length	21.0	24.0	10.4	6.9	8.5	9.0	10.3
Greatest width	13.2	16.0	5.8	3.8	5.1	5.2	5.9
Width at orbit	11.6	13.0	4.7	3.0	4.15	4.3	4.75
Jaw length	19.0	20.5	8.0	4.9	7.0	7.1	8.1
Length of basisphenoid	15.0	15.7	6.3	4.2	5.6	5.6	7.7
Width at wings	8.7	10.0	4.0	2.4	3.4	3.6	4.0
Width at otic capsules	9.9	9.0	3.7	3.0	3.5	4.05	4.4
Length of prevomers	6.8	9.1	3.0	2.0	2.5	2.75	3.0
Combined width	6.2	5.1	2.3	1.4	1.9	2.2	2.0
Length anterior part of nares to condyle	12.5	14.4	6.0	4.2	5.7	6.0	6.85
Total length of specimen	1004	790	350	686	290	337	278
Premaxillary teeth	3-4	3-4	4-4	4-3	4-3	3-4	3-3
Maxillary teeth	9-9	8-8	5-4	6-6	6-6	8-9	7-7
Prevomarine teeth	4-4	3-3	3-3	3-4	3-4	3-4	3-3
Palatine teeth	8-8	7-9	7-7	6-6	5-5	9-10	8-8
Dentary teeth	12-13	13-13	10-10	9-9	11-11	10-11	9-?
Splenic teeth	3-3	2-2	2-2	2-2	1-1	2-2	3-?

Caecilia disossea Taylor

(Fig. 20)

Caecilia disossea Taylor, *Caecilians of the World*, 1968, pp. 374-378, figs. 196-197. Type-locality, mouth of the Río Santiago, Perú (a river rising in southern Ecuador, flowing into the Río Marañón).

Data are taken from the skull of EHT-HMS No. 1808, from "Alto Cararey Napo-Pastaza, Ecuador."

This is a very elongate, slender species. The mesethmoid separates the frontals but does not enter between the posterior parts of the nasopremaxillae. The orbit of the eye is well-defined. The median points of the parietals separate the posterior part of the frontals slightly. See Table 5.

Caecilia volcani Taylor

(Fig. 21)

Caecilia volcani Taylor, *Univ. Kansas Sci. Bull.*, 1969, vol. 48, pp. 315-323, figs. 1-4. Type-locality, Valle de Antón, Panamá.

Data are recorded from the skull of EHT-HMS 4696, topotypic paratype.

The mesethmoid separates the frontals and pushes forward between the nasopremaxillae slightly; the parietals have two short median prongs that touch the mesethmoid. There is a fine suture from the orbit to the frontal and one from the orbit to the tentacular aperture. Thus the eye is between a large upper portion and a lower portion of the maxillopalatine. This may be an anomalous condition since it is the only known member of this family that I have seen having such an arrangement. The two parts seem to be fused solidly with the maxillopalatine. See Table 5.

Caecilia orientalis Taylor

(Fig. 22)

Caecilia orientalis Taylor, *Caecilians of the World*, 1968, pp. 417-425, figs. 220-224, 224a. Type-locality, La Bonita, Napo-Pastaza prov., elev. 6300 ft. Ecuador.

Data are from the skull of EHT-HMS No. 4677, from "Ecuador."

The mesethmoid is minute, separating the frontals completely; the premaxillae reach back to the posterior level of the internal nares; the pterygoids reach forward to practically the same level. See Table 5.

Caecilia albiventris Daudin

(Fig. 23)

Caecilia albiventris Daudin, *Histoire naturelle, générale et particulière des reptiles*. . . . 1803, pp. 423-426, pl. 92, fig. 1 (not fig. 2 as stated). Type-locality, "Surinam."

Data are from the skull of AMNH No. 49960, "Bogota," Colombia.

I am resurrecting this name from the synonymy of *Caecilia tentaculata* Linnaeus. The skull of the species differs from that of *C. tentaculata* in being longer and slenderer proportionally; the eye socket is larger, and the stapes is somewhat differently shaped; seemingly the nostril is proportionally much larger. See Table 5.

Oscaecilia Taylor

Oscaecilia Taylor, *Caecilians of the World*, 1968, p. 598. Type by designation, *Caecilia ochrocephala* Cope.

Taylor referred six species to this genus as follows: *Caecilia ochrocephala* Cope (1866); *C. polyzona* Fischer in Peters (1879); *C. elongata* Dunn (1942); *C. bassleri* Dunn (1942); *Oscaecilia hypereumeces* Taylor (1968); and *O. zweifeli* Taylor (1968). Of these, *O. polyzona*, known from three specimens, is a close relative of *O. ochrocephala*. *C. elongata* is problematical since the poorly described type and typotypic paratype have been destroyed, and one fragmentary specimen, also referred to the form, is seemingly not a member of the species. It unfortunately lacks the head and the anterior part of the body; the posterior part differs from the type in certain recorded characters.

These species appear to be more closely related to *Caecilia* and they differ so much from the remainder of the genera recognized in the family Caeciliidae that I have proposed that these two genera be placed in a distinct subfamily.

Oscaecilia ochrocephala (Cope)

(Figs. 24-25)

Caecilia ochrocephala Cope, Proc. Acad. Nat. Sci. Philadelphia, 1866, vol. 18, p. 132. Type-locality, Atlantic side, Isthmus of Darién, Panamá.

The data here recorded are from the skull of MCZ No. 14817, from Ancón, Canal Zone, Panamá.

For a considerable time this species was regarded a member of the African genus *Herpele*, which association seemingly is wholly unjustified.

The narrow mesethmoid separates the frontals completely and runs forward to separate the posterior parts of the nasomaxillae and posteriorly to separate the anterior prongs of the parietals. The squamosal is short (2.6 mm), the maxillopalatine being much longer (4.6 mm). No diastemata are present between the parietals and squamosals.

The snout projects considerably beyond the mouth, its anterior edge presenting a sharp transverse edge; the under surface of the projection is smooth and flat. The teeth of the premaxillaries and anterior maxillaries are large with very thick bases. The prevomers have an anterior flattened area preceding the prevomerine teeth; posteriorly they reach considerably behind the posterior level of the posterior nares, and are separated by a spine from the basisphenoid, which overlays the inner edges of the prevomers. The nares are largely surrounded by the palatine shelves of the maxillaries, the remainder by the prevomers.

The pterygoids are narrow and elongate, seemingly fused to the quadrates posteriorly. No ectopterygoids are apparent. The "wings" of the basisphenoid tend to turn down, leaving the posterior ventral surface somewhat domed (seen from below). A strong transverse boss is evident below the

TABLE 6. Measurements in mm and tooth counts of skulls of *Oscaecilia*.

Species	<i>ochrocephala</i>	<i>ochrocephala</i>	<i>bassleri</i>
Number	14817	41092	4675
Museum	MCZ	UIM	EHT-HMS
Locality	Ancón, Canal Zone	Gatun, Canal Zone	Ecuador
Total length	12.1	8.9	9.0
Greatest width	6.6	5.2	4.8
Jaw length	9.5	6.25	broken
Length of basisphenoid	8.6	5.7	5.6
Width at wings	3.55	3.3	3.2
Width at otic capsules	4.0	3.5	3.4
Length of prevomers	4.2	2.5	3.0
Combined width anterior border internal nares to condyle	7.2	5.0	5.15
Total length of specimen	542±	?	890±
Premaxillary teeth	3-2	2-3	4-3
Maxillary teeth	5-6	5-4	9-9
Prevomerine teeth	5-4	4-3	4-3
Palatine teeth	8-7	7-8	8-8
Dentary teeth	11-12	10-11	11-11
Splénial teeth	4-4	3-3	3-3

otic capsule. This capsule is scarcely inflated. The stapes makes a rather widened contact with the quadrate. The tentacular apertures are visible from a ventral view of the skull.

A second skull, EHT-HMS No. 1810, from Gatun, Canal Zone, Panamá differs in no essential detail, though it is smaller. See Table 6.

Oscaecilia bassleri (Dunn)

(Fig. 26)

Caecilia bassleri Dunn, Bull. Mus. Comp. Zool. Harvard College, 1942, vol. 91, p. 518. Type-locality, Río Pastaza, Ecuador.

The data here recorded are from the skull of EHT-HMS No. 4675, from Ecuador.

Unfortunately the type series of *C. bassleri* contains specimens of two species, *Oscaecilia bassleri* and *Caecilia disossea*. This has led to much confusion.

The character of the mesethmoid is quite similar to that of *O. ochrocephala* save that the forward prongs of the parietals are scarcely developed; there is no orbit, but the position of the eye is dimly visible through the semitransparent bone of the maxillopalatine. The area of contact of the stapes with the quadrate is smaller proportionally. The tentacular apertures are visible from the ventral face of the skull. The spine of the basisphenoid overlays the edges of the posterior projections of the prevomers. The forward projection of the snout has a rounded rather than a sharp tip in lateral view. See Table 6.

Subfamily **Dermophinae**

The Dermophinae have the general characteristics of the Caeciliidae but lack the characteristic distinguishing features of the Scolecomorphidae, Typhlonectidae and the Ichthyophidae. From the subfamily Caeciliinae, they differ in lacking the relatively large teeth, the tentacular aperture is never as far forward as the nostril, and there is a strong reduction in the range of the numbers of vertebrae. The tentacular aperture is in the maxillopalatine and seemingly never emerges from under the anterior edge of the bone.

The genera included in this subfamily show a considerable differentiation on the generic level, and future studies may provide data that would suggest the presence of other subfamily groups. Probably the most aberrant genus is *Idiocranium*, comprising only a single known species.

Dermophis Peters

Dermophis Peters, Monatsb. Akad. Wiss. Berlin, 1879, p. 937, fig. 6. Type of genus: *Siphonops mexicanus* Duméril and Bibron.

Peters (1879) assigned a series of species to this genus without designating a type. One, however, was named by G. N. Noble (1924) who designated *D. mexicanus* as the type. The species originally placed in the genus were *Siphonops mexicanus* Duméril and Bibron, *S. brevirostris* Peters, and four questioned species: *S. thomensis* Barboza du Bocage, *S. brasiliensis* Lütken, *S. proximus* Cope and *S. simus* Cope.

Of these species only the first is retained in the genus; the others are treated under other genera. Thus *S. brevirostris* and *S. thomensis* are recognized in *Schistometopum* Parker; *S. proximus* in *Gymnopsis* Peters; *S. simus* in *Cryptopsophis* Boulenger; and *S. brasiliensis* in *Luetkenotyphlus* Taylor.

Several other forms, species or subspecies, have, however, been added to the genus *Dermophis* by Taylor (1968). These are *Gymnopsis oaxacae* Mertens, *Dermophis occidentalis* Taylor, *Gymnopsis parviceps* Dunn, *Dermophis balboai* Taylor, *Dermophis glandulosus* Taylor, *Dermophis eburatus* Taylor, *Dermophis septentrionalis* Taylor, *Gymnopsis gracilior* Günther; and *Gymnophis* [sic] *clarki* Barbour as a subspecies of *Dermophis mexicanus*.

Dermophis is readily separated from *Gymnopsis* by two well-defined generic characters: the eye appears in an open socket, externally visible, and the splenial teeth are lacking. *Gymnopsis*, on the other hand, has the splenial teeth and there is no orbit, the eye being covered by bone. There are certain other differences as well.

Both of these genera are largely confined to Central America, only two known forms of *Dermophis* entering South America.

The species of the genus have the following characters: secondary folds present; scales present; three series of teeth (the splenials absent); parietals

and squamosals forming sutures; tentacle closer to eye than to nostril; eye in a socket, not covered by bone. Large and small species occur.

Skulls of several species are illustrated. That of *Dermophis eburatus* is described more at length; the other species illustrated are compared to it to point out differences that exist.

Dermophis eburatus Taylor

(Fig. 27)

Dermophis eburatus Taylor, Caecilians of the World, 1968, pp. 473-475, figs. 252, a, b, c, d, e; type-locality, "Nicaragua."

The data are taken from the skull of MCZ No. 12121, from Guatemala, C.A.

This species agrees in the basic family characters, lacking separate prefrontals, septomaxillae and orbitals, and having the premaxillae fused to the nasals to form nasopremaxillae. The frontals are normal but posteriorly they are partially separated by the mesethmoid, which is very narrow.

The squamosal is widened posteriorly, thus narrowing the parietal near its middle, but it widens considerably posterior to the squamosal. The outer posterior edges of the squamosal are slightly elevated above the jaw condyle, leaving a cavelike overhang for muscle attachment. The stapes, much widened, is widely overhung by a free edge of the dorsal basisphenoid, which conceals much of the bone from a dorsal view. The orbit is largely in the anterior part of the squamosal but is bordered anteriorly by the maxillopalatine; the tentacular aperture is relatively large near the anterior end of the maxillopalatine, not forming an anterior groove. The two upper dental series are subparallel. The compound basisphenoid bone has a sharp anterior spine that separates the prevomers for most of their length; the internal nares are largely surrounded by the palatine shelf; however, the prevomers border them on the anterior inner border for a short distance. The nares are elevated above the remainder of the palate (the skull seen from its ventral face); the pterygoid, seemingly, is partly fused to the quadrate, and an ectopterygoid is not discernible. The otic capsules are not swollen, but below the area two strongly developed outer transverse bosses are evident. See Table 7.

(All the bones, skull, jaws, vertebrae, and ribs of this specimen are a dark reddish brown. I presume that this is due to some chemical used in preservation.)

Dermophis costaricensis Taylor

(Fig. 28)

Dermophis costaricensis Taylor, Univ. Sci. Bull., 1955, vol. 37, pp. 506-509, fig. 2, Photo. (Type locality, Cinchona [Isla Bonita], Heredia Province, C. R. at near 4000 ft.)

Data are from the skull of KUMNH No. 66805.

This resembles the preceding skull of *D. eburatus* but with the following differences: the mesethmoid is evident between the anterior part of the

frontals and is shorter. The parietals are but slightly constricted mesially, and the squamosals are less widened posteriorly. The free edge of the dorsal part of the basisphenoid hides much less of the stapes, while the free outer posterior edge of the squamosal makes a very slight cavelike indentation above the jaw condyle. The otic capsules are slightly more inflated. See Table 7.

Dermophis balboai Taylor

(Fig. 29)

Dermophis balboai Taylor, Caecilians of the World, 1968, pp. 461-467, figs. 244-248. Type-locality, Tacarcuna, Darién, Panamá.

Data are taken from the skull of KUMNH No. 108935.

This is similar to *D. eburatus* but the mesethmoid is visible only as a narrow mesial line the entire length of the frontals, widening slightly anteriorly; the maxillopalatines border on the orbits for a greater distance; the stapes resemble those of *D. eburatus* more than those of *D. costaricensis*. The parietals are narrowed and the posterior part of the squamosals are as wide as in *D. eburatus*. See Table 7.

Dermophis parviceps (Dunn)

(Fig. 30)

Siphonops parviceps Dunn, Occ. Papers, Boston. Soc. Nat. Hist., 1924, vol. 5, pp. 93-94. Type-locality, La Loma (1200 ft.), Boco del Toro Province, Panamá.

Data are taken from the skull of KUMNH No. 36276.

There is no evidence of a mesethmoid. On the ventral surface the most striking character is that the palatine shelf of the maxillopalatine *completely surrounds the nares, the rim of which is unbroken*; the separation of the prevomers is marked by a rather strong ridge, the most elevated part being the spine of the basisphenoid. The parietals are only slightly constricted mesially. Only the inner edge of the stapes is hidden when seen from above. See Table 7.

Dermophis glandulosus Taylor

Dermophis glandulosus Taylor, Univ. Kansas Sci. Bull., 1955, vol. 37, pp. 509-511, fig. 3. Type-locality, San Isidro del General, San José Prov., Costa Rica.

Data are from the skull of KUMNH No. 56070, San Isidro del General, San Jose, C.R.

This skull has the mesethmoid well developed, completely separating the frontals. The parietals are only slightly narrowed. In contrast to *D. parviceps*, the posterior part of the prevomers is wider and with a concomitant widened space between the internal nares. The dorsal bones of the skull show a strong overlap anteriorly. See Table 7.

Dermophis occidentalis Taylor

(Fig. 32)

Dermophis occidentalis Taylor, Univ. Kansas Sci. Bull., 1955, vol. 37, pp. 503-506, fig. 1.

Data are from the skull of KUMNH No. 36296, topotypic paratype.

TABLE 7. Measurements in mm and tooth counts of *Dermophis*.

Species Number Museum Locality	<i>eburatus</i> 12121 MCZ Guatemala	<i>costaricensis</i> 66805 KUMNH Moravia Cartago, Costa Rica	<i>balboai</i> 108935 KUMNH Darién, Panamá	<i>parviceps</i> 36276 KUMNH Moravia Cartago, Costa Rica	<i>glandulosus</i> 56070 KUMNH San Isidro, C.R.	<i>occidentalis</i> 36296 KUMNH between San Isidro & Dominical, Costa Rica	<i>m. mexicanus</i> 66889 UIM Chiapas, México
Total length	20.0	13.5	14.05	8.2	8.85	6.75	16.3
Greatest width	14.5	8.5	9.5	5.0	6.4	4.0	10.6
Width at orbit	12.0	7.0	7.9	4.0	4.5	3.35	8.4
Length of jaws	18.5	?	12.1	7.0	5.1	14.3
Length of basisphenoid	16.5	11.2	11.5	6.25	7.5	5.0	10.8
Width at wings	7.7	4.8	5.2	3.0	3.5	2.1	6.0
Width at otic capsules	8.4	5.2	6.0	4.0	4.0	2.8	6.5
Length of prevomers	5.5	3.7	3.3	2.0	1.7	1.5	4.2
Combined width	6.7	4.1	4.0	2.05	2.1	1.9	4.9
Anterior border of internal nares to condyle	12.6	9.0	9.5	5.0	5.8	4.5	11.0
Total length of specimen	419	344	356	193	180	194	402
Premaxillary teeth	8-9	7-8	6-6	6-6	6-5	6-5	7-8
Maxillary teeth	13-13	14-2	12-11	8-10	8-7	8-8	11-11
Prevomerine teeth	9-9	9-10	6-5	6-6	6-6	6-6	8-8
Palatine teeth	14-13	16-16	15-14	11-11	11-10	8-7	11-10
Dentary teeth	18-18	14-14	12-12	12-11	10-11	14-13
Splenic teeth	0-0	0-0	0-0	0-0	0-0	0-0	0-0

The constriction of the parietals anterior to their middle is rather pronounced. The frontals are proportionally shorter than in previous species. The maxillopalatines form as much of the orbit as the squamosal. The posterior part of the prevomers is narrower. See Table 7.

Dermophis m. mexicanus (Duméril and Bibron)

(Fig. 33)

Siphonops mexicanus Duméril and Bibron, *Erpétologie générale*. . . . 1836, pp. 284-285. Type-locality "Mexico."

Data are from the skull of UIM No. 66889, Chiapas, México.

The narrow mesethmoid separates the rather elongate frontals for about half their length. The posterior parts of the prevomers are not especially narrowed. The stapes is proportionally less covered by the dorsolateral edge of the dorsal part of the basisphenoid; the transverse bosses below the otic capsules are prominent. See Table 7.

Gymnopsis Peters

Gymnopsis Peters, *Monatsb. Akad. Wiss. Berlin*, 1874, p. 616, pl. 1, fig. 1. Type of the genus, *Gymnopsis multiplicata* Peters.

Peters described this genus very briefly as follows: "Augen nicht von der Haut überzogen, frei, keine Gesichtsgruber." Only the type was included. Other distinguishing characters are: splenial teeth, secondaries, and scales present. Eye covered by bone. The tentacle is nearer to the commissure of the jaws than to the nostril.

A number of other species have been treated in the genus by Dunn (1942) as follows: *Siphonops proximus* Cope, *Rhinatrema unicolor* A. Duméril, *Siphonops oligozonus* Cope, *Gymnopsis multiplicata oaxacae*, Mertens, *Gymnopsis* [sic] *nicefori* Barbour, *Dermophis albiceps* Boulenger, *Gymnopsis* [sic] *clarki* Barbour, *Dermophis gracilior* Günther, and *Siphonops parviceps* Dunn. Dunn later (1944, 1945) described *Gymnopsis pricei* and *Gymnopsis braziliensis*. Gorham (1962) also referred *Dermophis costaricensis* Taylor, *Dermophis glandulosus* Taylor and *Dermophis occidentalis* Taylor to the genus *Gymnopsis*!

Of this list of species only *Gymnopsis multiplicata*, *G. proxima* and *G. oligozona* agree in having the essential characters of the genus, and only these are recognized by Taylor (1968). The other species mentioned are considered as belonging to other genera.

The skull characters are known to me by three specimens: one of *G. proxima* and two of *G. multiplicata*. (Since these two rather closely related forms appear to be separated without direct evidence of integradation, I am treating them as species rather than subspecies.)

Gymnopsis multiplicata Peters

(Fig. 34)

Gymnopsis multiplicata Peters, Monatsb. Akad. Wiss. Berlin 1874, p. 616, pl. 1, fig. 1. Type-locality, Veragua, Panamá.

Data are recorded from two skulls from Guanacaste, C.R., EHT-HMS No. 4702, and KUMNH 117457, but mostly from the latter.

The prefrontals, septomaxillae, and oculars do not appear as separate bones and the premaxillae and nasals are fused to form the nasopremaxillae. The mesethmoid is visible mesially at the junction of the nasopremaxillae and the frontals. The eye is without socket, bone covered, but is visible under the anterior part of the squamosal. The aperture of the tentacle is subcircular, cut in the maxillary, and not forming a forward-directed open groove. The stapes is present, large, and the bone seemingly not fenestrated. Ventrally the internal nares are somewhat narrowed, definitely diagonally placed and surrounded almost completely by the palatine portion of the maxillopalatine, although the prevomer borders the inner anterior edge for a very short distance. The prevomers are narrowly separated for more than four fifths of their length by a forward-projecting spine of the basisphenoid. A very narrow diastema follows the nares, between the basisphenoid and the palatine shelf. The tooth rows are nearly parallel. An ectopterygoid is present! The second skull differs in no significant point from the one described. See Table 8.

TABLE 8. Measurements in mm and tooth counts of the skulls of *Gymnopsis*.

Species	<i>multiplicata</i>	<i>multiplicata</i>	<i>proxima</i>
Number	4702	117457	4712
Museum	EHT-HMS	KUMNH	EHT-HMS
Locality	Guanacaste, C.R.	Guanacaste, C.R.	Turrialba, C.R.
Total length of skull	16.0	14.5	16.85
Greatest width	10.8	9.7	11.6
Length of jaw	16.0	13.7	15.7
Length of basisphenoid	13.65	12.6	11.6
Width at wings	5.9	5.1	6.3
Width greatest posteriorly	7.0	6.0	6.7
Length of prevomers	4.7	4.0	4.5
Combined width, greatest	5.0	4.1	5.0
Anterior edge of choanae to condyle	11.0	9.2	11.8
Premaxillary teeth	10-10	11-8	10-9
Maxillary teeth	14-15	12-12	16-16
Prevomerine teeth	10-10	7-8	9-9
Palatine teeth	15-16	14-13	20-19
Dentary teeth	19-20	16-16	20-20
Splénial teeth	1-1	1-1	1-1
Length of preserved animal	430	?	459

Gymnopsis proxima Cope

(Fig. 35)

Siphonops proximus Cope, Proc. Amer. Phil. Soc. 1877, vol. 17, p. 90. Type-locality, "Eastern Costa Rica."

Data are from the skull of EHT-HMS 4712, from Turrialba, C.R.

This skull is similar to that of the preceding species but the following characters obtain: the prevomers do not border the internal nares, they are separated by the basisphenoid for about two fifths of their length only. The diastema (fenestra) between the basisphenoid and the palatine shelf of the maxillary is a little larger. The anterior narrowed portion of the *stapes* is *fenestrated near to the point of contact with the quadrate*. The eye is visible under the anterior edge of the squamosal. The mesethmoid is not visible dorsally. See Table 8.

Siphonops Wagler

Siphonops Wagler, Isis, von Oken, Leipzig, 1828, p. 742, pl. 10, figs. 1, 2. The type of the genus is *Caecilia annulata* Mikan, by monotypy.

In an article, Isis, von Oken, 1828, "Ansätze aus seinem Systema Amphibiorum" Tab. X., descriptions and comments on several genera are given by Wagler. He includes a single species, *annulatus*, in *Siphonops*, seemingly attributing it to himself, citing Wagler's "Serpentes brasiliensis" pl. 26, fig. 1. In his Natürliches System der Amphibien, 1830, p. 198, the single species *Caecilia annulata* is properly attributed to Mikan.

The genus as now understood includes six species: the type *Siphonops annulatus* Mikan, *S. paulensis* Boettger, *S. hardyi* Boulenger, *S. insulanus* Ihering, *S. confusionis* Taylor, and *S. leucoderus* Taylor. One species that has been associated with the genus, *Siphonops brasiliensis*, I regard as belonging to a genus *Luetkenotyphlus* Taylor.

Siphonops has been characterized as lacking secondary folds, being without scales, the tentacle much nearer to the eye than to the nostrils, the eye in a socket that is continuous with the tentacular aperture, and having a very narrow diastema between the squamosal and parietal. The splenial teeth are lacking, and there is no terminal sucking disc. There is a well-defined unsegmented terminal "shield."

Skulls of two species, *Siphonops annulatus* and *S. paulensis* have been available.

Siphonops annulatus (Mikan)

(Figs. 36-38)

Caecilia annulata Mikan, Delectus florae et faunae brasiliensis, Vidabonae, 1820, folio, pl. 11. Type-locality, Sebastianopolis (=Rio de Janeiro), Brasil.

Data here given are principally from the skull of MCZ No. 19407, from "Río Pastazo to Marañon," Ecuador.

This species lacks prefrontals, septomaxillae, and oculars, and has the premaxillae and nasals fused. The mesethmoid is moderately large, com-

pletely separating the frontals. The latter are greatly narrowed on their inner margins so that their contact with the mesethmoid is less than one fifth of their length, measured on their outer margins. The parietals, on the other hand, have their greatest length on their inner margins, sometimes more than double the length of their outer margins.

The orbits and the tentacular apertures are continuous with each other, cut between the squamosals and the maxillopalatines. The stapes are present but relatively small and slender. The prevomers are relatively large, extending back a little beyond the internal nares. Following the nares are large diastemata between the basisphenoid and the palatal shelves of the maxillary; the internal nares are almost completely surrounded by the palatine shelves, the prevomers touching them only on their anterior borders for a short distance. The pterygoids are widened, and seemingly fused to the quadrate; ectopterygoids are present.

A second skull, UIM No. 56668, agrees very well with that described. In this it is likewise difficult to interpret the relationship between the pterygoid and quadrate. Anteriorly the pterygoid is attached to the palatine shelf by thin cartilage rather than by overlap.

A third skull, EHT-HMS No. 1848, purporting to be of this species, is from Teresopolis, Guanabara, Brasil. It seems to differ in that if the pterygoid is present, it is seemingly fused solidly with the quadrate. If an ectopterygoid was present, it has been lost. The shape of the stapes is slightly different. See Table 9.

Siphonops paulensis Boettger

(Fig. 39)

Siphonops paulensis Boettger, Katalog der Batrachier Sammlung im Museum der Senckenbergischen Naturforschenden Gesellschaft in Frankfurt am Main, 1892, p. 62. Type-locality, São Paulo, Brasil.

The data here given are taken from the skull of AMNH No. 23433, "Brasil." (Skull partly broken.)

This differs from the preceding species in having the stapes differently shaped. Also in this species the palatine shelves *completely surround* the internal nares. Ectopterygoids are present and each seemingly has one tooth. See Table 9.

Wiedersheim, in his "Anatomie der Gymnophionen" Jena, 1879, pl. 1, figs. 1-12, gives figures of "*S. annulatus*." These however may well be *S. paulensis*, since this species was not recognized until three years later. The external appearance of the two species in preservatives is very similar.

Geotrypetes Peters

Geotrypetes Peters, Sitzb. Ges. Naturf. Freunde, Berlin, 1882, p. 55. The type-species is *Caecilia seraphini* A. Duméril, by monotypy.

Peters (1879) originally placed the type species in the genus *Hypogeophis*.

TABLE 9. Measurements in mm and tooth counts of skulls of *Siphonops*.

Species	<i>annulatus</i>	<i>annulatus</i>	<i>annulatus</i>	<i>paulensis</i>
Number	19407	56668	1848	23433
Museum	MCZ	UIM	EHT-HMS	AMNH
Locality	Ecuador	Limón Cocha, Ecuador	Teresopolis, Guanabara, Brasil	"Brasil"
Total length of skull	15.4	15.4	13.0	13.7
Greatest width	11.0	11.2	9.4	9.55
Width at orbit	9.1	9.3	7.9	8.0
Length of jaws	14.8	15.1	12.7	12.7
Length of basisphenoid	9.9	10.4	8.3	8.5
Width at "wings"	6.2	6.8	5.2	5.7
Width at otic capsules	6.8	6.4	6.0	6.2
Length of prevomers	4.2	5.2	3.5	4.2
Combined width of prevomers	5.0	5.0	3.9	3.8
Anterior border internal nares to condyle	10.2	10.4	8.55	9.6
Premaxillary teeth	12-11	10-10	8.7	8+-?
Maxillary teeth	7-7	8-7	7-7	11-?
Prevomerine teeth	7-7	8-6	6-6	7-?
Palatine teeth	10-9	10-10	8-8	11-?
Dentary teeth	16-16	15-15	11-11	15-?
Splenal teeth	0-0	0-0	0-0	0-0
Total length of specimen	356	397	?	453

Since 1880, Parker (1936) has described *Geotrypetes angeli* and recognized a new subspecies *G. seraphini occidentalis*. Taylor (1968) described *G. congoensis* and *G. pseudoangeli*.

Geotrypetes seraphini seraphini (A. Duméril)
(Fig. 40)

Caecilia seraphini A. Duméril, Archiv. Mus. Nat. Hist., 1859, vol. 10, p. 222. Type-locality, Gaboon.

Two skulls are at hand, AMNH No. 23466, South Cameroons and MCZ No. 3424, Metet, Cameroons. The data here presented are from the second.

This skull is quite remarkable in having teeth on the ectopterygoid, which lies below the pterygoid. Dorsally the mesethmoid separates the frontals for nearly half their length. Diastemata are present between the parietals and squamosals which run forward into the orbit. The tentacular apertures emerge at the orbits and, as deep, wide-open grooves, run forward to a point on the nasomaxillae. On the ventral surface the prevomers do not reach as far back as the middle of the internal nares. The prevomers each have a large fenestra and a median forward projection anterior to the prevomerine teeth. They are separated for most of the length behind the teeth by a spine of the basisphenoid. The maxillopalatines *completely sur-*

round the internal nares, behind which are enormous diastemata between the basisphenoid and palatine shelves, and the pterygoids. See Table 10.

The "wings" of the basisphenoid are greatly narrowed as compared with skulls of other genera. The skulls of *Geotrypetes* as far as known, differ from most of the other genera of the subfamily Dermophinae of the Caeciliidae in that they have ectopterygoid teeth and have the diastemata between the squamosals and parietals penetrating the orbital rim. The skulls are seemingly more fragile than is usual in other genera of the family.

Geotrypetes seraphini occidentalis Parker

(Fig. 41)

Geotrypetes seraphini occidentalis Parker, Zool. Meded. Rijks. Mus. Nat. Hist., Leiden, 1936, pp. 99-100. Type-locality, French Guinea and the Gold Coast Region (Ghana).

Data here given are taken from the skull of EHT-HMS No. 4653, Tafo, Ghana.

Dorsally the mesethmoid separates the frontals, runs forward separating the nasopremaxillae for a distance, and then appears again at their anterior parts; posteriorly the anterior prongs of the parietals are likewise separated by the mesethmoid. The parietals narrow mesially with their posterior parts declivous. Broad diastemata are present between the squamosals and parietals; also, the suture between the anterior part of the squamosal and parietal and the squamosal and frontal runs forward, breaking the continuity of the large orbit of the eye. The orbit is continuous with the proximal part of the tentacular groove. The tentacular groove is open for a short distance, then is covered over by bone of the maxillopalatine, but later emerges from under the anterior part of this same bone, the groove continuing forward to a point below but near the back edge of the nostril. The orbital opening is large and somewhat pear-shaped. Two processes of the prevomer run forward anterior to the prevomerine teeth. Posteriorly the prevomers are separated by the short spine of the basisphenoid for a distance, with their posterior ends not reaching to the level of the middle of the internal nares. The nares are *completely surrounded* by the maxillopalatine. There are two very large openings posterior to the nares. The ectopterygoids bear teeth (not visible in the Figure); the pterygoid touches the palatine shelf; the wings of the basisphenoid are much narrowed. See Table 10.

Herpele Peters

Herpele Peters, Monatsb. Akad. Wiss. Berlin, 1879, p. 939. Type of genus, *Caecilia squalostoma* Stutchbury, by monotypy.

Peters defined this genus on the basis of the following characters: eye under the skull bones; tentacular aperture circular, behind and below nostril; similar to *Hypogeophis rostratus*. Scales in folds; two tooth rows in lower jaw.

Herpele squalostoma (Stutchbury)

(Fig. 42)

Caecilia squalostoma Stutchbury, Trans. Linnean Soc. London (1), vol. 17, 1837, p. 362. Type-locality, Gaboon.

Data here recorded are from a skull of EHT-HMS No. 3412 from Metet, Cameroons, Africa.

The mesethmoid appears minutely at the anterior and posterior ends of the common suture between the frontals; in neither case is the visible part more than 0.5 mm long. The eye is under the squamosal bone. This bone is rather elongate but not as long as the maxillopalatine. The tentacular aperture is at anterior end of the maxillopalatine, with the groove continued slightly along the nasopremaxilla, the apertures barely visible from the ventral face of skull. The prevomers are short and separated by the spine of the basisphenoid for less than half their length, their posterior extensions being somewhat widened and lying below the basisphenoid instead of above it as in *Oscaecilia*, their forward extensions reaching anterior to the prevomerine teeth. There is a diastema between the basisphenoid and the palatine shelves, the small forward-extending part of the pterygoid is above the palatine shelf rather than on its inner edge. Small ectopterygoids are present, touching the pterygoid. The otic capsules are somewhat inflated. See Table 10.

Uraeotyphlus Peters

Uraeotyphlus Peters, Monatsb. Akad. Wiss. Berlin, 1879, p. 933. Type-species, *Caecilia oxyura* Duméril and Bibron, by subsequent designation.

Peters (1879) assigned two species to the genus, the type and *Caecilia malabarica* Beddome. Boulenger (1882) later described *Uraeotyphlus africanus* (now transferred to *Geotrypetes seraphini seraphini*). Annandale (1913) described *Uraeotyphlus menoni* and Seshachar (1939) described *U. narayani*.

Now four species are recognized in the genus. All are Indian in distribution. Peters reports *oxyurus* from the Seychelles Islands but this doubtless is in error.

Uraeotyphlus oxyurus (Duméril and Bibron)

(Fig. 43)

Coecilia oxyurus Duméril and Bibron, Erpétologie générale, 1841, vol. 8, p. 280. Type-locality, Malabar, India.

Data here recorded are from the skull of MCZ 9484, Taliparabamba, Travancore, India.

The mesethmoid does not appear on the dorsal skull surface. The prefrontals and septomaxillae are not present and the premaxillae and nasals are fused, forming the large nasopremaxillae. The eye is in an orbit that is continuous with the deep open groove of the tentacle. This extends forward to a point below the back edge of the nostril. The orbits are bordered for more

TABLE 10. Measurements in mm and tooth counts of *Geotrypetes*, *Herpele*, *Uraeotyphlus* and *Schistometopum*.

Species Number Museum Locality	<i>G. s. seraphini</i> 3424 MCZ Metet, Cameroons	<i>G. s. occidentalis</i> 4653 EHT-HMS Tafo, Ghana	<i>H. squalostoma</i> 3412* EHT-HMS Metet, Cameroons	<i>U. oxyurus</i> 9484 MCZ Talipara- bamba, Travancore	<i>S. gregorii</i> 20117 MCZ Lake Peccatoni, Kenya	<i>S. gregorii</i> 20146 MCZ Lake Peccatoni, Kenya
Total length of skull	9.0	11.3	10.7	7.8	10.4	10.5
Greatest width	6.0	7.7	6.45	4.3	6.3	6.7
Length of jaw	8.0	9.5	9.5
Length of basisphenoid	6.8	8.3	7.2	5.0	7.1	7.3
Width at wings	3.7	5.2	4.0	2.7	3.8	4.1
Width at otic capsules	3.9	6.4	4.4	3.35	4.5	4.65
Length of prevomers	2.1	3.0	2.3	2.4	2.2	2.3
Combined width of prevomers	2.0	2.8	3.1	2.9	3.1
From anterior border of internal nares to condyle	6.0	7.7	7.2	5.0	6.6	7.0
Premaxillary teeth	5-4	5-4	4-5	5-4	6-7	7-7
Maxillary teeth	12-12	12-11	12-11	11-13	8-8	10-9
Prevomarine teeth	5-4	4-5	6-7	7-7	5-5	6-6
Palatine teeth	12-12	10-10	11-10	10-11	11-10	10-9
Dentary teeth	18-19	16-16	12-11	12-12	11-12	15-14
Splénial teeth	10-10	17-16	3-3	8-8	1-1(?)	1-1
Ectopterygoid teeth	5-5	5-5	0-0	0-0	0-0	0-0
Total length of specimen	?	354	357	215	336	356

than half of their circumference by free, narrow, curved ocular bones (post-frontals), while below they are bordered by the maxillopalatines. The stapes are present, touching the quadrates. The prevomers extend forward a little beyond the prevomerine teeth, while posteriorly they reach to the posterior level of the the internal nares, the spine of the basisphenoid separating them for about one fifth of their total length. They border the inner sides of the internal nares but for the greater part of their circumference the nares are bordered by the palatine shelves of the maxillae. See Table 10.

The skull is defective, broken, and parts missing, so that certain characters cannot be examined and recorded.

Schistometopum Parker

Schistometopum Parker, Ann. Mag. Nat. Hist., ser. 11, vol. 7, p. 17, fig. 4. Type-species, *Dermophis gregorii* Boulenger, by designation.

Two species were originally assigned to the genus, *S. gregorii*, and *S. thomensis* (Bocage). Peters described *Siphonops brevirostris* in 1874 which has been regarded a synonym of *S. thomensis* by certain authors. Taylor (1964) described *Schistometopum ephèle*.

Schistometopum gregorii (Boulenger)

(Figs. 44-45)

Dermophis gregorii Boulenger, Proc. Zool. Soc. London, 1894, p. 646, pl. 40, fig. 4. Type-locality, Ngatana, Tana River, Kenya.

Data recorded are from the skull of MCZ No. 20117, Lake Peccatoni, Kenya.

This species has been redescribed by Nieden (1912) as *Boulengerula denhardti* from the Tana Region, Kenya and by Boettger (1913) as *Bdellophis unicolor in* Voeltzkow from Lake Peccatoni, Wituland, Kenya.

The slender mesethmoid separates the frontals and pushes in slightly between the nasopremaxillae. The eye orbits are cut between the squamosal and the maxillopalatine, but lie chiefly in the former. The tentacular apertures appear near the anterior end of the maxillopalatines, which are definitely shorter than the squamosals. The stapes are much constricted behind the point of contact with the quadrates.

The prevomers are very short, projecting forward beyond the prevomerine teeth for a short distance, but not reaching back as far as the middle of the internal nares. The diastemata between the basisphenoid and palatal shelves are small. Seemingly small ectopterygoids are present (broken in this specimen).

A second skull, MCZ 20146, agrees in all essential details with the preceding. See Table 10.

Hypogeophis Peters

Hypogeophis Peters, Monatsb. Akad. Wiss. Berlin, 1879, p. 936. Type-species *Caecilia rostrata* Cuvier.

Peters (1879) considered two species as belonging to the genus, the type, and *Caecilia seraphini* A. Duméril. In 1880 he proposed *Geotrypetes* as a new genus for the second species.

Parker (1941, 1958), who reviewed the species of *Hypogeophis*, concluded that there was a single species *H. rostratus*, with three subspecies: *H. r. rostratus*, *H. r. guentheri* Boulenger, and *H. r. praslini* Parker. All are confined to the Seychelles Islands in the Indian Ocean, but each has its own range, on different islands. Taylor (1969a) has added a fourth subspecies, *H. r. lionneti*.

Hypogeophis rostratus rostratus (Cuvier)

(Fig. 46)

Caecilia rostrata Cuvier, Règne Animal, 2nd ed. 1829, vol. 2, p. 100. Type-locality, Mahé, Seychelles (most probably).

Data here recorded are taken from the skull, MCZ No. 48935.

The prefrontals, septomaxillae, and oculars are absent or fused to surrounding bones and the premaxillae and nasals are fused to form the nasopremaxillae. The stapes are present. The mesethmoid does not appear on the dorsal surface of the skull. The basisphenoid is fused with the various occipitals and otic elements to form a compound bone (as in all gymno-phiones).

The eye socket is cut in the squamosal. The tentacular apertures are separate from the orbits, opening far forward at the end of the maxillopalatines, the grooves continuing forward along the nasopremaxillae, the openings partially visible in a ventral view. No diastemata are present between the squamosals and parietals. The internal nares are largely surrounded by the maxillopalatines, but the prevomers border them on the anterior inner edge.

There are very small diastemata behind the internal nares between the basisphenoid and palatal shelves of the maxillopalatines. The basisphenoid separates only the posterior tips of the prevomers and is strongly constricted in front of the otic capsules. The pterygoids seemingly are fused to the quadrate, and relatively narrow. A small ectopterygoid is present. There appears to be a small element separated from the palatine portion of the maxillopalatine which, if it touches the pterygoid, does so below the lateral wings of the basisphenoid. The snout projects considerably beyond the premaxillary teeth. See Table 11.

Grandisonia Taylor

Grandisonia Taylor, Caecilians of the World, 1968, p. 749, fig. 409. Type of genus, *Hypogeophis alternans* Stejneger.

Taylor referred three species to the genus. These were *Hypogeophis alternans* Stejneger, *Dermophis sechellensis* Boulenger, and *Dermophis larvata* Ahl. In addition, two other species were referred with some doubt, *Hypogeophis brevis* Boulenger and a new species *Grandisonia diminutiva*

Taylor, since neither the anatomy nor the life histories of these diminutive species are known. They are the smallest species of the Gymnophiona.

Grandisonia alternans (Stejneger)

(Fig. 47)

Hypogeophis alternans Stejneger, Proc. U.S. Nat. Mus. Washington, 1893, vol. 16, p. 739; type-locality, Mahé, Seychelles Islands.

Skull data here recorded are of EHT-HMS No. 4647, from Mahé, Seychelles.

The skull has the typical reduced number of bones of the family Caeciliidae. The mesethmoid does not appear on the dorsal surface of the skull. There are no distinct diastemata between the squamosals and the parietals; the suture, however, is cartilage covered and when this is removed there is a slight break between them. The rims of the orbits, between the squamosals and the maxillopalatines, are continuous with the tentacular apertures and the tentacular grooves which run forward to the anterior end of the maxillopalatines. The stapes are prominent.

On the ventral surface of the skull the basisphenoid is strongly constricted between the otic capsules and the "wings," and tapers anteriorly to a spine, which, running forward, separates the prevomers for more than half their length. The prevomers are wide, anteriorly they scarcely extend beyond the prevomerine teeth; posteriorly they do not reach the middle of the internal nares, but border the nares for a short distance. An ectopterygoid is present; the pterygoid is seemingly fused to the quadrate. There are small diastemata between the basisphenoid and the palatine shelves of the maxillopalatines. The separation between the internal nares is greater than usual because the part of the basisphenoid extending between the prevomers is widened, thus greatly narrowing the prevomers posteriorly. See Table 11.

Grandisonia sechellensis (Boulenger)

(Fig. 48)

Dermophis sechellensis Boulenger, Trans. Linnaean Soc. London; Zool., 1911, vol. 14, p. 376, fig. 3. Type-locality, Mahé, Seychelles.

Hypogeophis sechellensis Parker, Am. Mag. Nat. Hist. (1941), ser. 11, vol. 7, p. 16, fig. 2.

The data here given are from a damaged skull, AMNH 23673, "Seychelles Islands," with no specific locality.

Mr. Boulenger and Dr. Parker studied the caecilians of the Seychelles. Boulenger (1909) referred some specimens of this species to his *Cryptopsophis multiplicata*, and two years later described them as a new species, *Dermophis sechellensis*. Parker first regarded this species as a *Dermophis* (1941). Ahl (1926) had described it as *Dermophis flaviventer*. Parker later (1958) referred it to *Hypogeophis sechellensis* and still later seemingly regarded it as a member of the genus *Praslinia* Boulenger. Taylor (1968) placed it in his genus *Grandisonia*.

This skull differs very little from Parker's figure (*loc. cit.*), the nasopremaxillary is proportionally longer with no trace of a mesethmoid dorsally. (A slight exposure of this element shows in Parker's figure.) The outer edges of the frontals are longer, and the parietals are less constricted anterior to their middle.

On the ventral surface of the skull the prevomers are short, reaching to the anterior part of the internal nares, and are separated for about half their length by the spine of the basisphenoid. There is a strong constriction of the basisphenoid just anterior to the otic capsules. The eye orbit is cut chiefly in the squamosal but its border is continuous with the tentacular aperture. A pterygoid process and an ectopterygoid are present. See Table 11.

Idiocranium Parker

Idiocranium Parker, Proc. Zool. Soc. London, 1936, pp. 160-163. Type of genus, *Idiocranium russeli*.

This genus has certain characters which are unique in the Gymnophiona. These were recognized by Dr. Parker who has given an excellent description of this diminutive creature.

Idiocranium russeli Parker

(Fig. 49)

Idiocranium russeli Parker, Proc. Zool. Soc. London, 1936, pp. 160-163, figs. 6, 8. Type-locality, Makumunu, Asumbo, Mamfe Division, Cameroons (now included in Nigeria?).

The data recorded here are taken from EHT-HMS No. 4687. Paratype.

The large dorsal nasopremaxillae are separated their entire length by a large, somewhat triangular mesethmoid which runs forward, terminating in a point. Following this on the dorsal surface of the skull is a pair of small subquadrangular frontals which are separated from the maxillopalatines by the contact of the nasopremaxillary with the squamosal, and having an area less than one third that of the parietals. The orbits of the eyes are between the elongate squamosals and the maxillopalatines. The larger tentacular apertures emerge from the anterior ends of the maxillopalatines and the tentacular groove continues forward some distance beyond the opening, along the side of the nasomaxillae. The stapes is well defined, the "neck" joining the quadrate being very short. The otic capsule is distinctly inflated.

The internal nares are surrounded by the maxillopalatines and the prevomers, the latter bones bordering their inner edges for a short distance, then extending back to the posterior level of the internal nares; there are no diastemata between the basisphenoid and the palatine shelves of the maxillae. The pterygoid reaches forward one third of the way to the internal nares. No ectopterygoid is present. See Table 11.

The greatly enlarged mesethmoid, the separation of the nasopremaxillae, the reduction of the size of the prefrontals and the separation of the frontals

TABLE 11. Measurements in mm and tooth counts of skulls of *Hypogeophis*, *Grandisonia*, *Idiocranium* and *Boulengerula*.

Species Number Museum Locality	<i>H. r. rostratus</i> 48935 MCZ St. Anne Island	<i>G. alternans</i> 4647 EHT-HMS Mahé	<i>G. sechellensis</i> 23673 AMNH "Seychelles"	<i>I. russeli</i> 4687 EHT-HMS Makumunu	<i>B. boulengeri</i> 12309 MCZ Amani, Usambara Mts., Tanganyika
Total length of skull	8.6	11.1	5.15	4.5	4.7
Greatest width	5	7	2.8	2.2	2.3
Width at orbits	4	2.45	1.7	3.4
Length of jaw	7.4	10	4.3
Length basisphenoid (ventral)	5.3	8	4.2	3.35	2.65
Width at "wings," greatest	3.3	4.25	1.8	1.7	1.4
Width at otic capsules	3.7	4.8	2.25	2.05	1.75
Length of prevomers	2.2	2.6	1.2	1.0	0.9
Greatest combined width of prevomers	1.75	2.7	1.0	0.9	0.9
Length anterior nares to occipital condyle	5.2	5.5	3.5	3.2	4.5
Premaxillary teeth	6-6	9-9	7-7	6-6	4-5
Maxillary teeth	18-18	15-14	12-13	13-14	5-6
Prevomerine teeth	9-8	8-8	8-7	6-6	4-4
Palatine teeth	17-17	16-15	13-13	11-12	8-8
Dentary teeth	14-13	20-20	12-?	11-12	8-8
Splénial teeth	3-3	6-5	7-?	2-2	0-0
Total length of specimen in preservation	254	?	?	?	178

from the maxillopalatine easily distinguish this genus from all other Gymnophiona.

Boulengerula Tornier

Boulengerula Tornier, Kriechthiere Deutsch-Ost-Afrikas, Beiträge zur Systematik und Descendenzlehre. Berlin, 1897, p. 164 (type of the genus, *B. boulengeri* from Usambara Mts., Tanganyika [Tanzania] Africa).

Generic characters indicated by Tornier are: parietal and squamosal forming a suture without diastema; no splenial teeth present; eyes roofed over by bone; no scales present; tentacle conical and extrusible, equally distant from nostril and symphysis of jaws. Only the type species is known.

Boulengerula boulengeri Tornier

(Fig. 50)

Boulengerula boulengeri Tornier, Kriechthiere Deutsch-Ost-Afrikas. Beiträge zur Systematik und Descendenzlehre. Berlin, 1897, p. 164. Type-locality Usambara Mts., Tanganyika (Tanzania), Africa.

Data are from a defective skull, MCZ No. 12309, Amani, Usambara Mts., Tanganyika (Tanzania), Africa.

The skull agrees with family characters in reduction of the number of dorsal skull bones; the mesethmoid appears narrowly on the median dorsal line, completely separating the prefrontals and forming a very slight wedge between the posterior ends of the nasopremaxillae, and a larger wedge between the anterior ends of the parietals. The median length of the frontals is about half the median length of the parietals.

There is no eye socket; the eye, if present, is bone covered. The tentacular aperture is cut in the maxillopalatine, its groove not extending beyond these. The parietals and squamosals form sutures without diastemata, the parietals widening very slightly behind the posterior level of the squamosals. The snout projects beyond the mouth. The basisphenoid is relatively very wide anteriorly at the point of contact with the prevomers, except for a spine from the basisphenoid that separates the greatly narrowed prevomers for half of their length. The prevomers reach posteriorly behind the posterior level of the internal nares.

A short break occurs in the continuity of the prevomeropalatine tooth series. The pterygoids are present and fused to the quadrate. The otic capsules are obviously inflated. See Table 11.

Afrocaecilia Taylor

Afrocaecilia Taylor, Caecilians of the World, 1968, p. 321. Type of the genus, *Boulengerula taitanus* Loveridge.

Afrocaecilia is characterized as follows: eye under bone; tongue free laterally and anteriorly; no scales; no secondaries; splenial teeth present; tentacle small, distant from nostril; no tail; an unsegmented terminal "shield."

Taylor referred three species to the genus: the type, *Boulengerula taitanus*, *B. uluguruensis* and *B. changamwensis*. All are small species, east African in distribution. The members of the genus may readily be differentiated from *Boulengerula* by the presence of splenial teeth.

Afrocaecilia uluguruensis (Barbour and Loveridge)

(Fig. 51)

Barbourula uluguruensis Barbour and Loveridge, Mem. Mus. Comp. Zool., Harvard College, vol. 50, 1928, pp. 183-184. Type-locality, Vituri (2000 ft. elev.), Uluguru Mountains, Northeastern Tanganyika (Tanzania).

One skull from a topotypic paratype has been available for study, EHT-HMS No. 4649. The characteristics are as follows:

The eye if present, is concealed under the squamosal bone. The tentacular aperture is at or near the anterior end of the maxillopalatine, which is relatively small. The nasopremaxilla is relatively large, the mesethmoid not being visible on the dorsal surface of skull. The frontals are quadrangular, their common suture about equaling half of the common parietal suture length.

The prevomers are separated by the spine of the basisphenoid for more than two thirds of their length. Very narrow diastemata posterior to the internal nares lie between the maxillopalatine shelf and the basisphenoid. The basisphenoid is widened where it first meets the prevomers. The pterygoid appears to be fused with the quadrate. The lateral sutures of the maxillopalatine are difficult to follow. See Table 12.

Afrocaecilia taitana (Loveridge)

(Fig. 52)

Boulengerula taitanus Loveridge, Bull. Mus. Comp. Zool., Harvard College, vol. 79, 1935, p. 16. Type-locality, Mt. Mbololo (4800 ft. elev.), Teila Hills, Kenya.

Data here are recorded from the skull of MCZ No. 20021, topotype.

The characters differing from *A. uluguruensis* are: the skull is longer and perhaps slenderer, the prevomers may reach back only to the posterior level of the internal nares (not distinctly farther as in *A. uluguruensis*), and an ectopterygoid is present (seemingly absent in the two other species). It has been injured during the lifetime of the animal, as one of the bones on the head has been broken and partially mended. See Table 12.

Afrocaecilia changamwensis (Loveridge)

(Fig. 53)

Boulengerula changamwensis Loveridge, Bull. Mus. Comp. Zool., Harvard College, 1932, vol. 72, p. 381. Type-locality, Changamwe (192 ft. elev.) near Mombasa, Kenya, Africa.

Data are from the skull of a topotypic paratype, EHT-HMS No. 4651.

The differences of this skull from the above two are small. The prevomers are somewhat differently shaped as is the anterior spine of the basi-

TABLE 12. Measurements in mm and tooth counts of skulls of *Afrocaecilia*.

Species	<i>uluguruensis</i>	<i>taitana</i>	<i>changamwensis</i>
Number	4649	20021	4651
Museum	EHT-HMS	MCZ	EHT-HMS
Locality	Uluguru Mts.	Teita Hills, Kenya	Changamwe, Kenya
Total length of skull	5.8	7.3	5.7
Greatest width	3.2	3.6	3.25
Length of lower jaw	5.2	6.3	5.1
Length of basisphenoid	4.4	3.5	4.2
Width at otic capsules	2.0	2.6	2.05
Width at "wings"	1.35	2.35	1.8
Length of prevomers	1.4	1.7	1.7
Combined width, greatest	1.5	1.85	1.5
Anterior border of internal nares to end of skull	3.55	4.7	3.7
Premaxillary teeth	6-8	?-?	6-7
Maxillary teeth	?-8	12-11	8-?
Prevomerine teeth	5-4	4-5	5-4
Palatine teeth	6-7	9-8	?-10
Dentary teeth	10-10	12-12	10-10
Splénial teeth	3-2	1-1	2-2
Total length of specimen	232	?	234

sphenoid. The fused? pterygoid is present but I am not wholly certain that there is an ectopterygoid. The squamosal is elongate as in the other two skulls. See Table 12.

Gegeneophis Peters

Gegenes Günther, Proc. Zool. Soc. London, 1875, p. 577, type of genus, *Epicrium carnosum* Beddome (preoccupied by Hubner, 1816, for a genus of Lepidoptera).

Gegeneophis Peters, Monatsb. Akad. Wiss. Berlin, 1879, p. 932 (type of genus, *Epicrium carnosum* Beddome).

Gegenophis Boulenger (error or emendation), Catalogue of the Batrachia Gradientia s. Caudata and Batrachia Apoda in the Collection of the British Museum, 2nd Ed. 1882, p. 101.

This genus is, so far as known, confined to India. It comprises three species, one of which, *G. fulleri*, may be doubtfully associated. The other two, *G. ramaswamii* and *G. carnosus*, seemingly belong to the same genus.

The type species, *G. carnosus*, is small, and none has been available for an examination of the skull.

The combination of external characters that serve to define the genus are: eye without orbit, solidly covered by bone; splénial teeth present; no diastema between prevomerine and palatine teeth; tentacle small, behind and below nostril; secondary folds present posteriorly; scales are present, two to four rows posteriorly; tongue with two narial plugs, vent transverse.

Gegeneophis ramaswamii Taylor

(Figs. 54, 55)

Gegeneophis ramaswamii Taylor, Senck. Biol., Frankfurt am Main, 1964, Bd. 45, Heft 3/5,

TABLE 13. Measurements in mm and tooth counts of skulls of *Gegeneophis ramaswamii* (topotypic paratypes).

Number Museum Locality	29452 MCZ Kerala, India	29454 MCZ Kerala, India	29456 MCZ Kerala, India
Total length of skull	10.0	9.05	8.5
Greatest width	6.0	4.95	5.9
Length of lower jaw	10.0	8.3
Length of basisphenoid	6.5	6.0	5.7
Width (at wings)	3.2	2.75	2.85
Width posterior to constriction	4.3	3.4	3.55
Length of prevomers	2.6	2.0	2.00
Combined width of prevomers (greatest)	3.0	2.35	2.3
Anterior border of choana to condyle	6.7	6.0	5.8
Premaxillary teeth	4-5	4-6	5-5
Maxillary teeth	14-15	11-10	10-11
Prevomers teeth	5-5	5-4	5-5
Palatine teeth	12-13	10-12	12-11
Dentary teeth	13-13	13-13
Splenic teeth	3-3	3-3
Total length of specimen	305	263	242

Dec. 1, 1964, pp. 227-231, text figs. 1, 2 (type-locality Tenmalai Forest, Kerala [state], southern India); Caecilians of the World, Lawrence, Kansas, 1968, pp. 739-746, figs. 402-406.

Data recorded here are from the skull of MCZ No. 29452.

The prefrontals, septomaxillae, and oculars do not appear; the premaxillae and nasals are united. The mesethmoid is not visible dorsally. The posterior part of the skull is declivous, rather abruptly so from the parietal border. The stapes are relatively very large. There is no eye socket. The internal nares are almost surrounded by the maxillopalatines but are bordered for a short distance on their inner side by the prevomer. A small diastema is present between the basisphenoid and pterygoid following the nares.

Two other skulls available do not differ in essential details. See Table 13.

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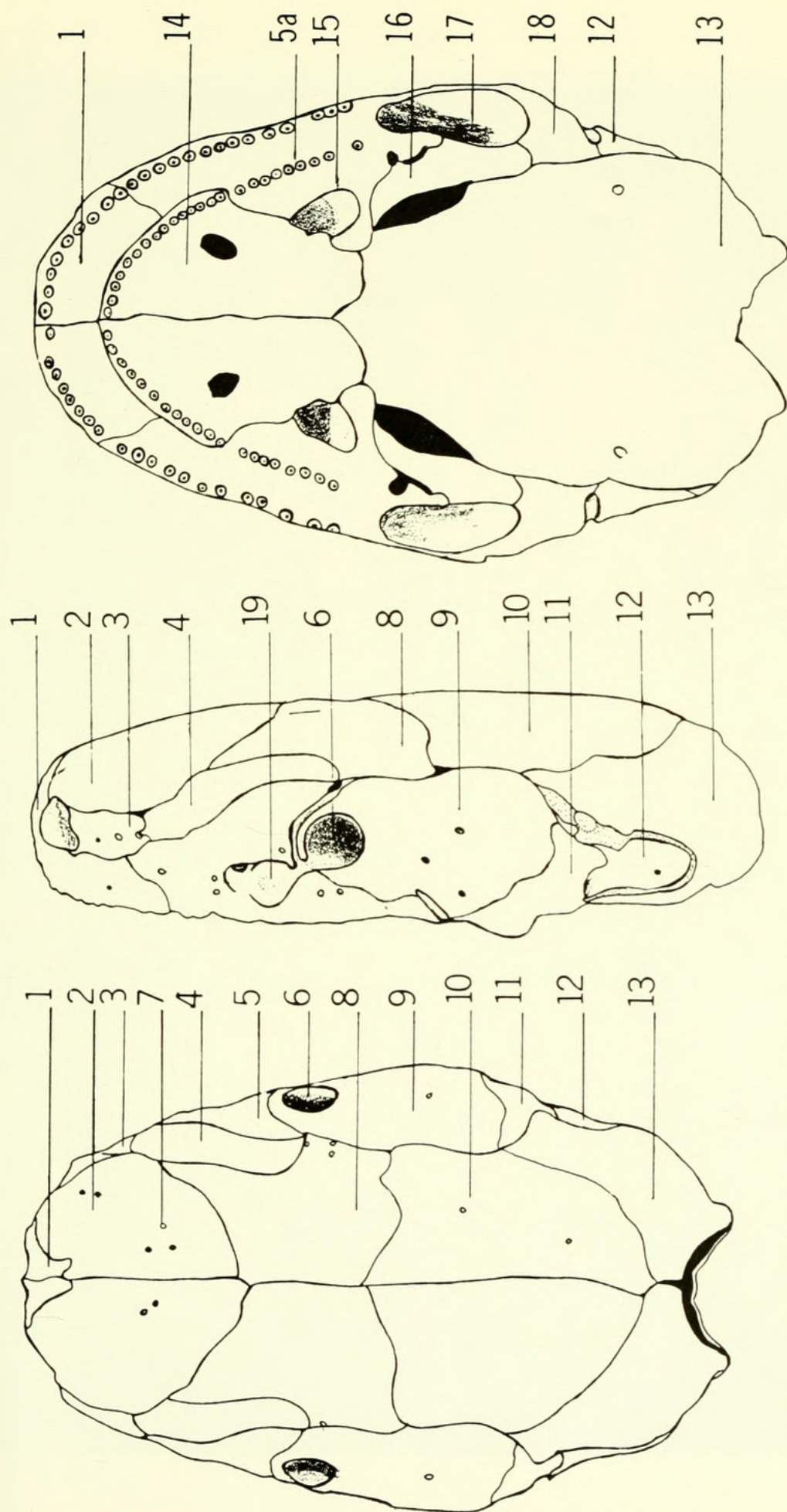


FIG. 1. Generalized diagram of a Caccilian skull. Dorsal, lateral, and ventral views of the skull of *Caudacacilia weberi* Taylor. 1, premaxilla; 2, nasal; 3, septomaxilla; 4, prefrontal; 5, maxilla; 5a, palatine shelf of maxilla; 6, orbit of eye; 7, fenestra for nerves or blood vessels; 8, frontal; 9, squamosal; 10, parietal; 11, quadrate; 12, stapes; 13, basisphenoid (compound); 14, prevomer; 15, internal naris (choana); 16, pterygoid; 17, fenestra for jaw muscles; 18, quadrate; 19, tentacular groove.

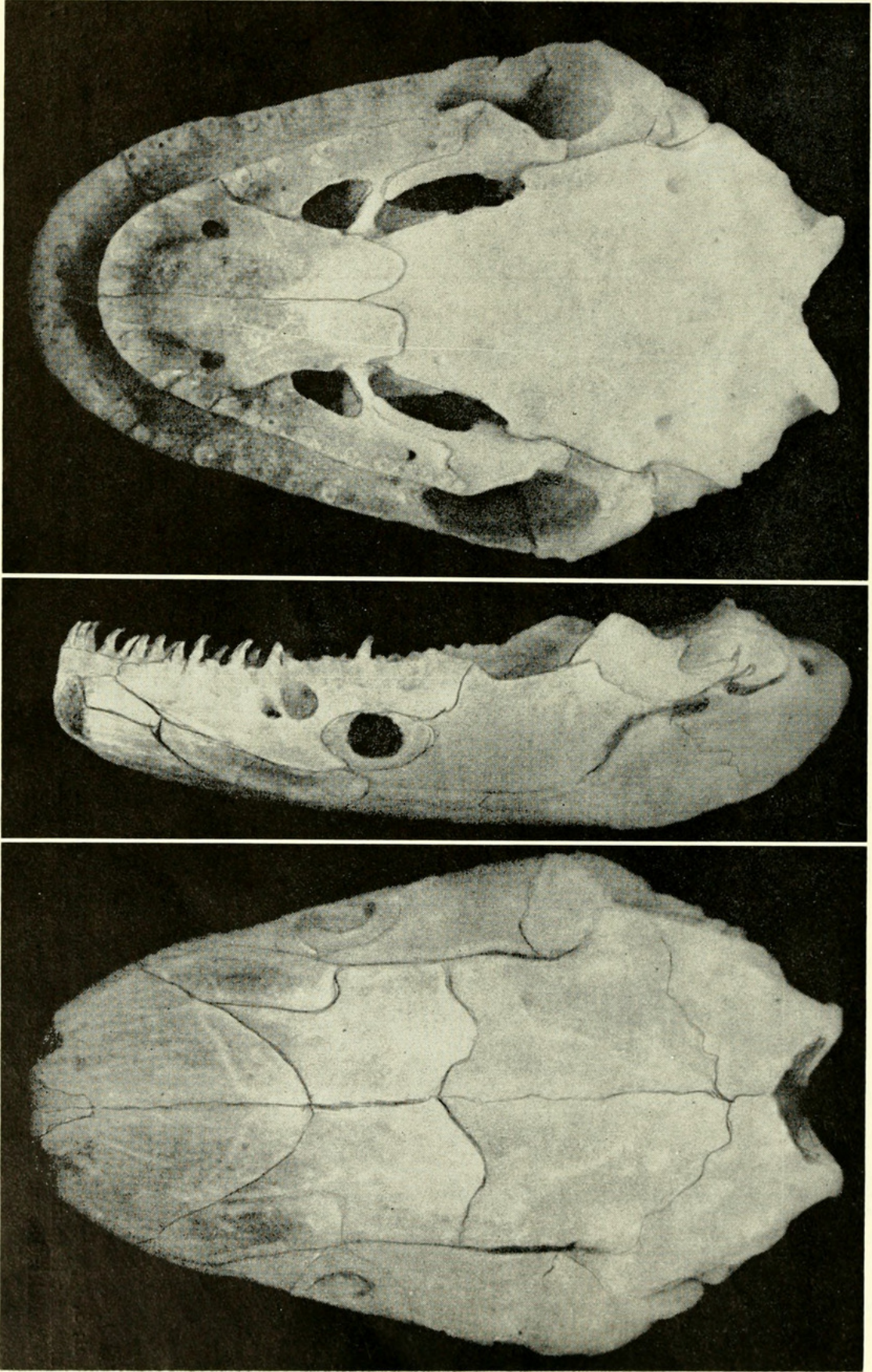


FIG. 2. *Ichthyophis glutinosus* (Linnaeus). KUMNH No. 31291, Numunukula, Tonacombe Estates, Uva Hills, Uva Province, Ceylon. Total length of specimen, 320 mm; length of skull, 13.0 mm; width of skull, 8.0 mm. (Note: ventral portion of squamosal broken, exposing the pterygoid laterally.)

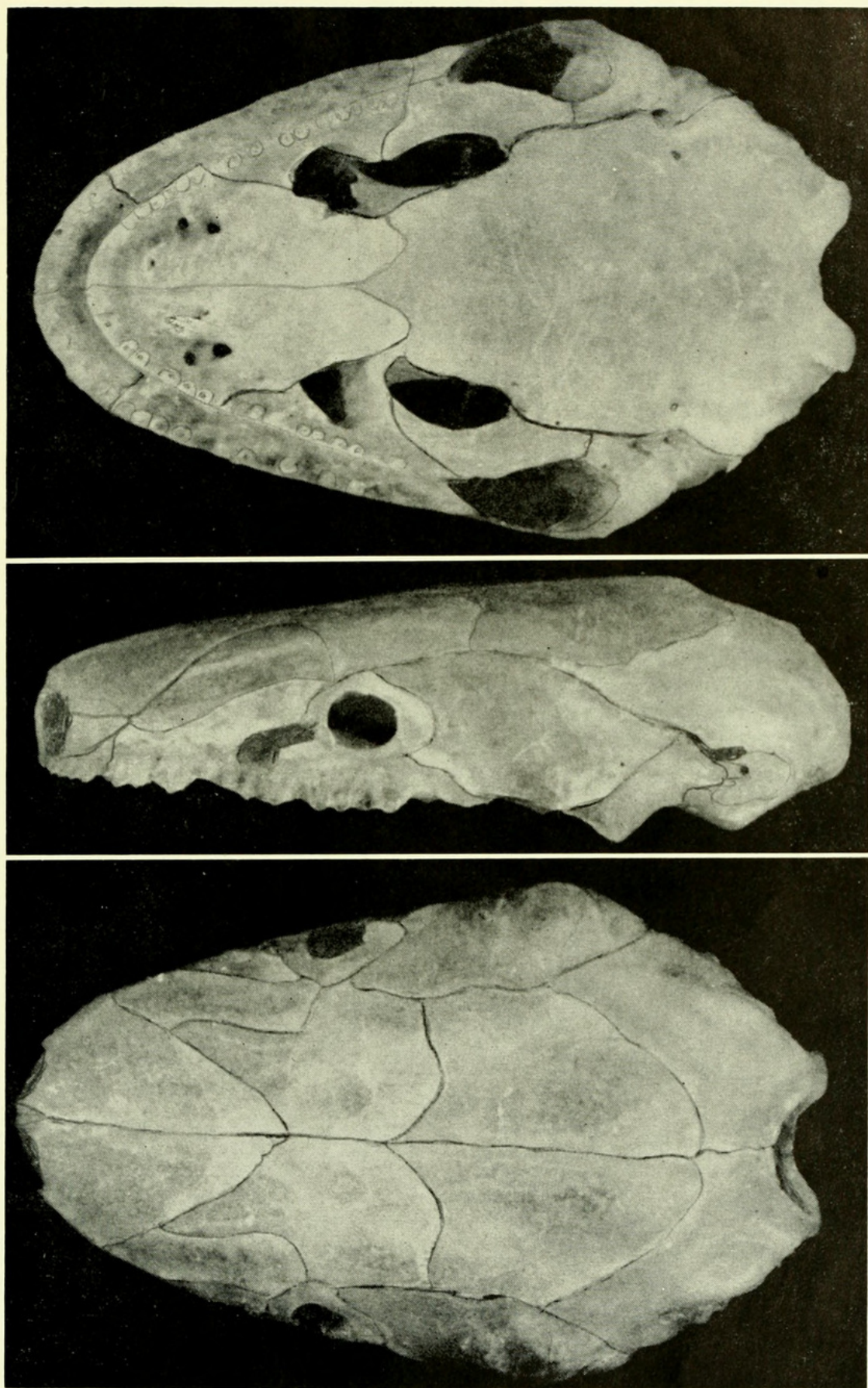


FIG. 3. *Ichthyophis beddomei* Peters. EHT-HMS Coll. No. 3186, Kotegehar, Mysore, India. Total length of specimen, 258 mm; length of skull, 11.0 mm; width of skull, 7.0 mm. (Small break on palatine shelf.)

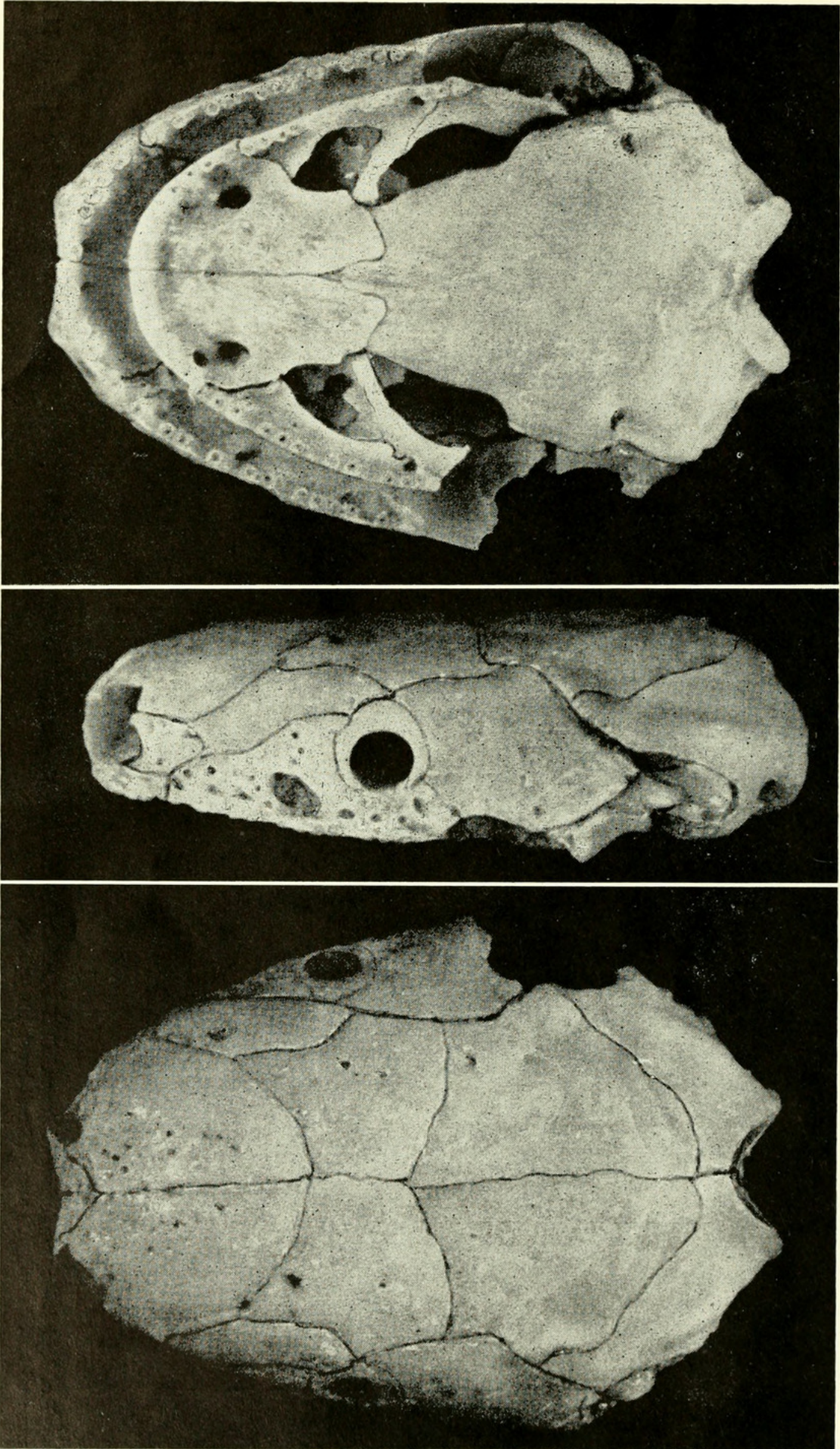


FIG. 4. *Ichthyophis singaporensis* Taylor. BMNH No. RR, 1959.1.2.43. Type. Singapore Island. Total length of specimen, 243 mm; length of skull, 10.4 mm; width of skull, 7.0 mm. (Side of skull broken.)

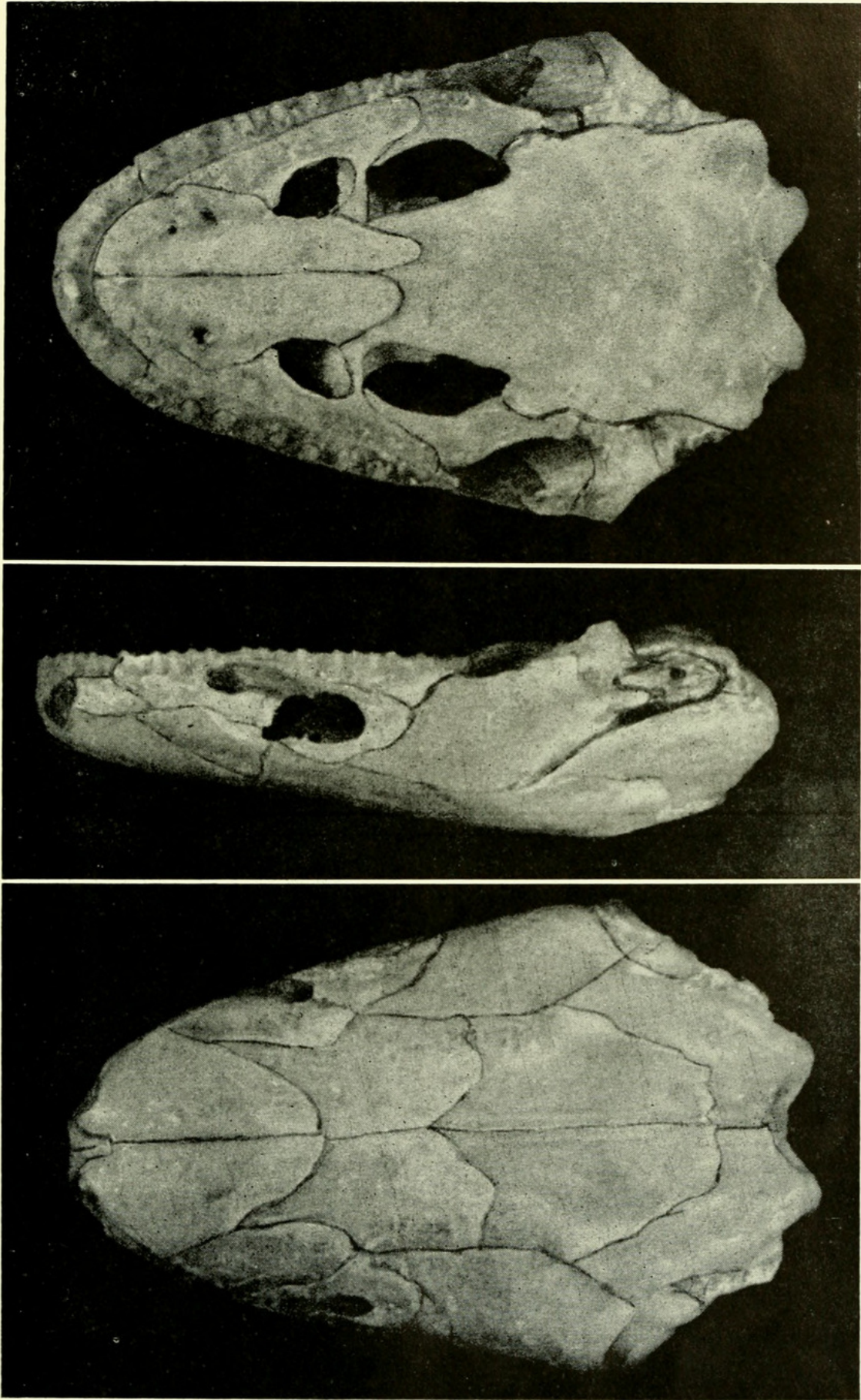


FIG. 5. *Ichthyophis koh taoensis* Taylor. EHT-HMS Coll. No. 3935. About 10 miles N. of Chiang Dao, Northern Chiang Mai Province, Northern Thailand. Total length of specimen, 309 mm; length of skull, 11.7 mm; width of skull, 6.8 mm. (Orbit rim broken, when photographed.)

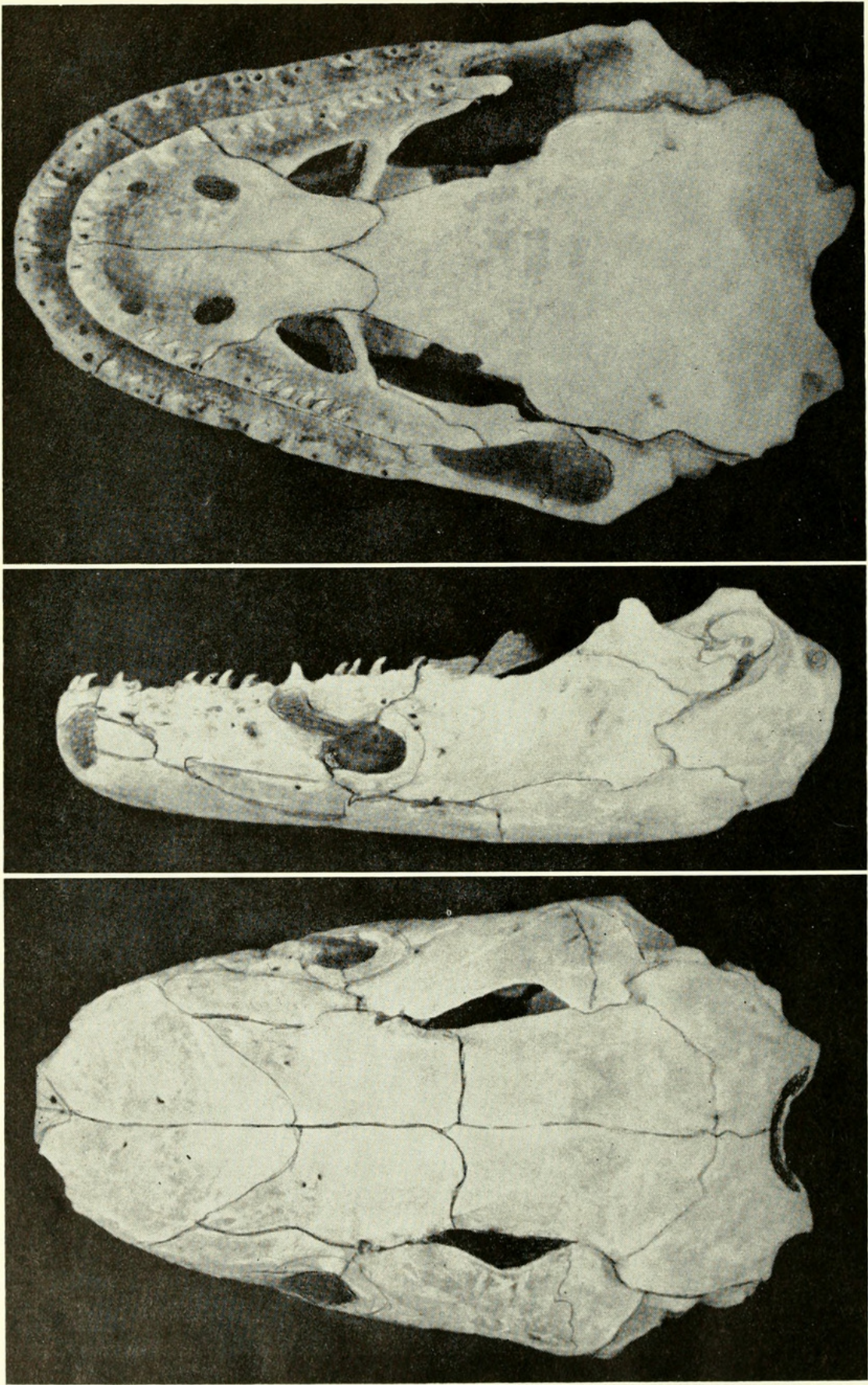


FIG. 6. *Ichthyophis kohtaoensis* Taylor. EHT-HMS Coll. No. 1838, Dansai Prov., Thailand. Total length of specimen, 333 mm; length of skull, 14.0 mm; width of skull, 9.0 mm. (Portion of orbit rim broken; left pterygoid missing.)

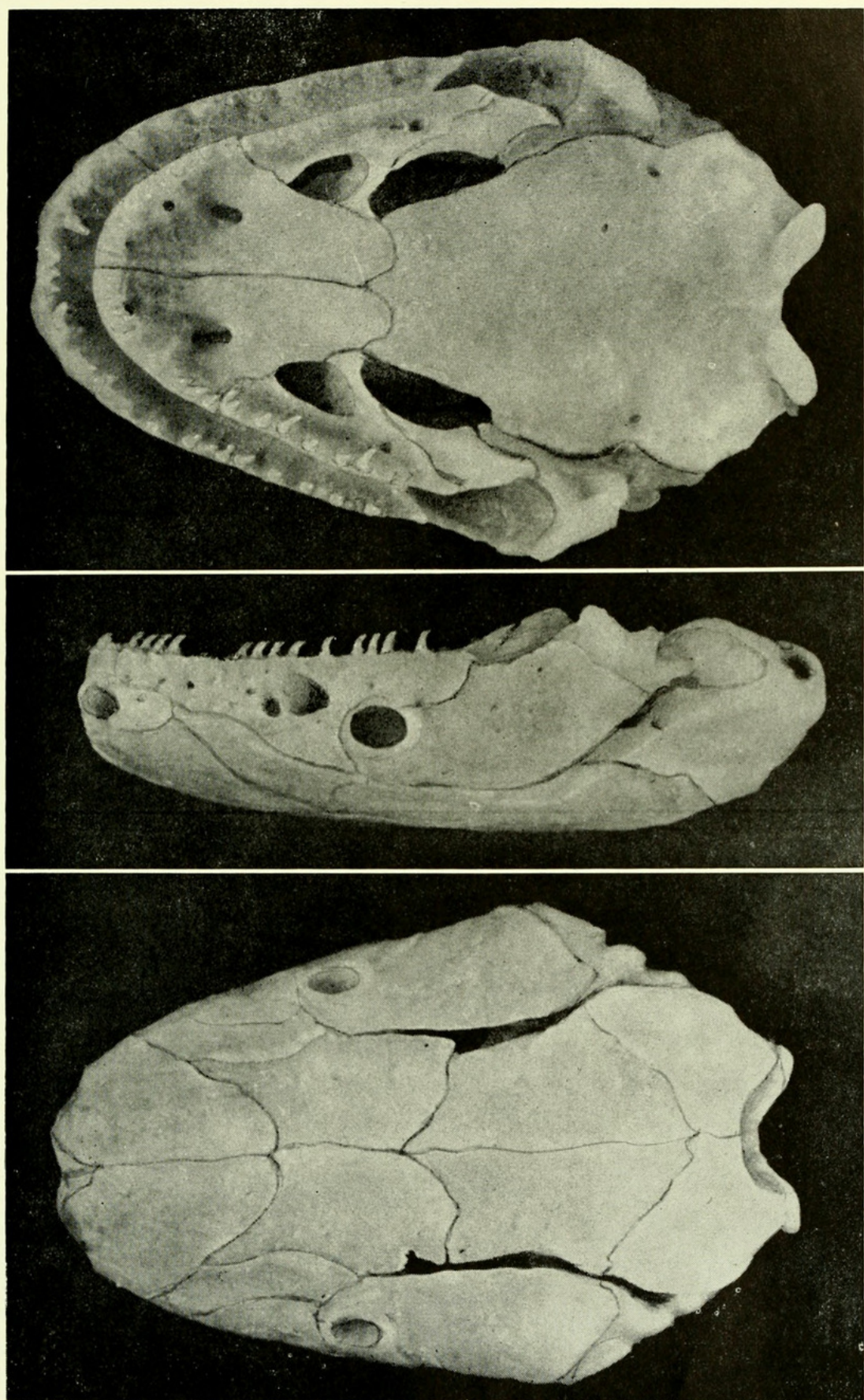


FIG. 7. *Ichthyophis mindanaoensis* Taylor. DSBM No. 20926. Bank of Dapitan River, 11 km. SE Buena Suerte, Misamis, P.I., elev. ca. 3700 ft. Total length of specimen, 259 mm; length of skull, 11.5 mm; width of skull, 7.4 mm.

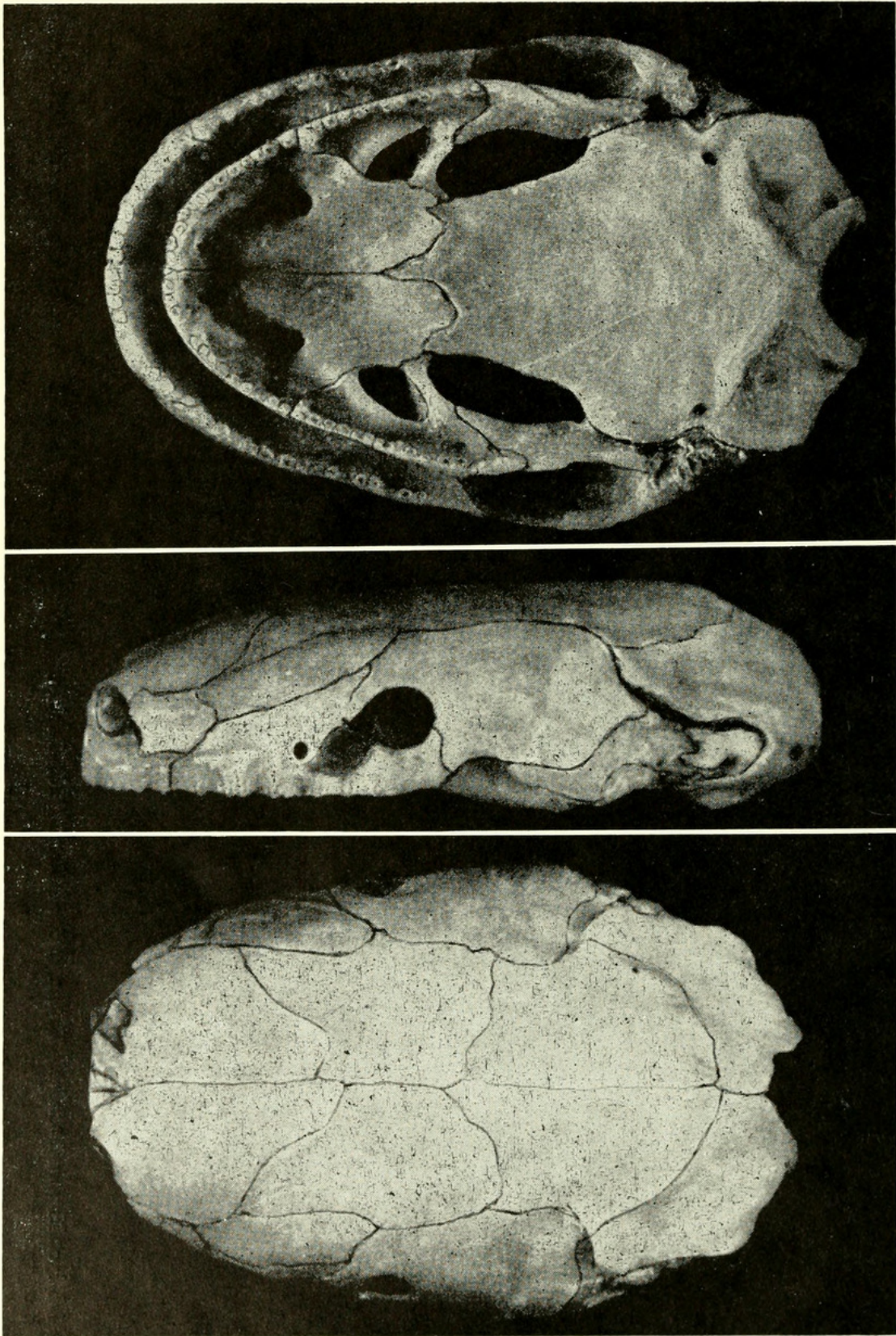


FIG. 8. *Caudacaealia nigroflava* (Taylor). EHT-HMS Coll. No. 1734. Bukit Lagong Forest Reserve, Selangor, Malaya (near Kuala Lumpur). Total length of specimen, 385 mm; length of skull, 12.0 mm; width of skull, 8.0 mm.

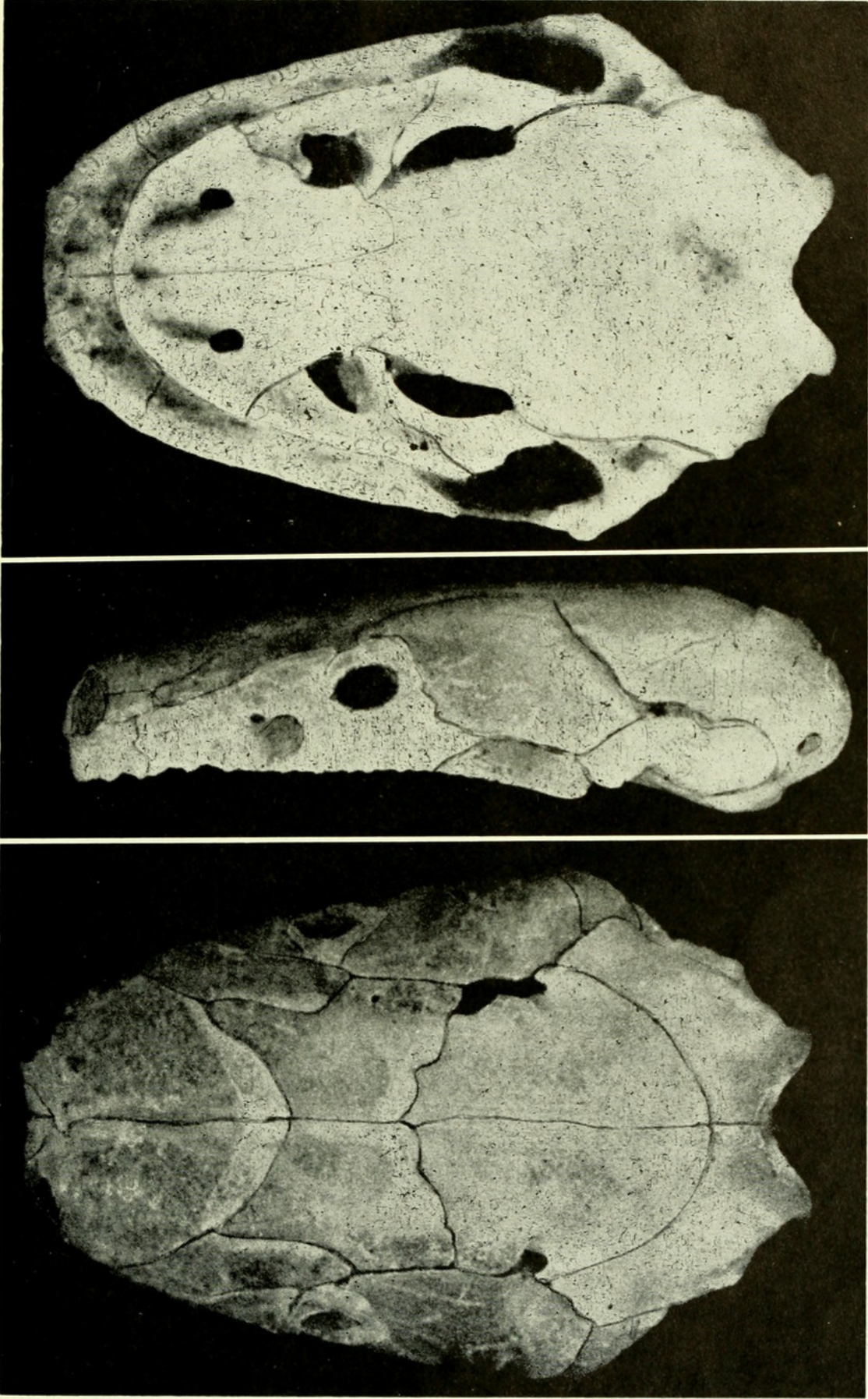


FIG. 9. *Caudacaelia asplenica* Taylor. EHT-HMS Coll. No. 1373, LaDoo Tin Mine, Yala Province, Thailand. Total length of specimen, 238 mm; length of skull, 9.5 mm; width of skull, 6.3 mm.

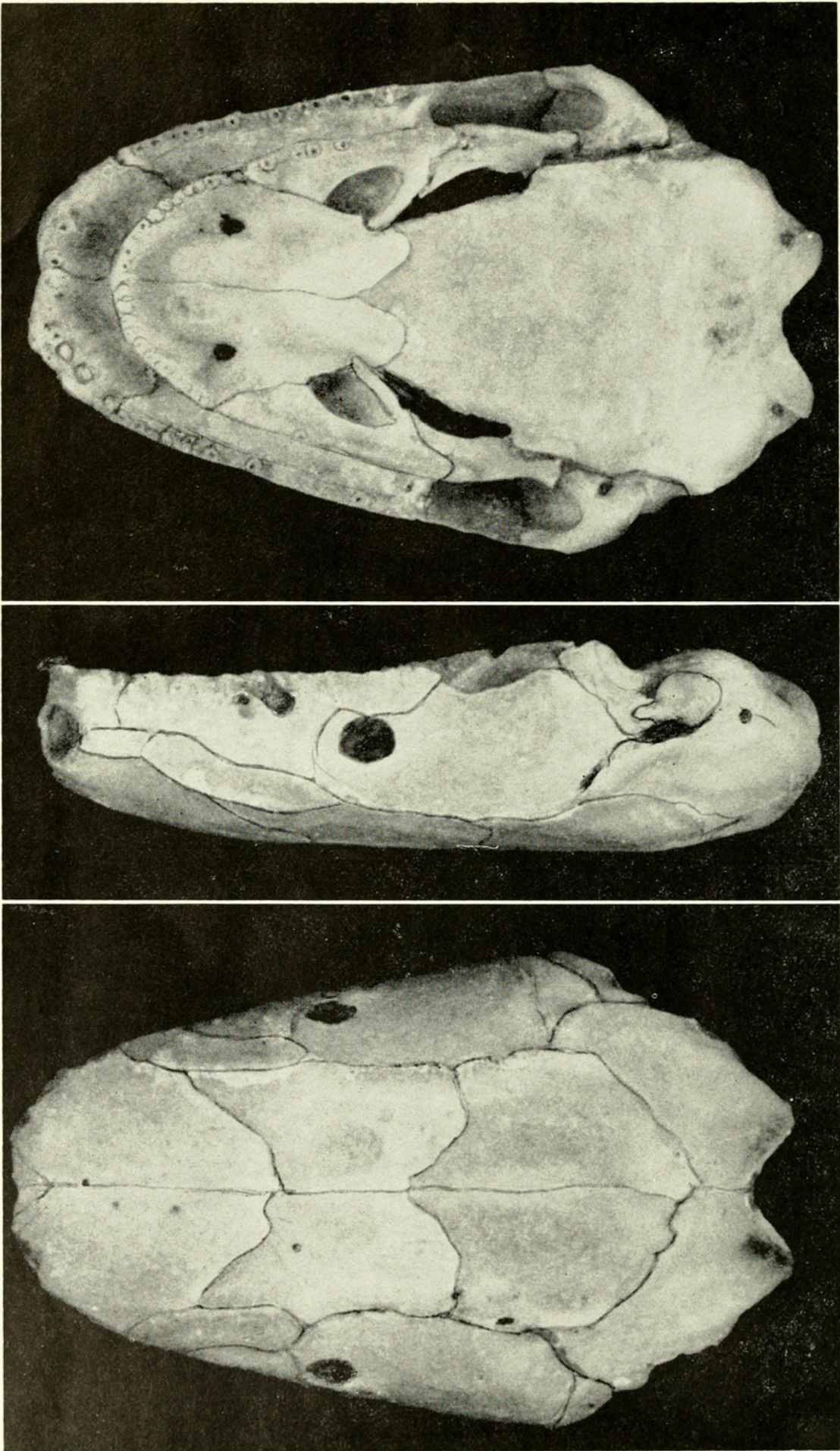


FIG. 10. *Caudacacilia larutensis* (Taylor). EHT-HMS Coll. No. 3359, Maxwell's Hill, Larut Hills, Perak, Malaya. Total length of specimen, 252 mm; length of skull, 11.0 mm; width of skull, 6.8 mm.

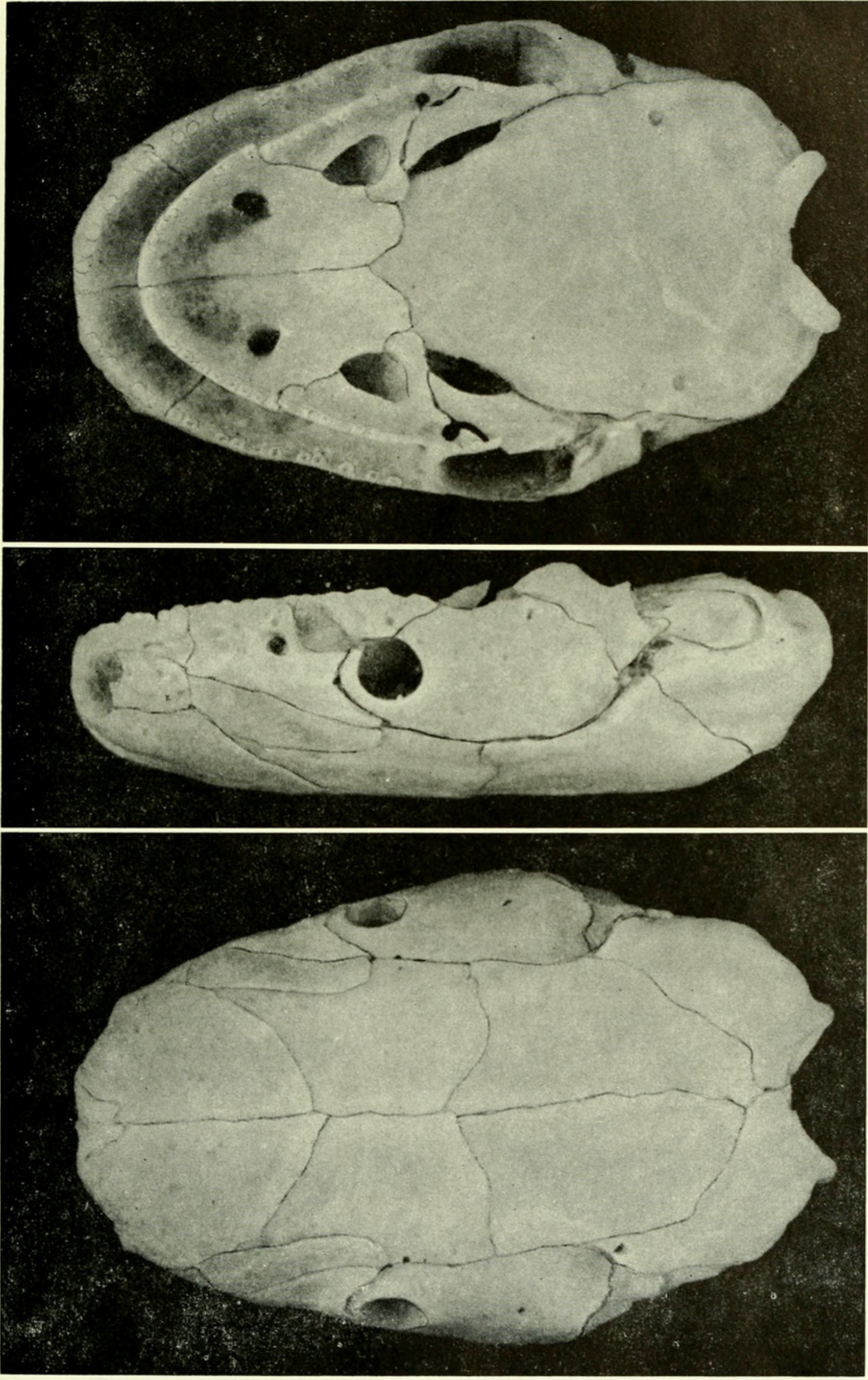


FIG. 11. *Caudacacilia weberi* (Taylor). DSBM No. 21764. Near Malatgan River, Palawan, P.I. (paratype of the neotype). Total length of specimen, 209 mm; length of skull, 9.0 mm; width of skull, 5.4 mm.

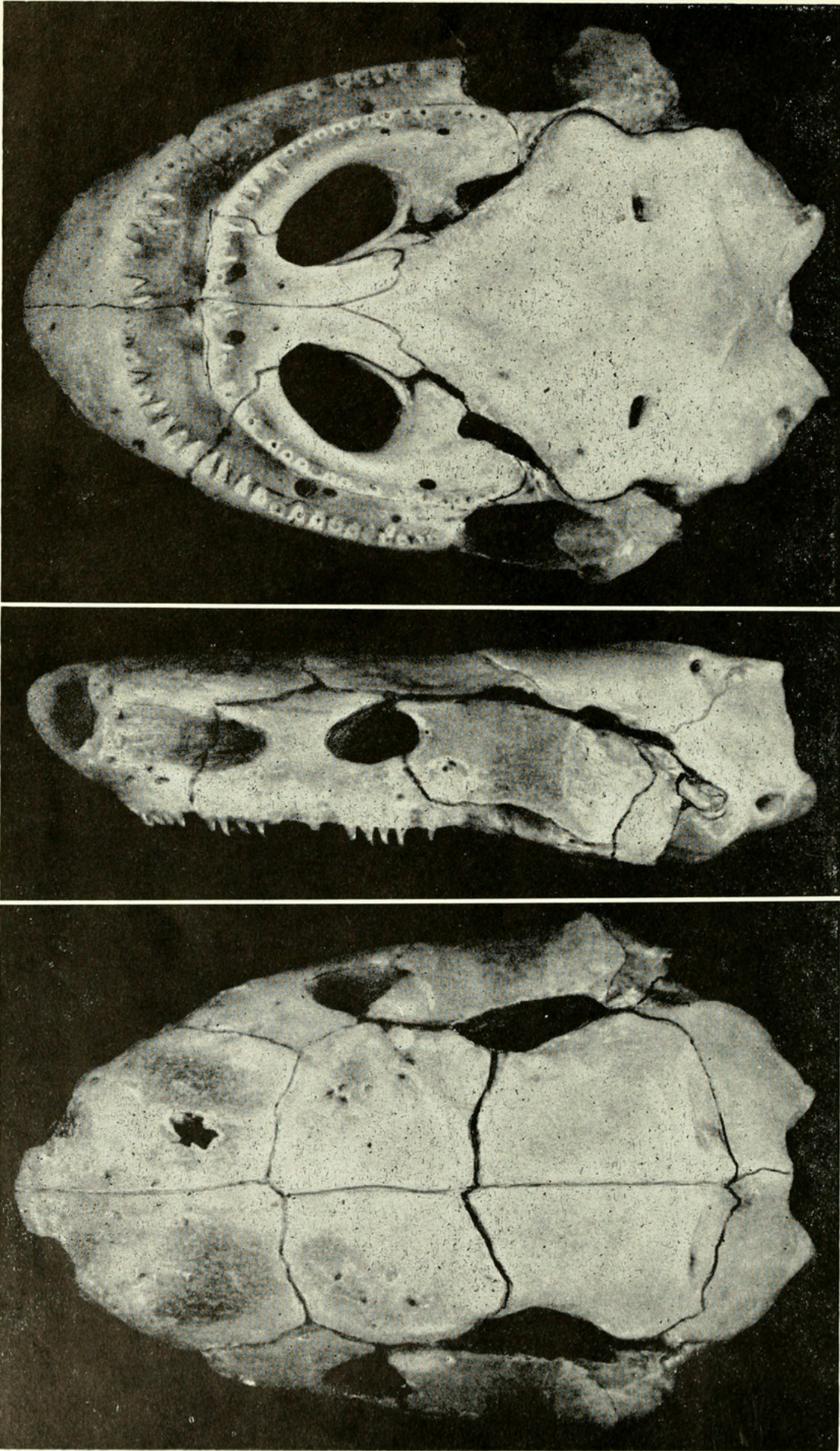


FIG. 12. *Typhlonectes compressicaudus* (Duméril and B.bron. EHT-HMS Coll. No. 1731, Belém, Brasil. Total length of specimen, 432 mm; length of skull, 16.5 mm; width of skull, 11.2 mm.

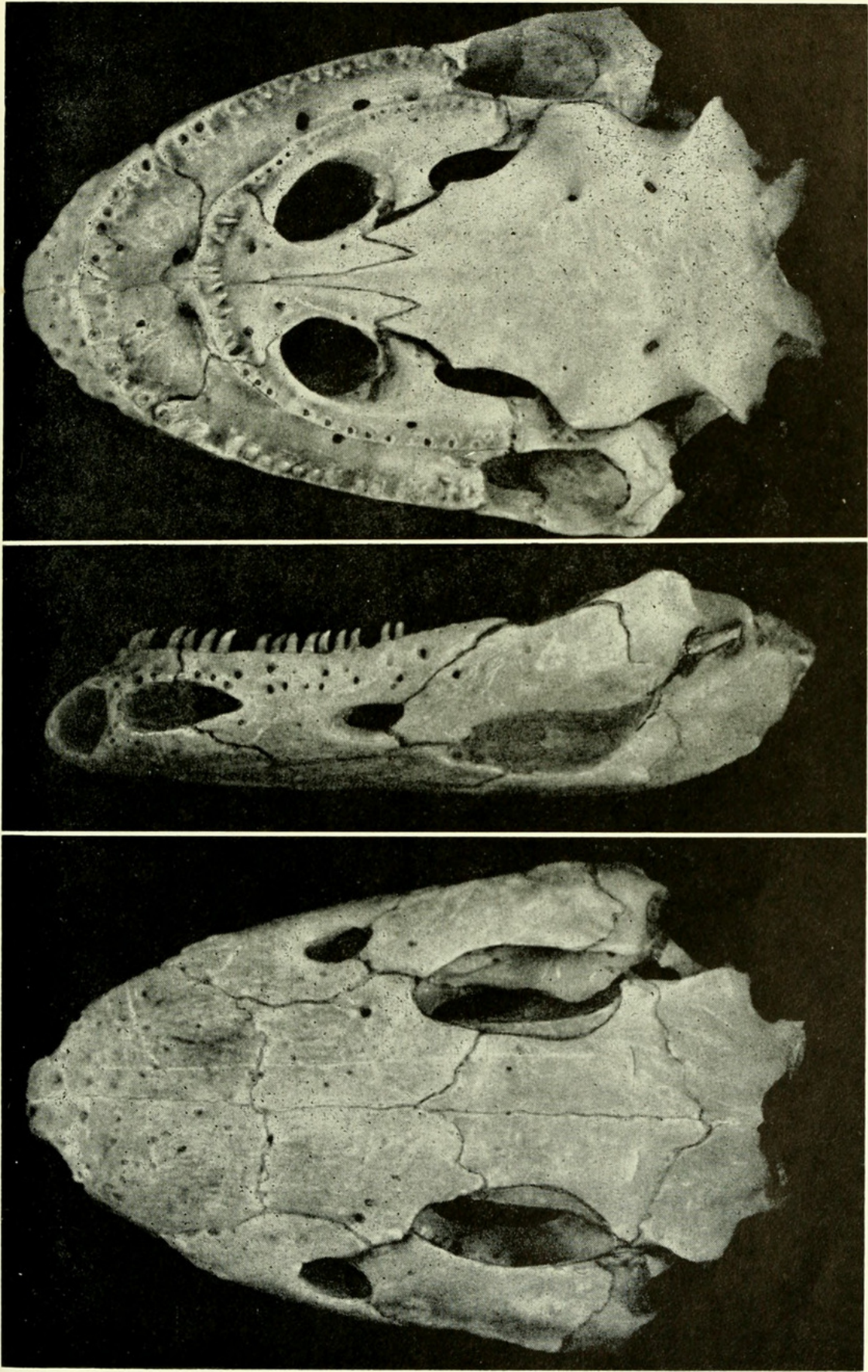


FIG. 13. *Typhlonectes natans* Fischer, in Peters. MCZ No. 24524, Cúcuta, Colombia. Total length of specimen, 650 mm; length of skull, 22.4 mm; width of skull, 14.8 mm.

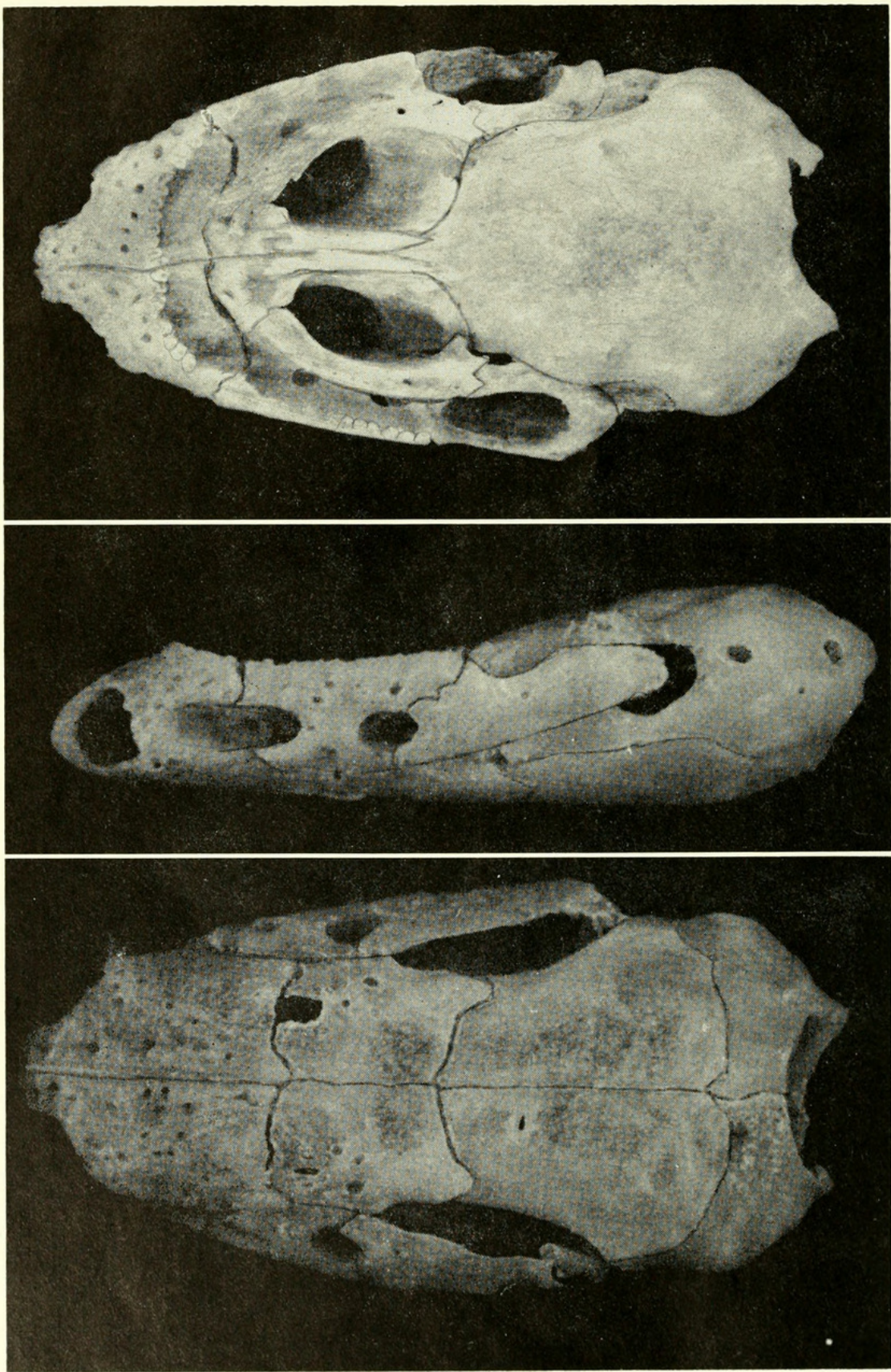


FIG. 14. *Potamotyphlus kaupii* (Berthold). UIM No. 787. Uncertain locality. Total length of specimen, 452 mm; length of skull, 11.1 mm; width of skull, 5.5 mm.

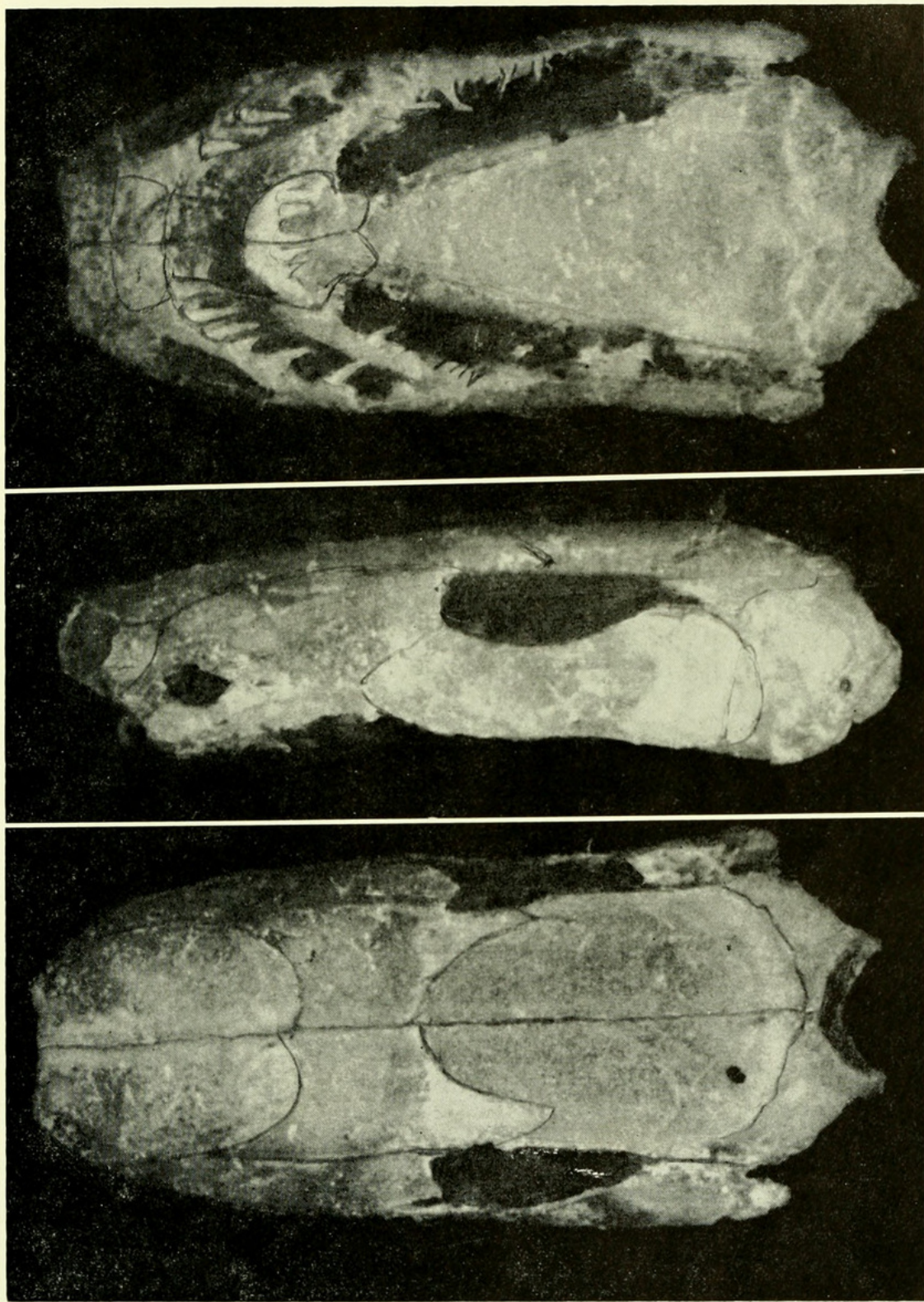


FIG. 15. *Scolecomorphus vittatus* (Boulenger). EHT-HMS Coll. No. 4642, Nyange, Vituri, Uluguru Mts., Tanganyika (Tanzania), Africa. Total length of specimen, $230 \pm$ mm; length of skull, 7.25 mm; width of skull, 3.7 mm.

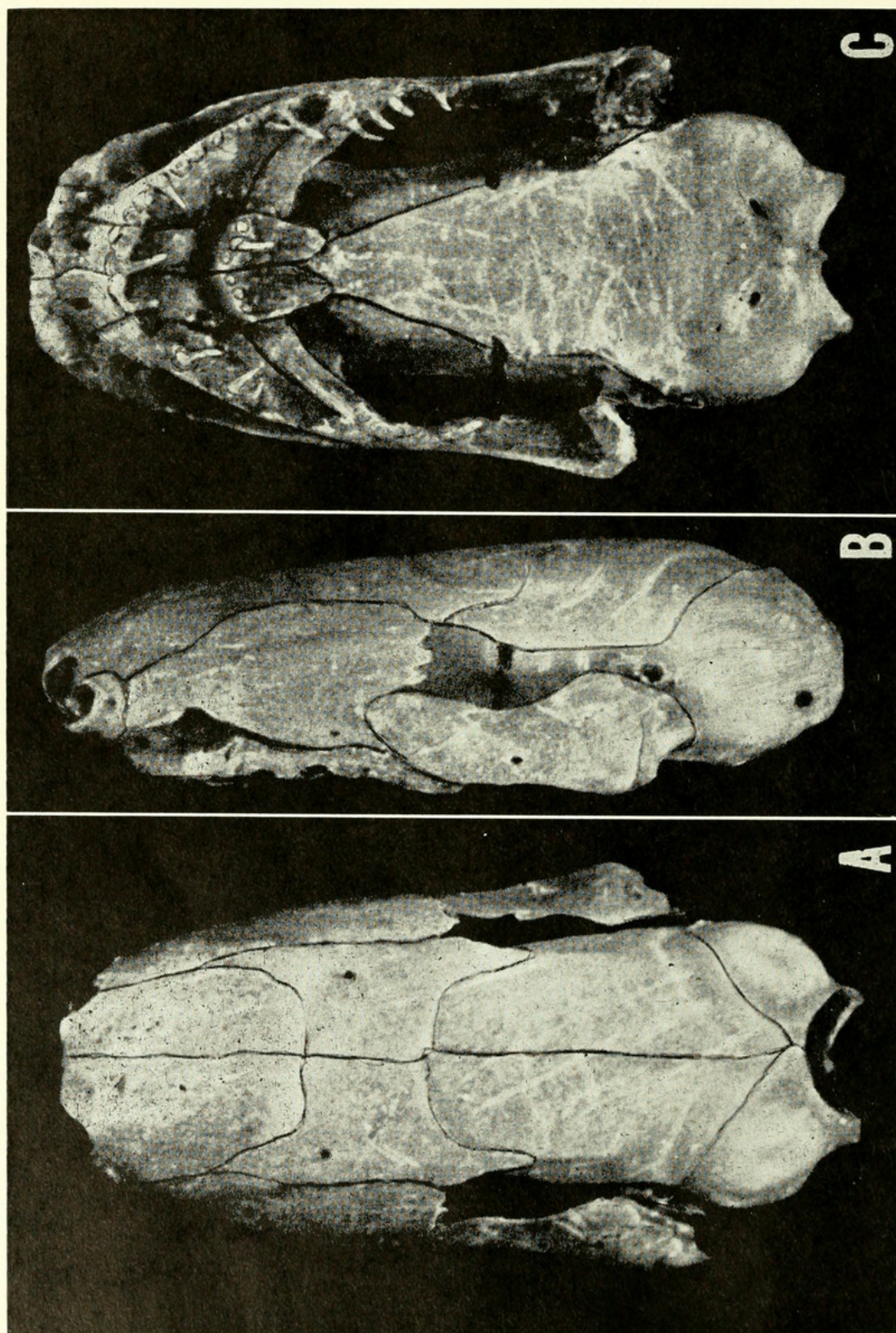


FIG. 16. *Scolecormorphus kirkii* Boulenger. MCZ No. 27120. Cholo Mts. 3600 ft. elev. Cholo district, Nyasaland (Malawi), Africa. Total length of specimen, 270 mm; length of skull, 7.9 mm; width of skull, 4.05 mm.

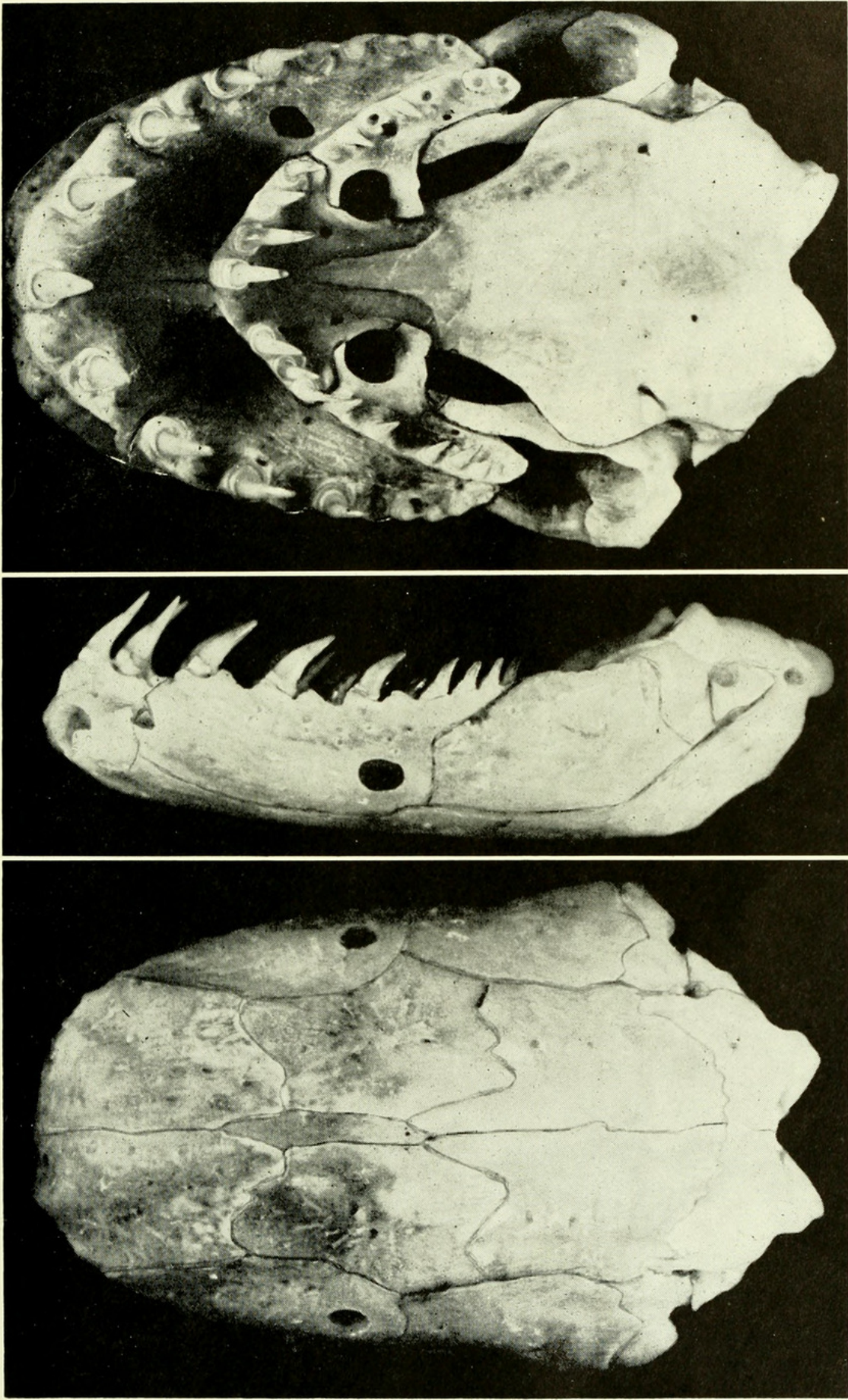


FIG. 17. *Caecilia nigrigans* Boulenger. KUMNH No. 94377, Cana, Darién, Panamá. Total length of specimen, 1004 mm; length of skull, 21.0 mm; width of skull, 13.2 mm.

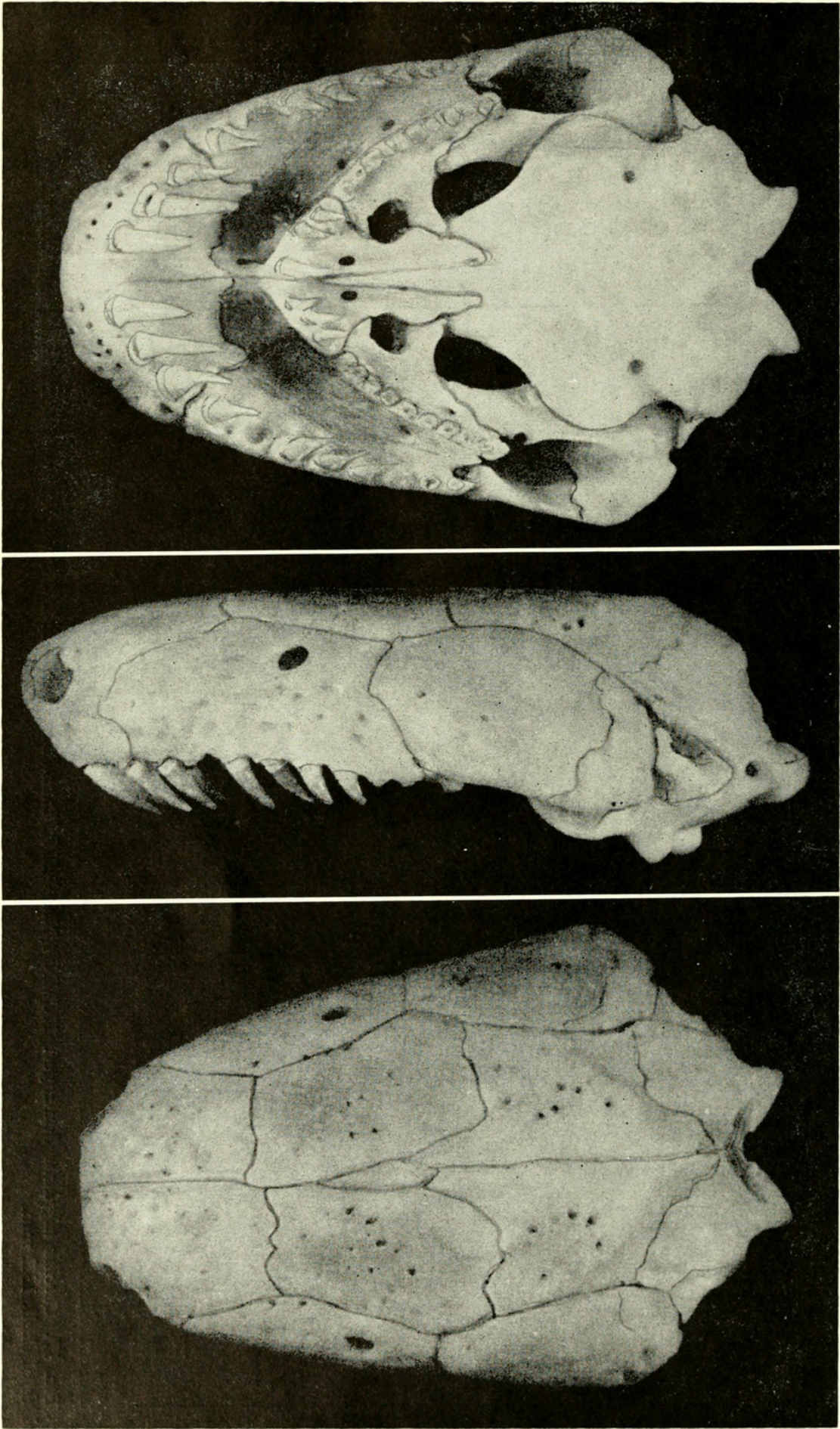


FIG. 18. *Caecilia tentaculata* Linnaeus. KUMNH No. 104438, Santa Cecilia, Napo-Pastaza, Ecuador. Total length of specimen, 790 mm; length of skull, 24.0 mm; width of skull, 16.0 mm.

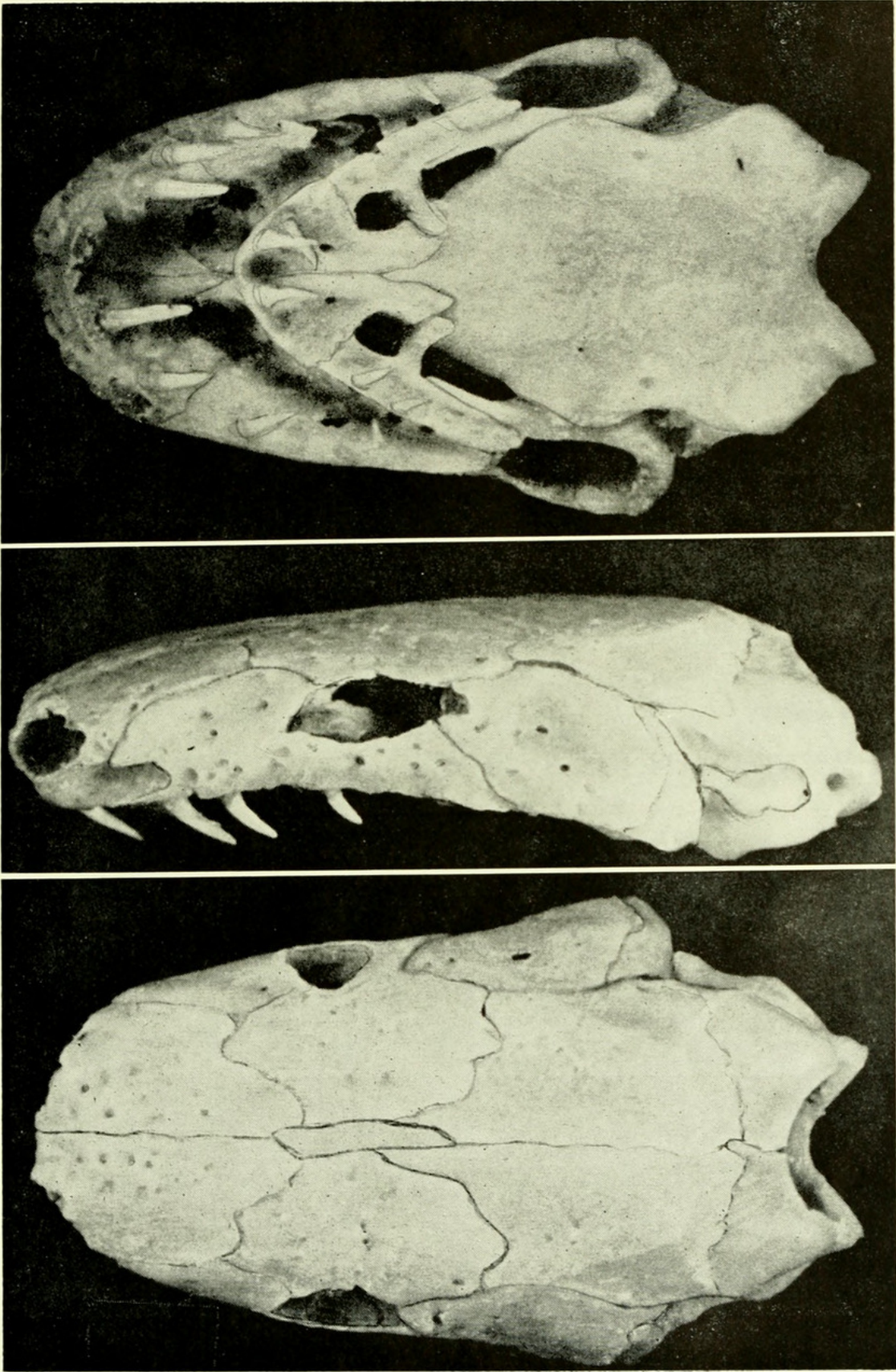


FIG. 19. *Caecilia degenerata* Dunn. AMNH No. 23354. Colombia, S.A. (no specific locality). Total length of specimen, 350 mm; length of skull, 10.4 mm; width of skull, 5.8 mm.

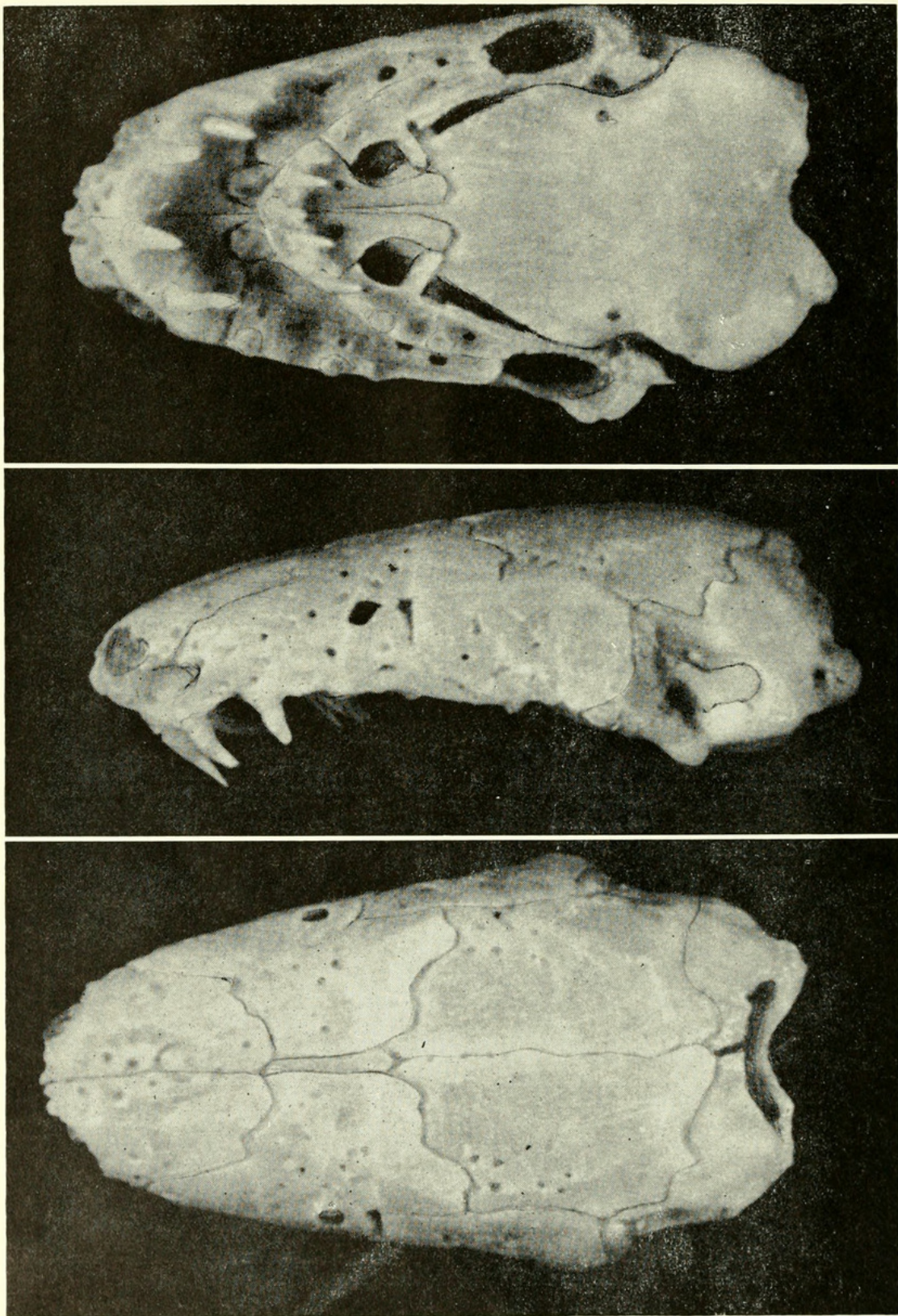


FIG. 20. *Caecilia disossea* Taylor. EHT-HMS Coll. No. 1808. Alto Cararay, Napo-Pastaza, Ecuador. Total length of specimen, 686 mm; length of skull, 6.9 mm; width of skull, 3.8 mm.

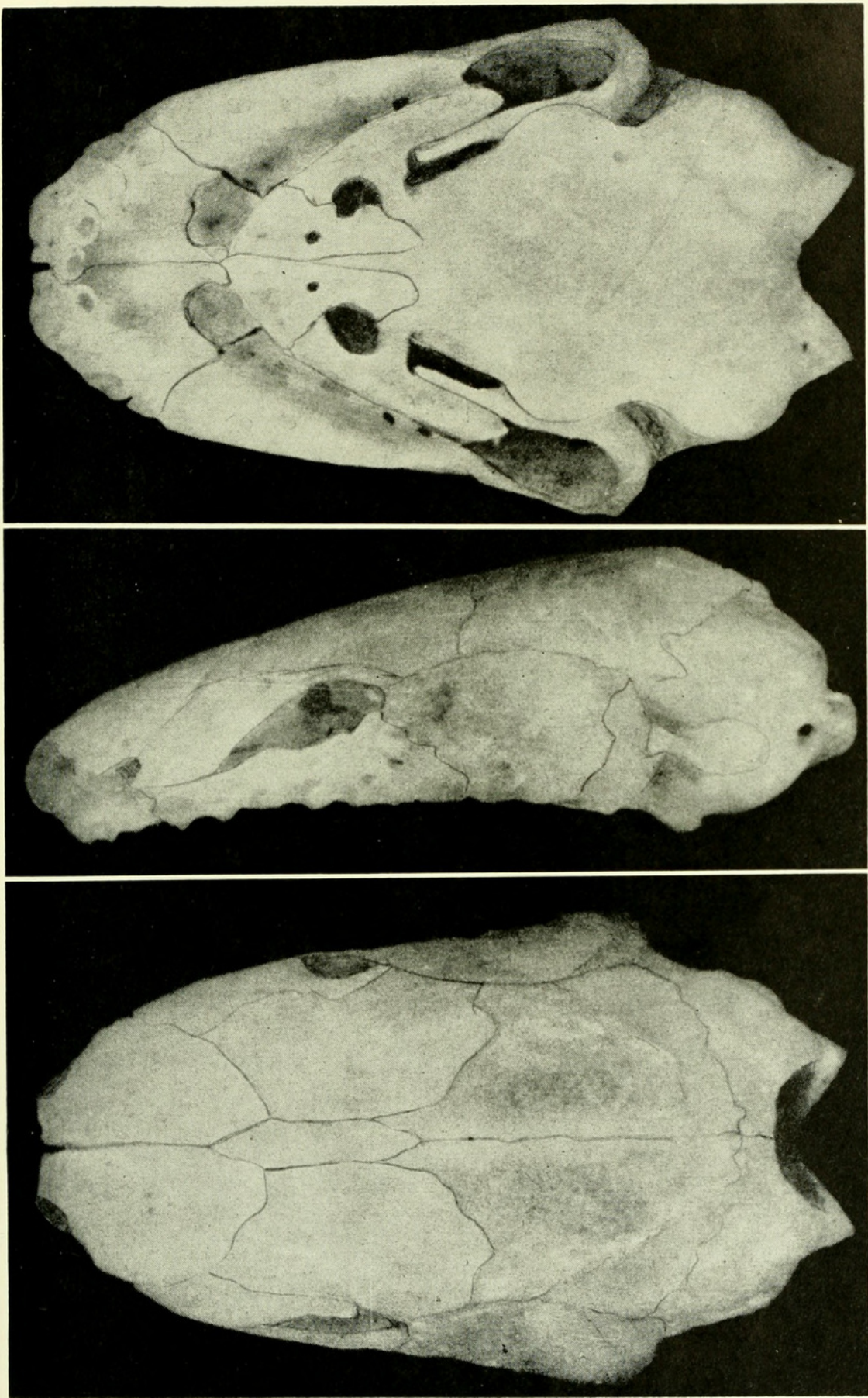


FIG. 21. *Caecilia volcani* Taylor. EHT-HMS Coll. No. 4696. Valle de Antón, Coclé, Panamá. Total length of specimen, 290 mm; length of skull, 8.5 mm; width of skull, 5.1 mm.

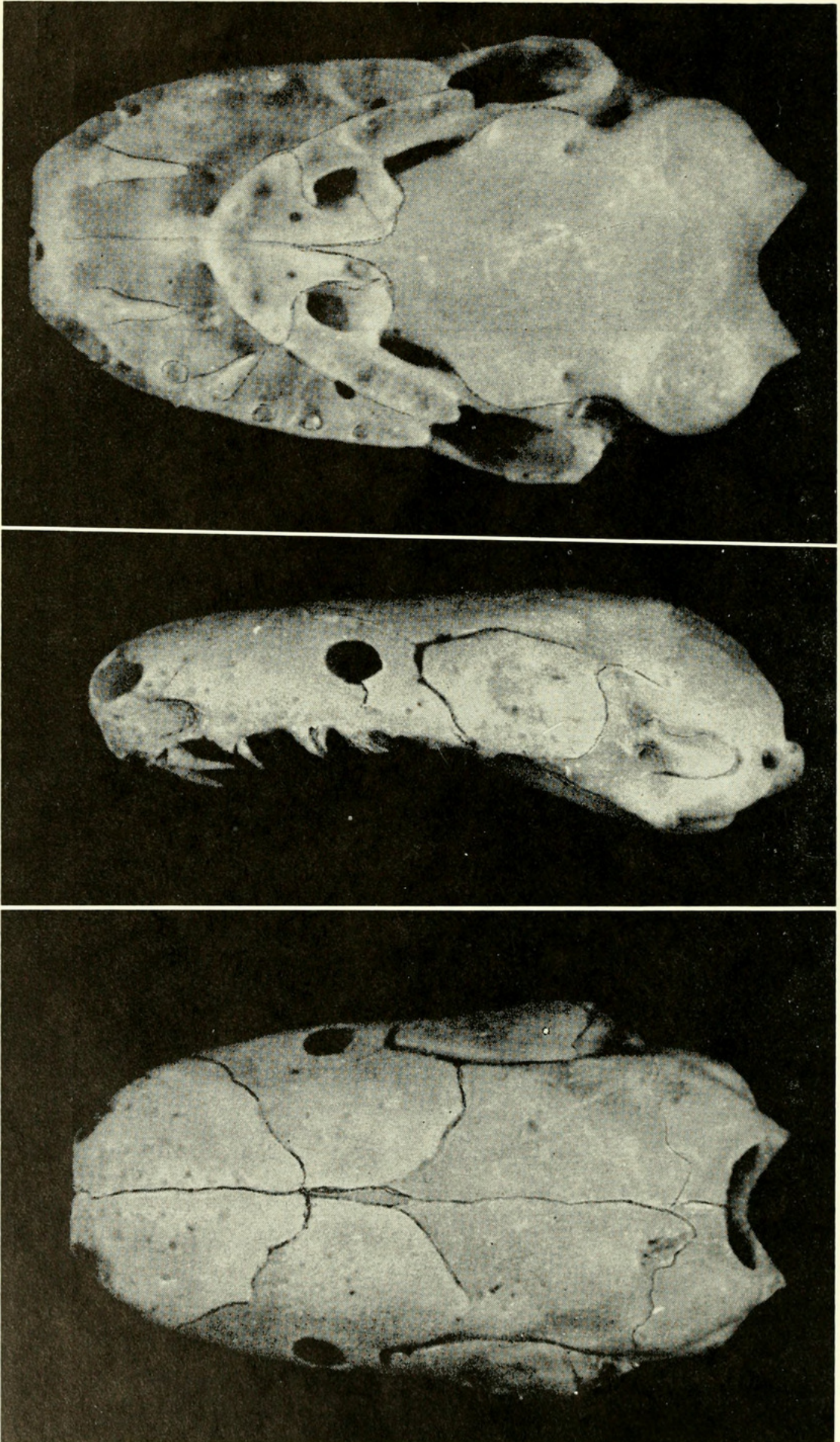


FIG. 22. *Caecilia orientalis* Taylor. EHT-HMS Coll. No. 4677, "Ecuador." Total length of specimen, 337 mm; length of skull, 9.0 mm; width of skull, 5.2 mm.

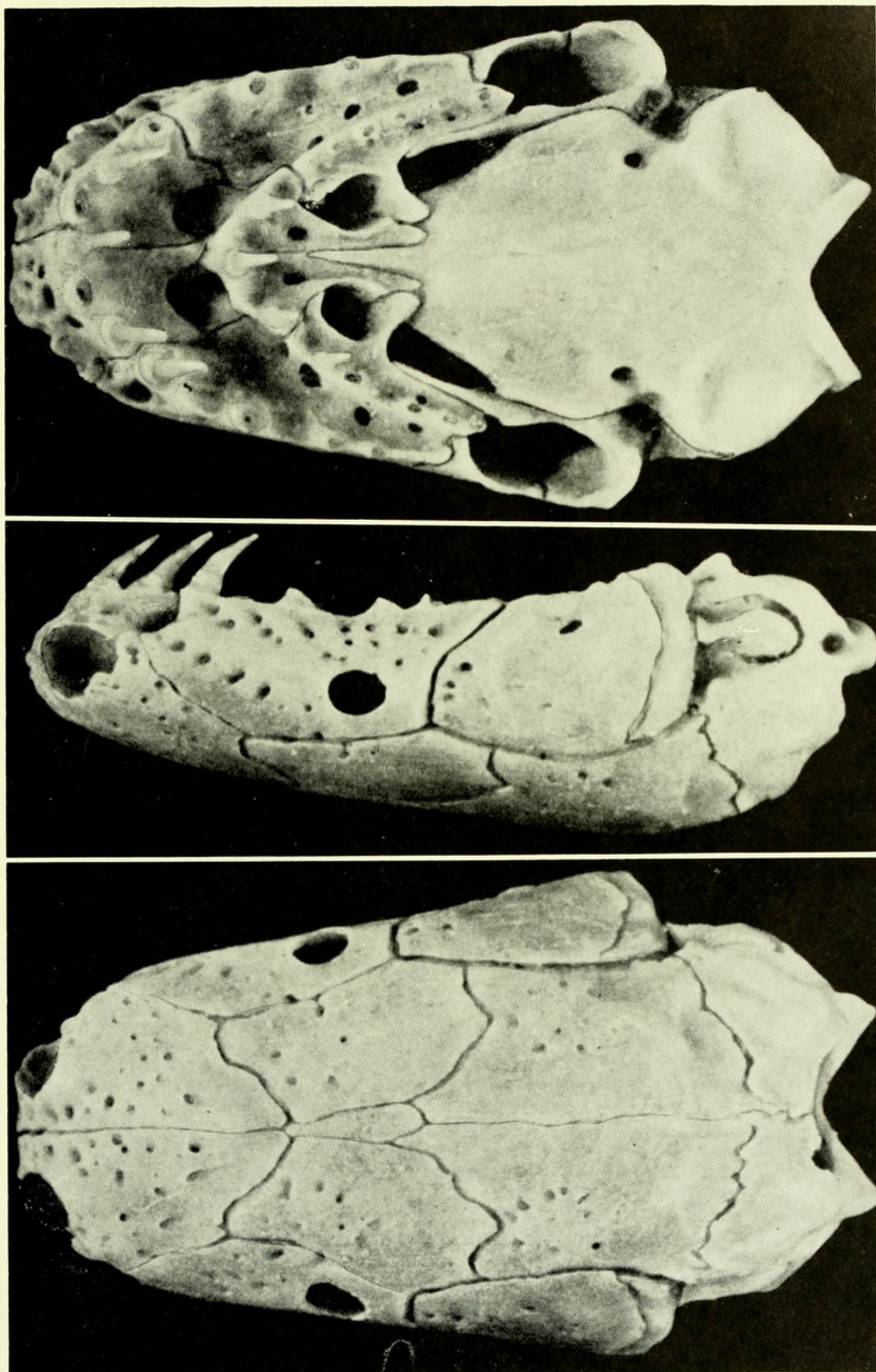


FIG. 23. *Caecilia albiventris* Daudin. AMNH No. 49960, "Bogota!" Colombia. Total length of specimen, 278 mm; length of skull, 10.3 mm; width of skull, 5.9 mm.

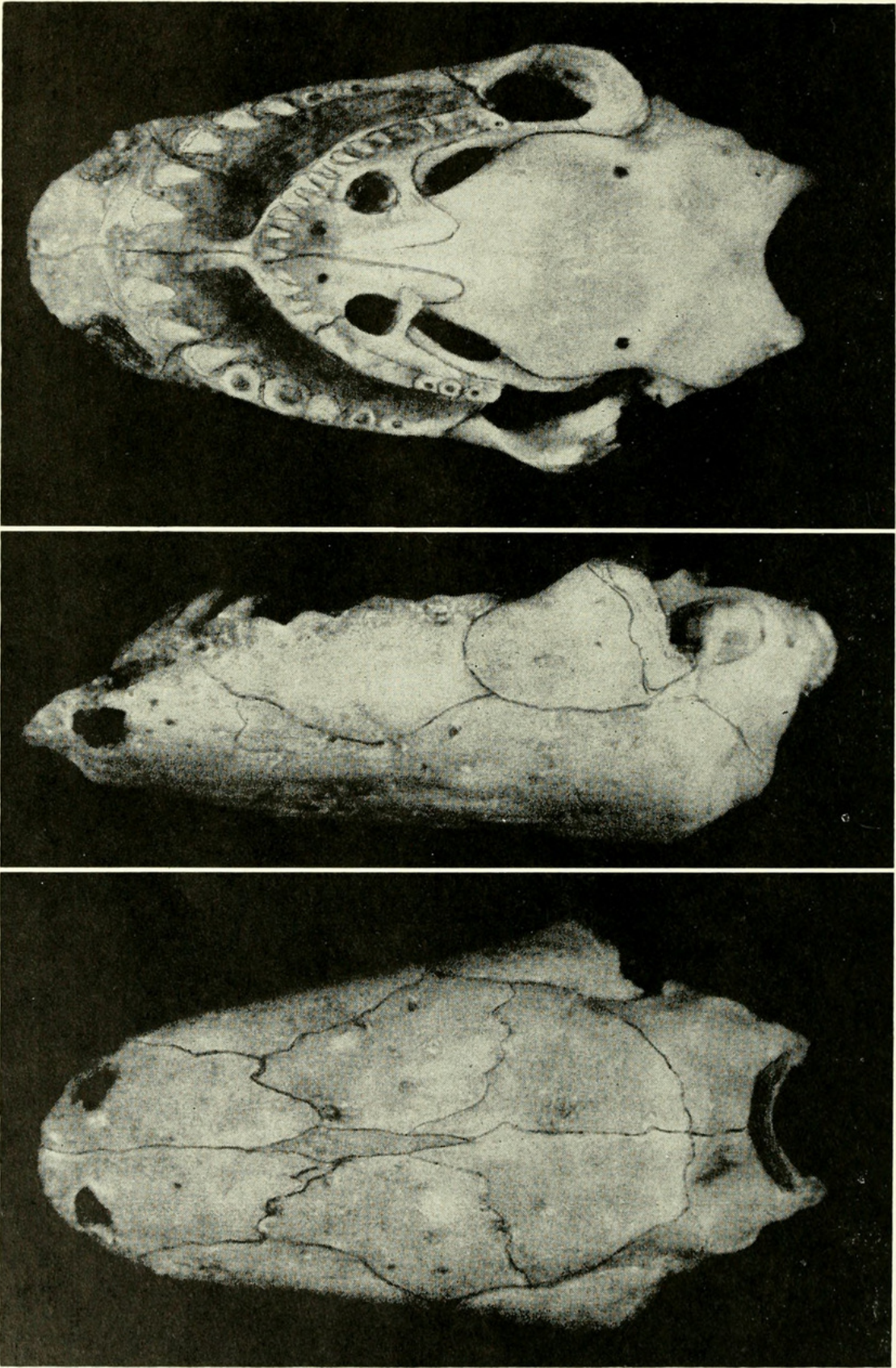


FIG. 24. *Oscacilia ochrocephala* (Cope). MCZ No. 14817, Ancón, Canal Zone, Panamá. Total length of specimen, $542 \pm$ mm; length of skull, 12.1 mm; width of skull, 6.6 mm.

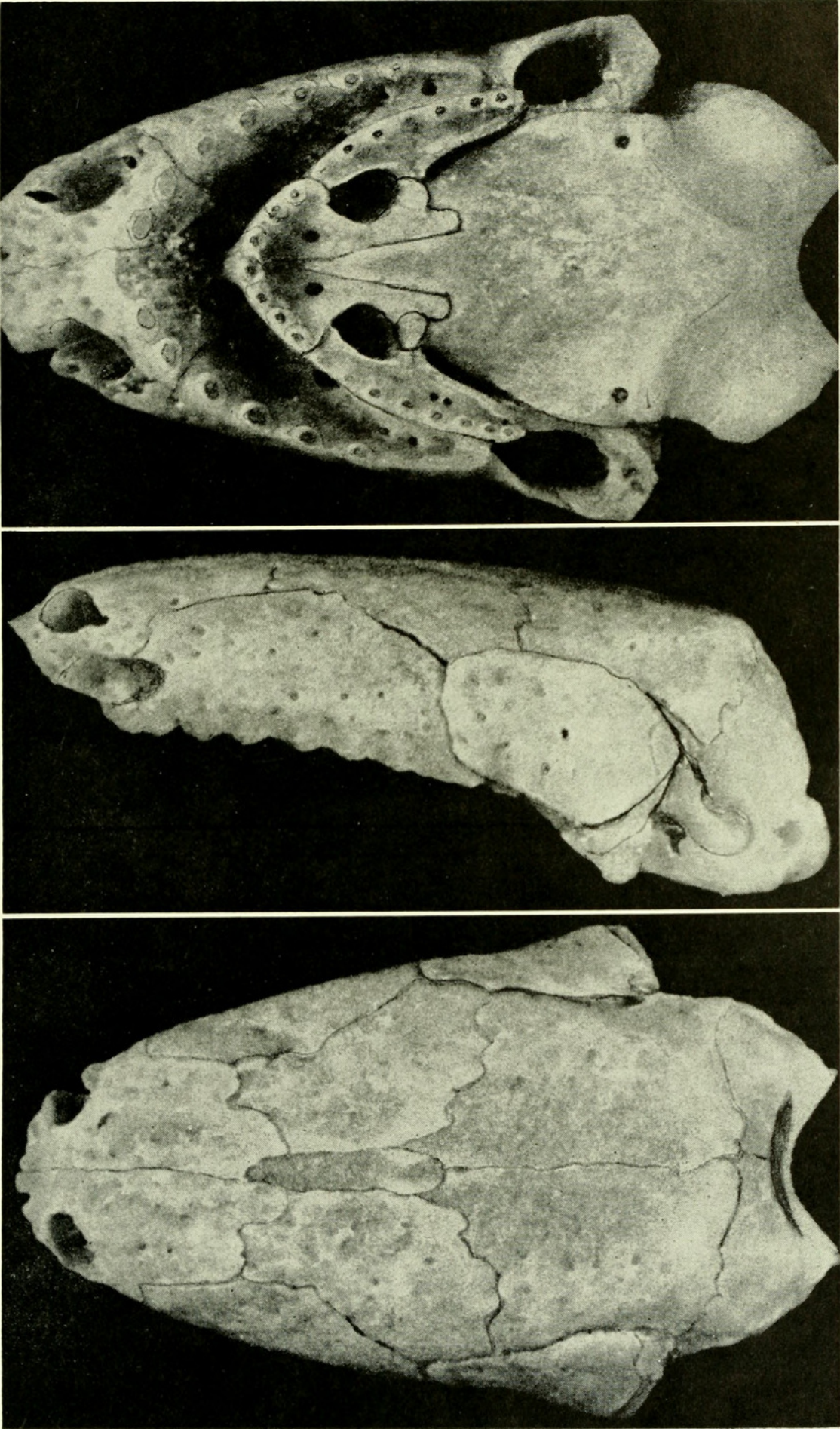


FIG. 25. *Osaecilia ochrocephala* (Cope). UIM No. 41092, Gatun, Canal Zone, Panamá. Length of skull, 8.9 mm; width of skull, 5.2 mm.

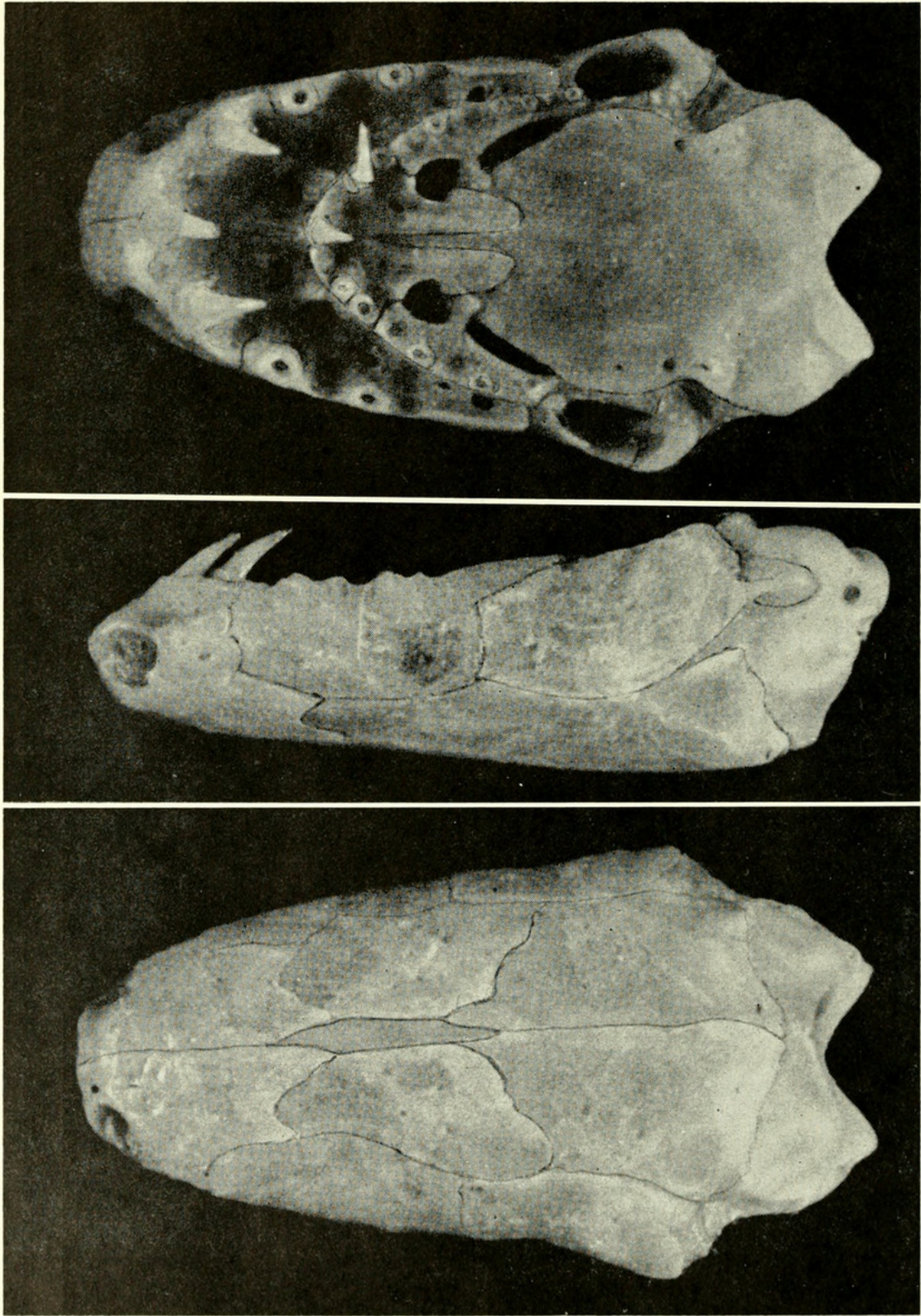


FIG. 26. *Osaecilia bassleri* (Dunn). EHT-HMS Coll. No. 4675, "Ecuador." Total length of specimen, $890 \pm$ mm; length of skull, 9.0 mm; width of skull, 4.8 mm.

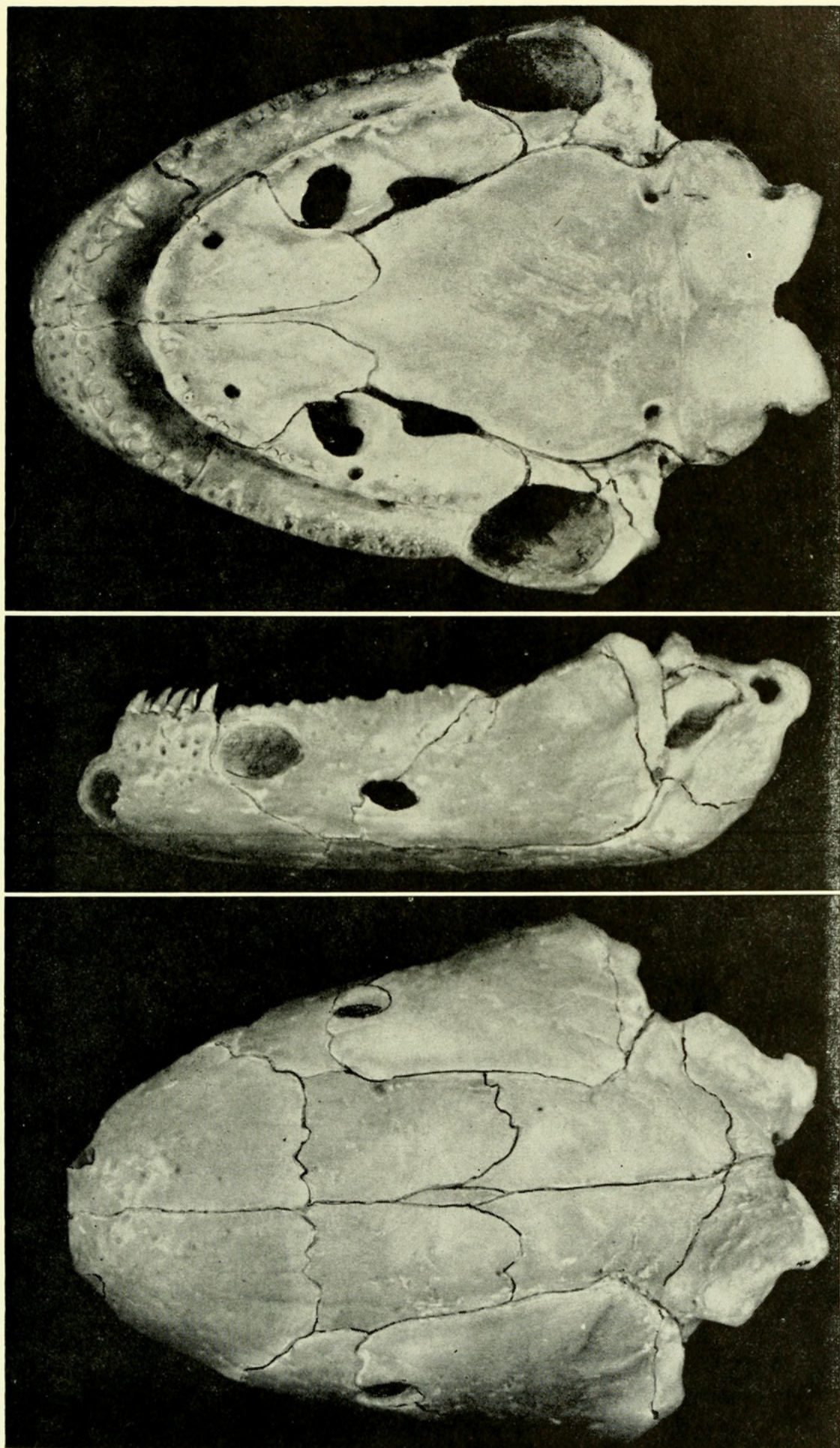


FIG. 27. *Dermophis eburatus* Taylor. MCZ No. 12121, Guatemala, C.A. Total length of specimen, 419 mm; length of skull, 20.0 mm; width of skull, 14.5 mm.

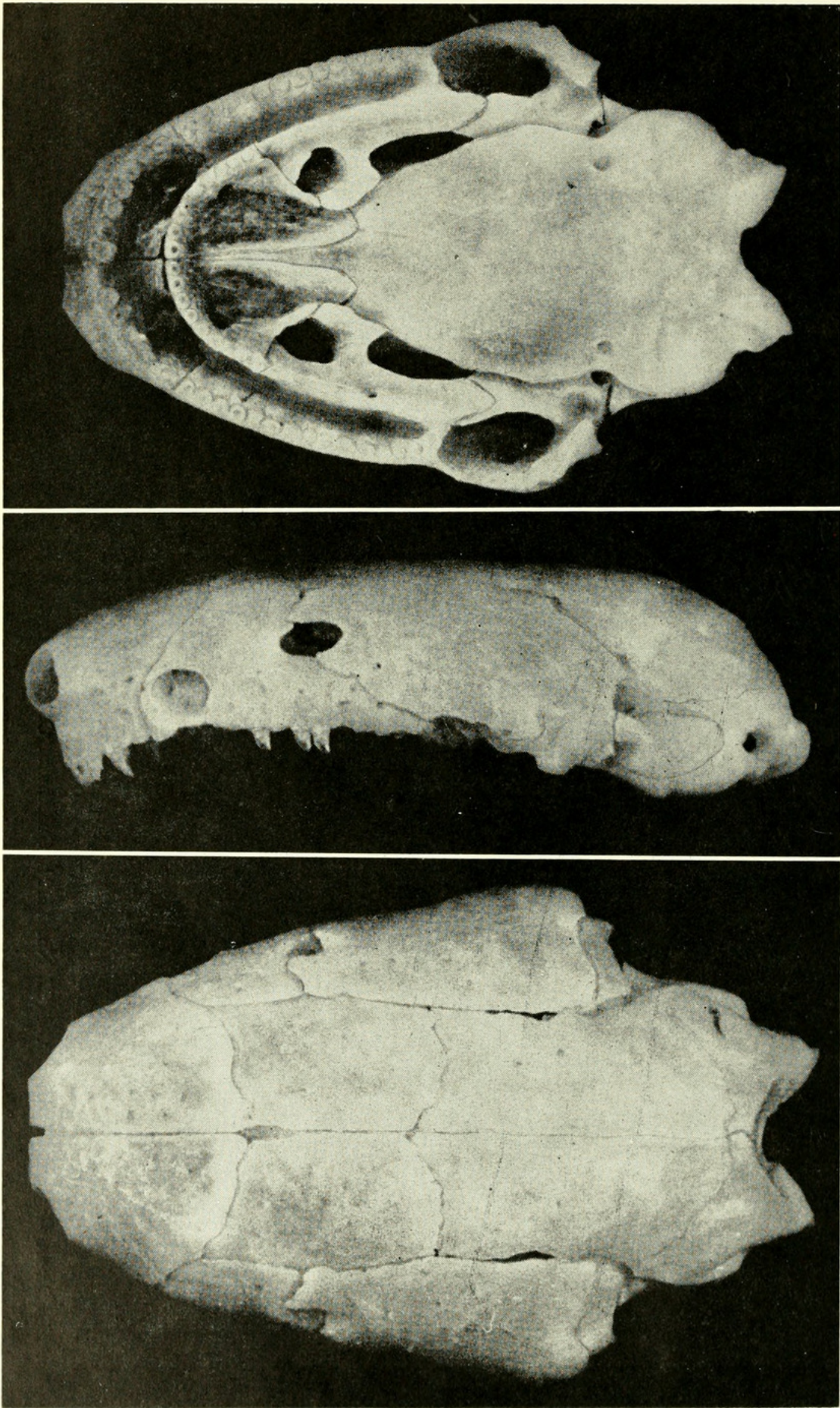


FIG. 28. *Dermophis costaricensis* Taylor. KUMNH No. 66805, Moravia, Cartago Prov., Costa Rica. Total length of specimen, 344 mm; length of skull, 13.5 mm; width of skull, 8.5 mm.

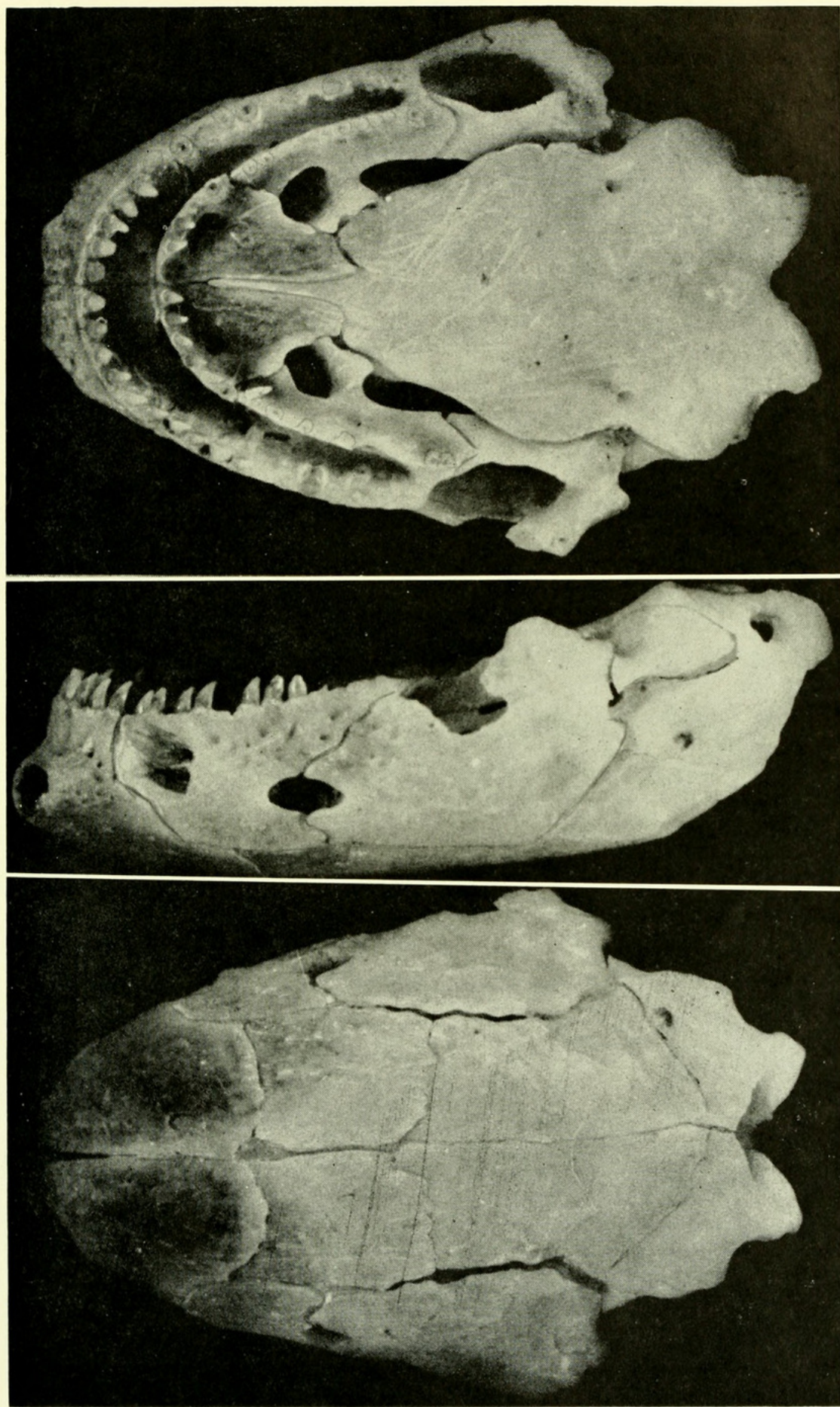


FIG. 29. *Dermophis balboai* Taylor. KUMNH No. 108935, Darién, Panamá. Total length of specimen, 356 mm; length of skull, 14.05 mm; width of skull, 9.5 mm.

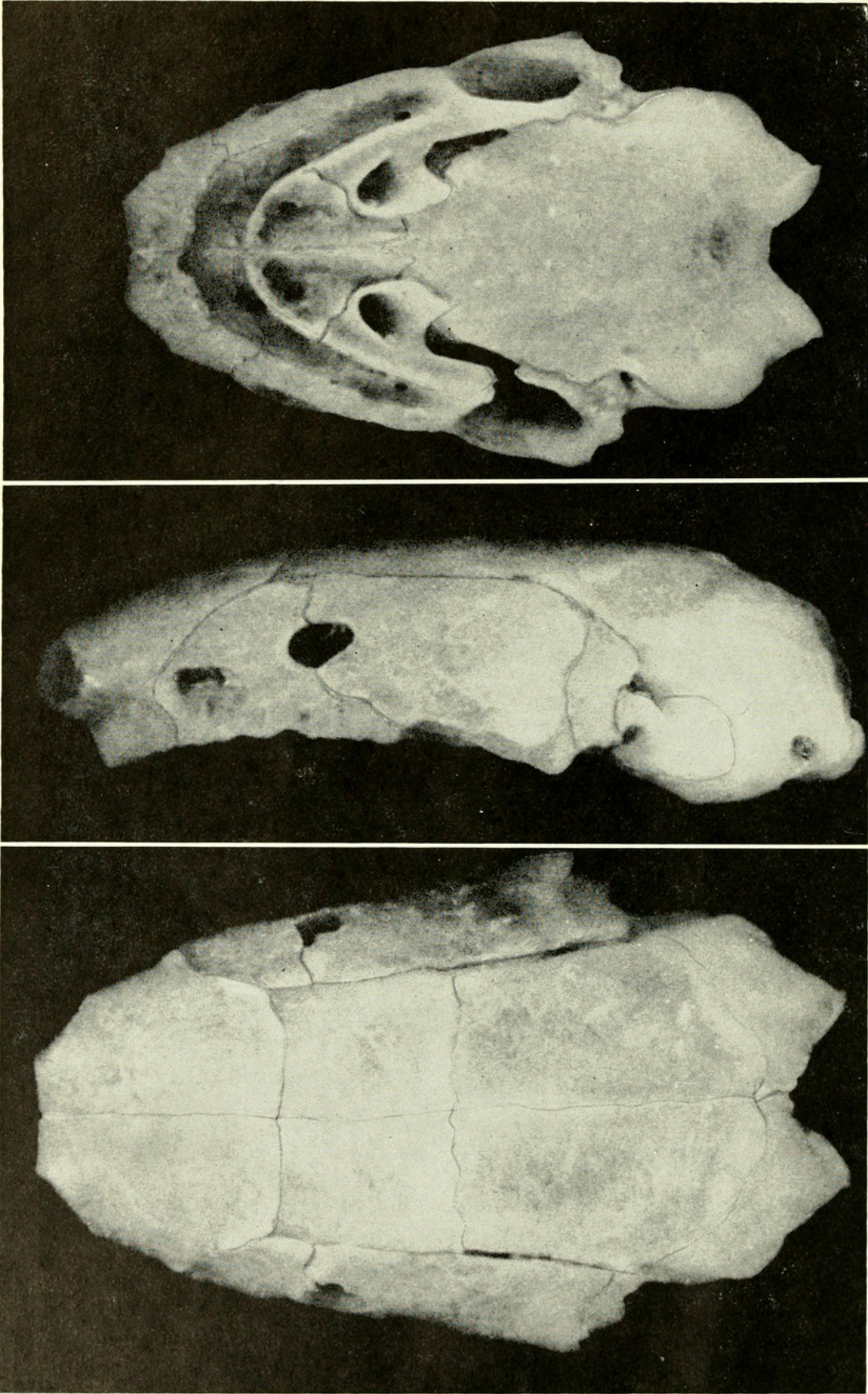


FIG. 30. *Dermophis parviceps* (Dunn). KUMNH No. 36276, Cartago, Costa Rica. Total length of specimen, 193 mm; length of skull, 8.2 mm; width of skull, 5.0 mm.

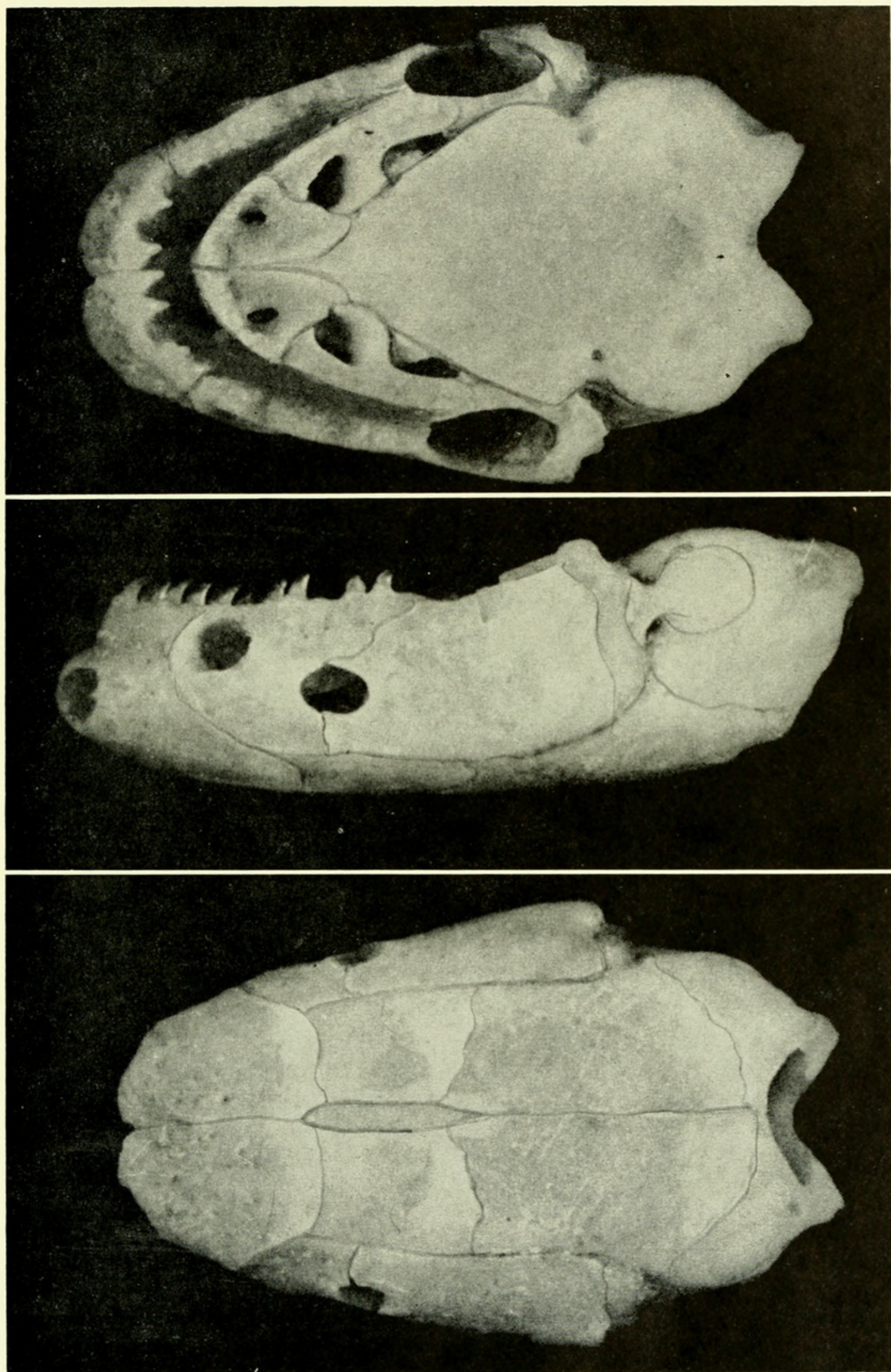


FIG. 31. *Dermophis glandulosus* Taylor. KUMNH No. 56070, San Isidro del General, San José Prov., Costa Rica. Total length of specimen, 180 mm; length of skull, 8.85 mm; width of skull, 6.4 mm.

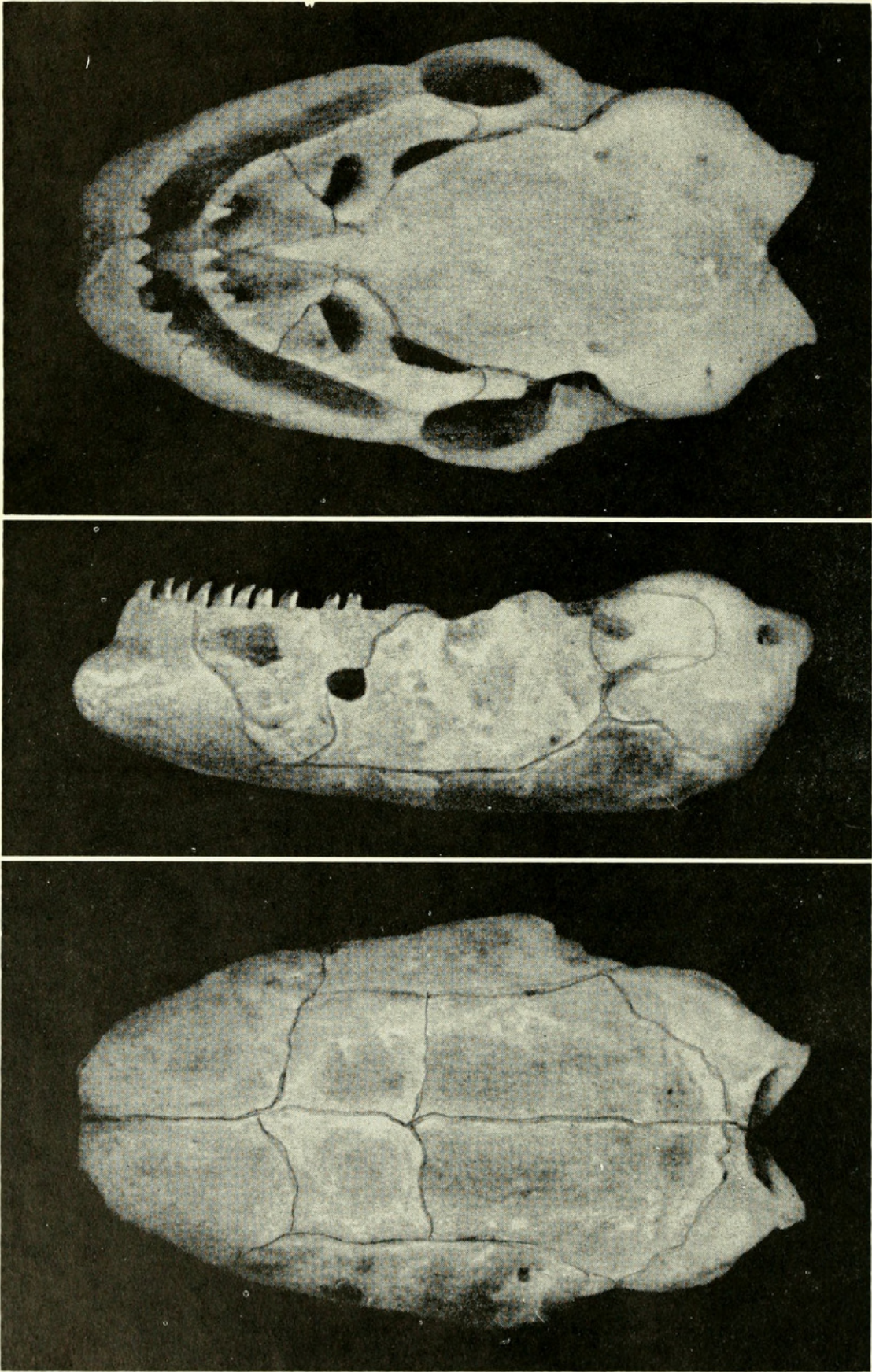


FIG. 32. *Dermophis occidentalis* Taylor. KUMNH No. 36296, "between San Isidro del General and Dominical." Total length of specimen, 194 mm; length of skull, 6.75 mm; width of skull, 4.0 mm.

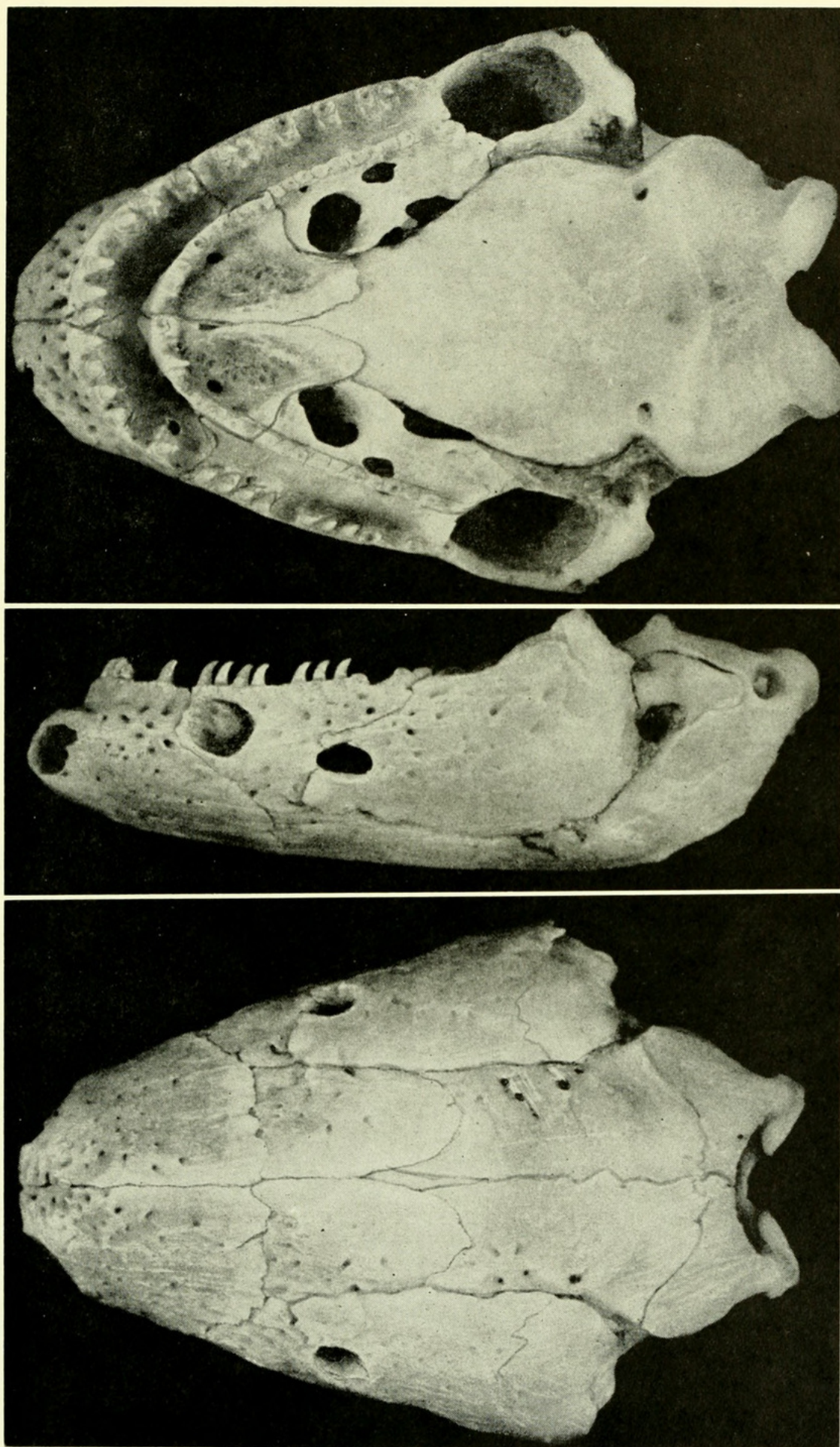


FIG. 33. *Dermophis mexicanus mexicanus* (Duméril and Eibron). UIM No. 66889, Chiapas, Mexico. Total length of specimen, 402 mm; length of skull, 16.3 mm; width of skull, 10.6 mm.

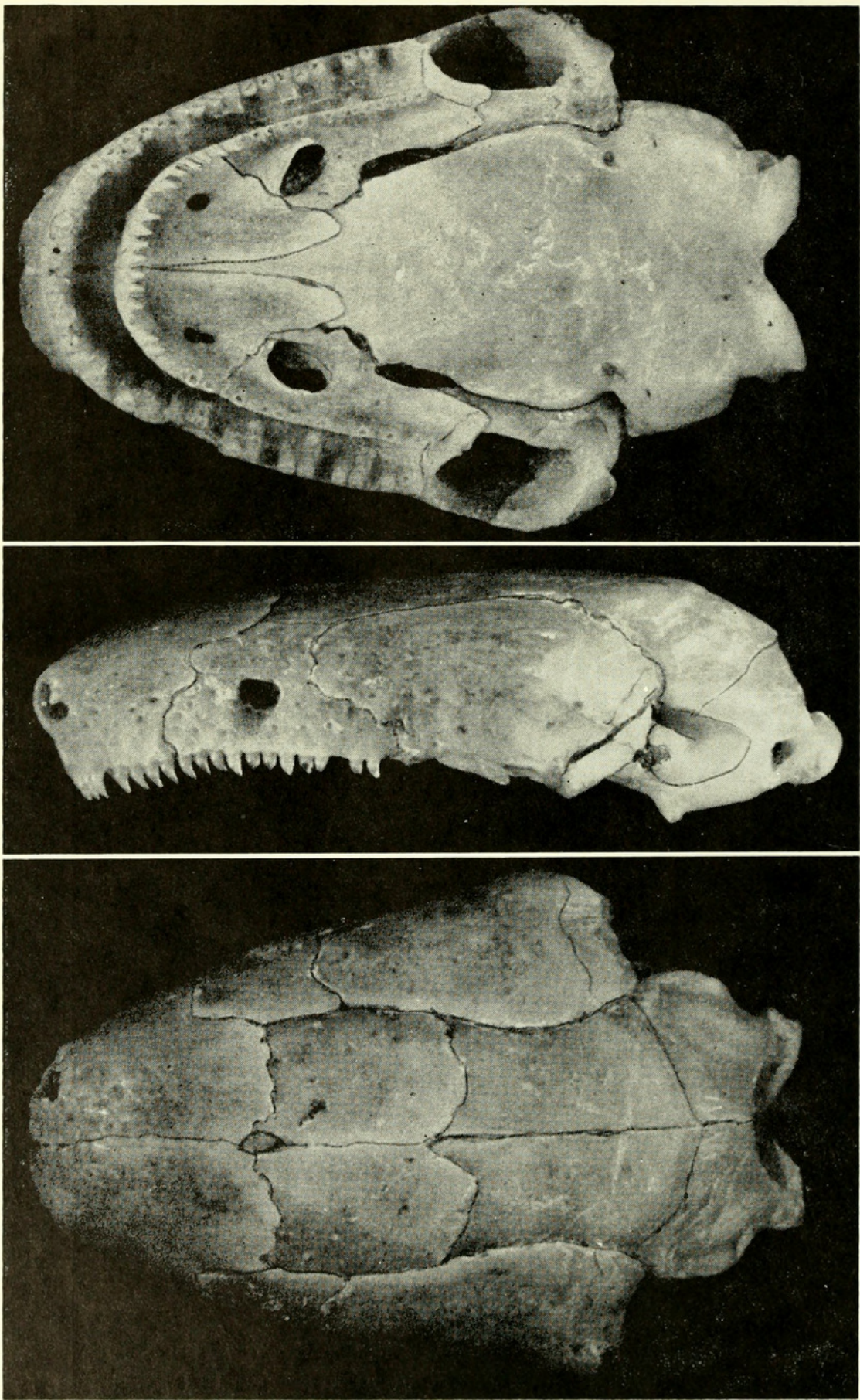


FIG. 34. *Gymnopsis multiplicata* Peters. EHT-HMS Coll. No. 4702, San Bosco (Rancho), Tilarán, Guanacaste, Costa Rica. Total length of specimen, 430 mm; length of skull, 16.0 mm; width of skull, 10.8 mm.

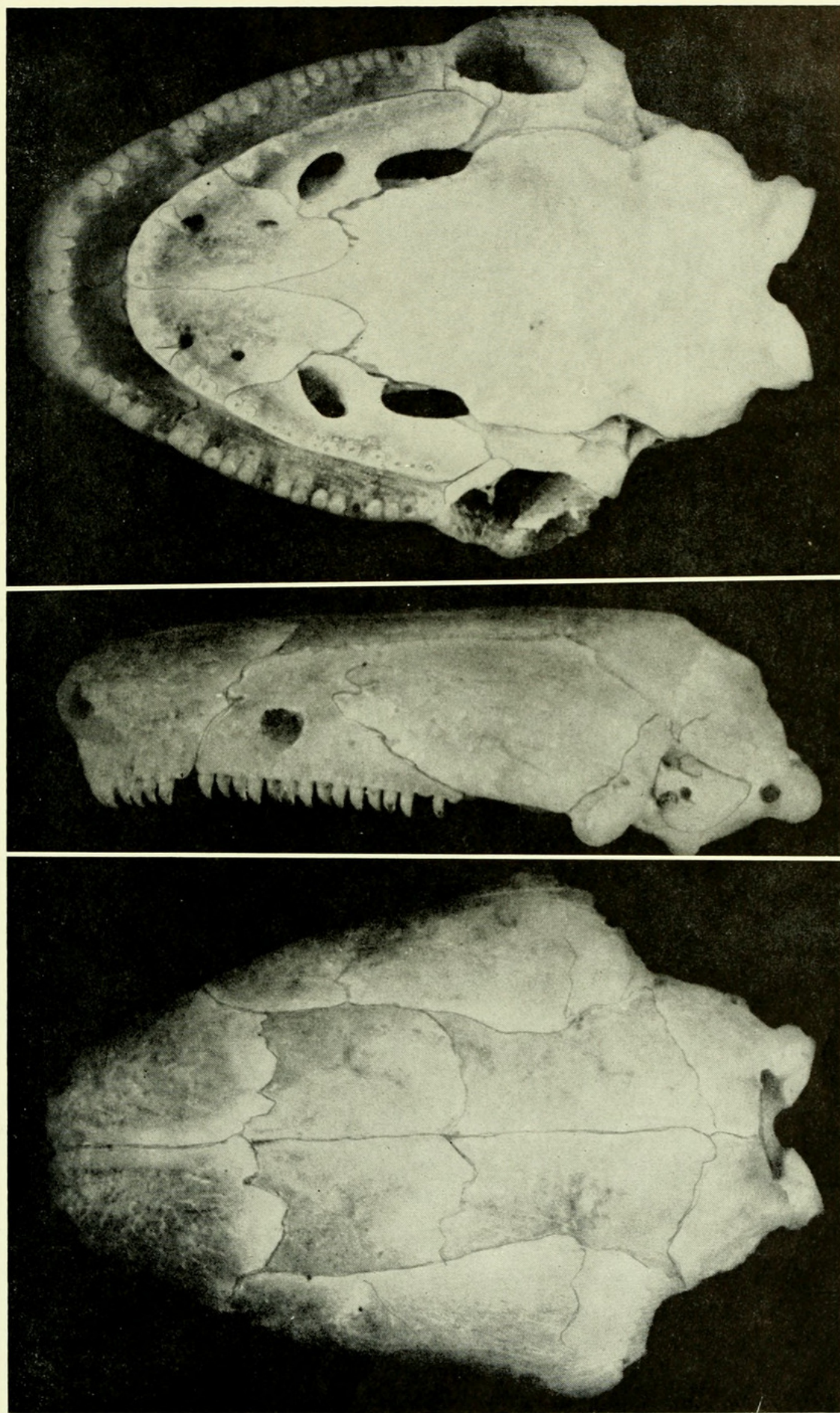


FIG. 35. *Gymnopsis proxima* (Cope). EHT-HMS Coll. No. 4712, Dominica (Rancho), Turrialba, Cartago, Costa Rica. Total length of specimen, 459 mm; length of skull, 16.85 mm; width of skull, 11.6 mm.

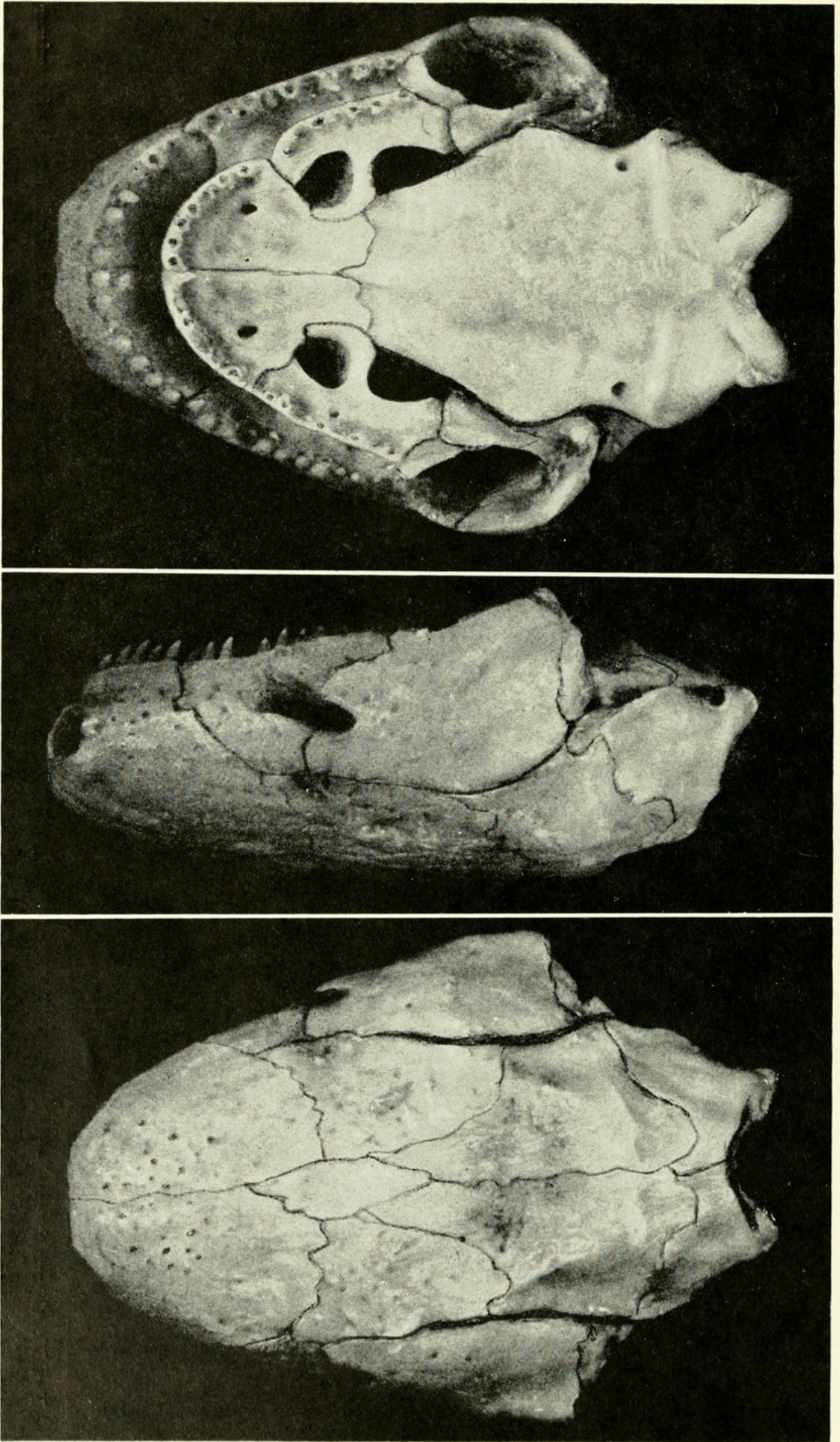


FIG. 36. *Siphonops annulatus* (Mikan). MCZ No. 19407, "Pastaza River to Marañon," Ecuador. Total length of specimen, 356 mm; length of skull, 15.4 mm; width of skull, 11.0 mm.

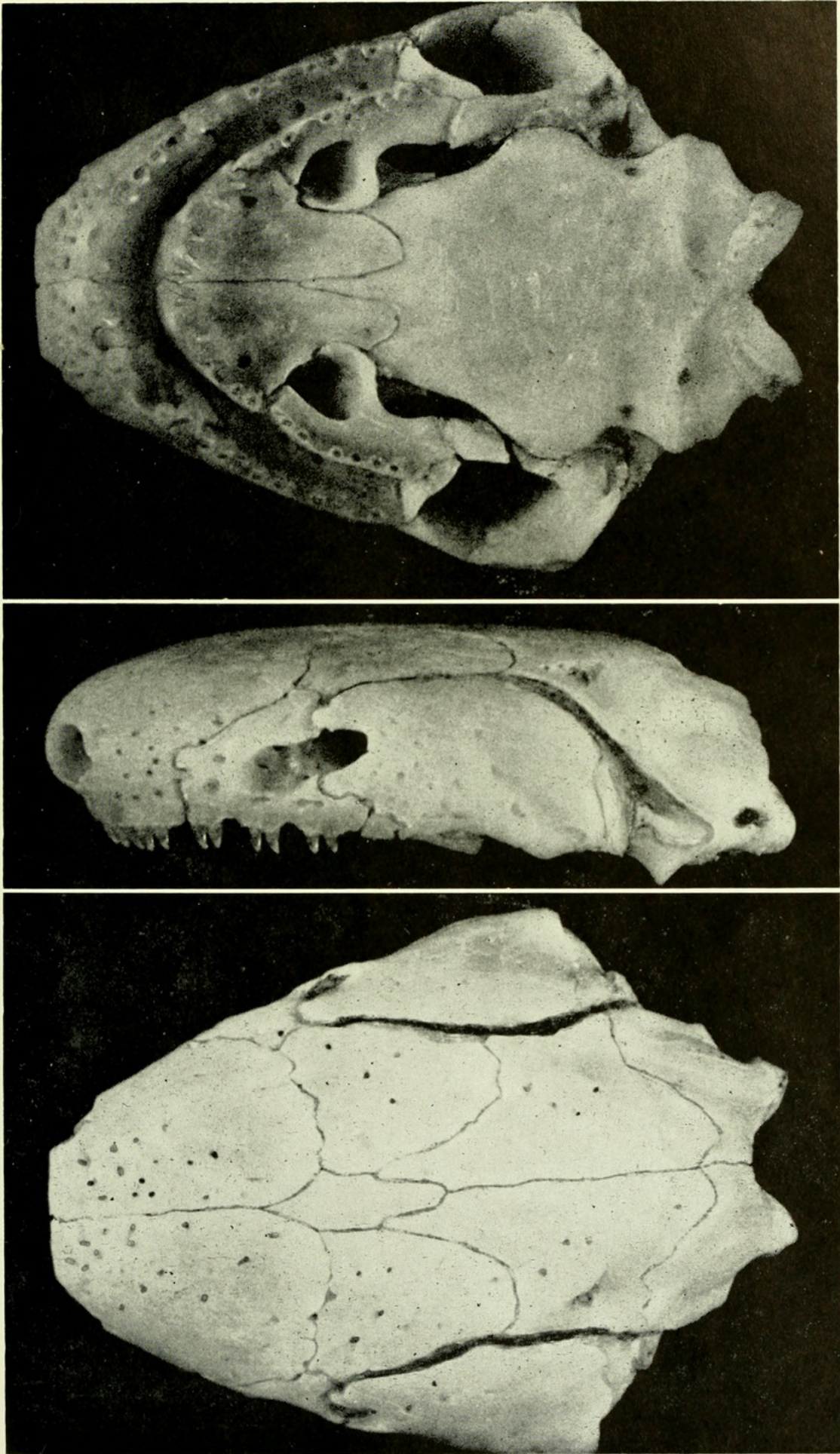


FIG. 37. *Siphonops annulatus* (Mikan). UIM No. 56668, Limón Cocha, Ecuador. Total length of specimen, 397 mm; length of skull, 15.4 mm; width of skull 11.2 mm.

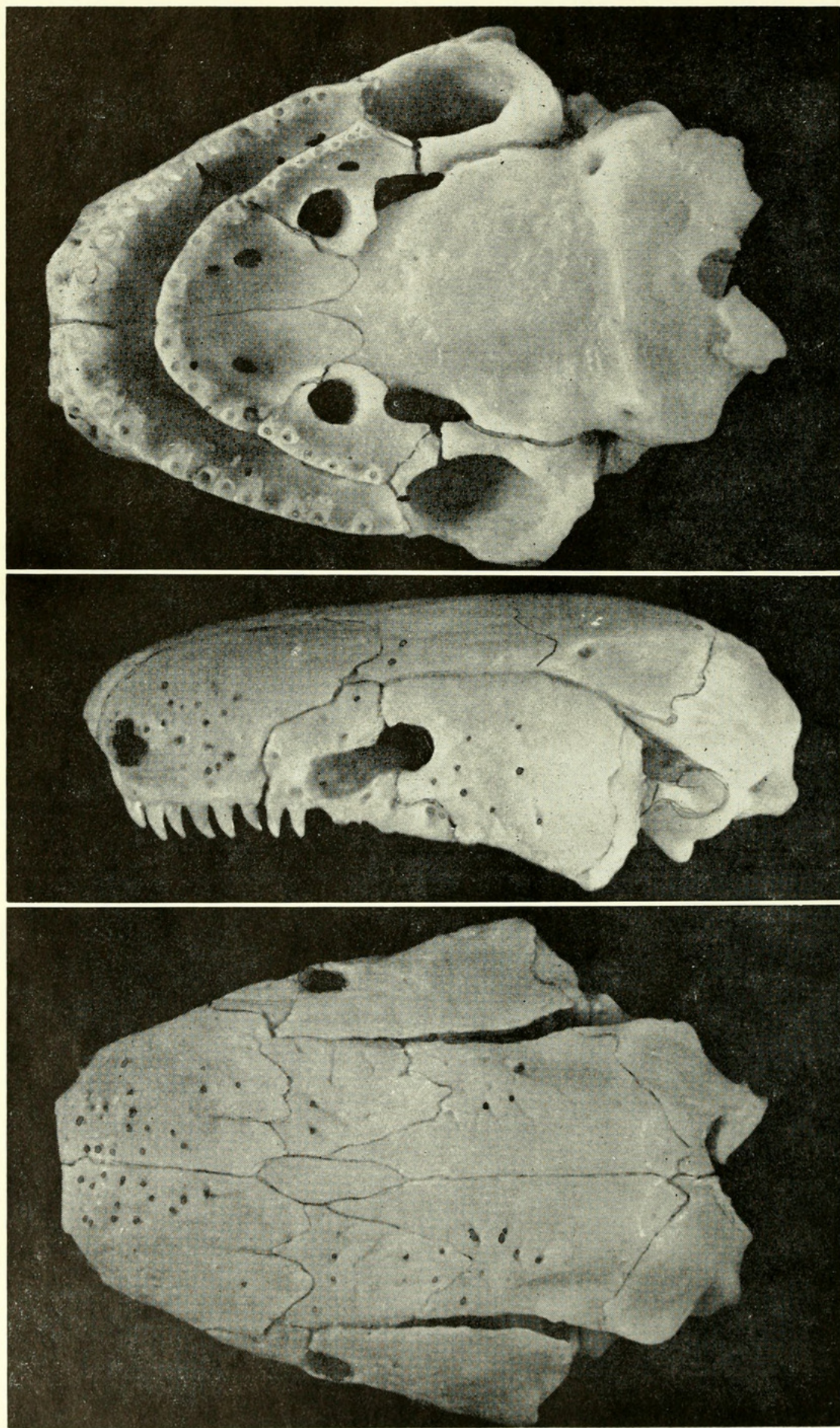


FIG. 38. *Siphonops annulatus* (Mikan). EHT-HMS Coll. No. 1848, Tercsopolis, Guanabara, Brasil. Length of skull, 13.0 mm; width of skull, 9.4 mm.

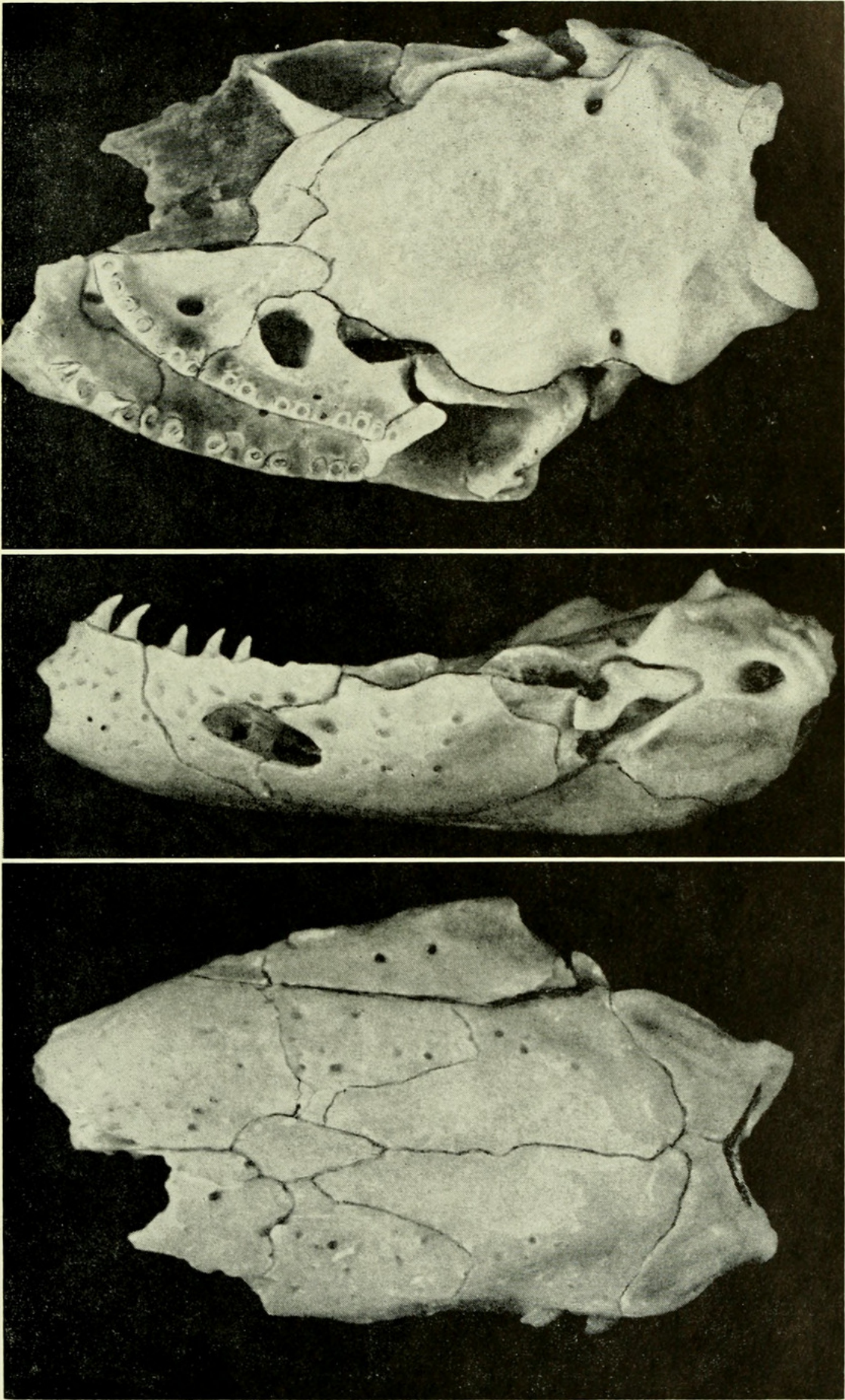


FIG. 39. *Siphonops paulensis* Boettger. AMNH No. 23433, "Brasil." Total length of specimen, 453 mm; length of skull, 13.7 mm; width of skull, 9.55 mm. (Left side of skull badly broken.)

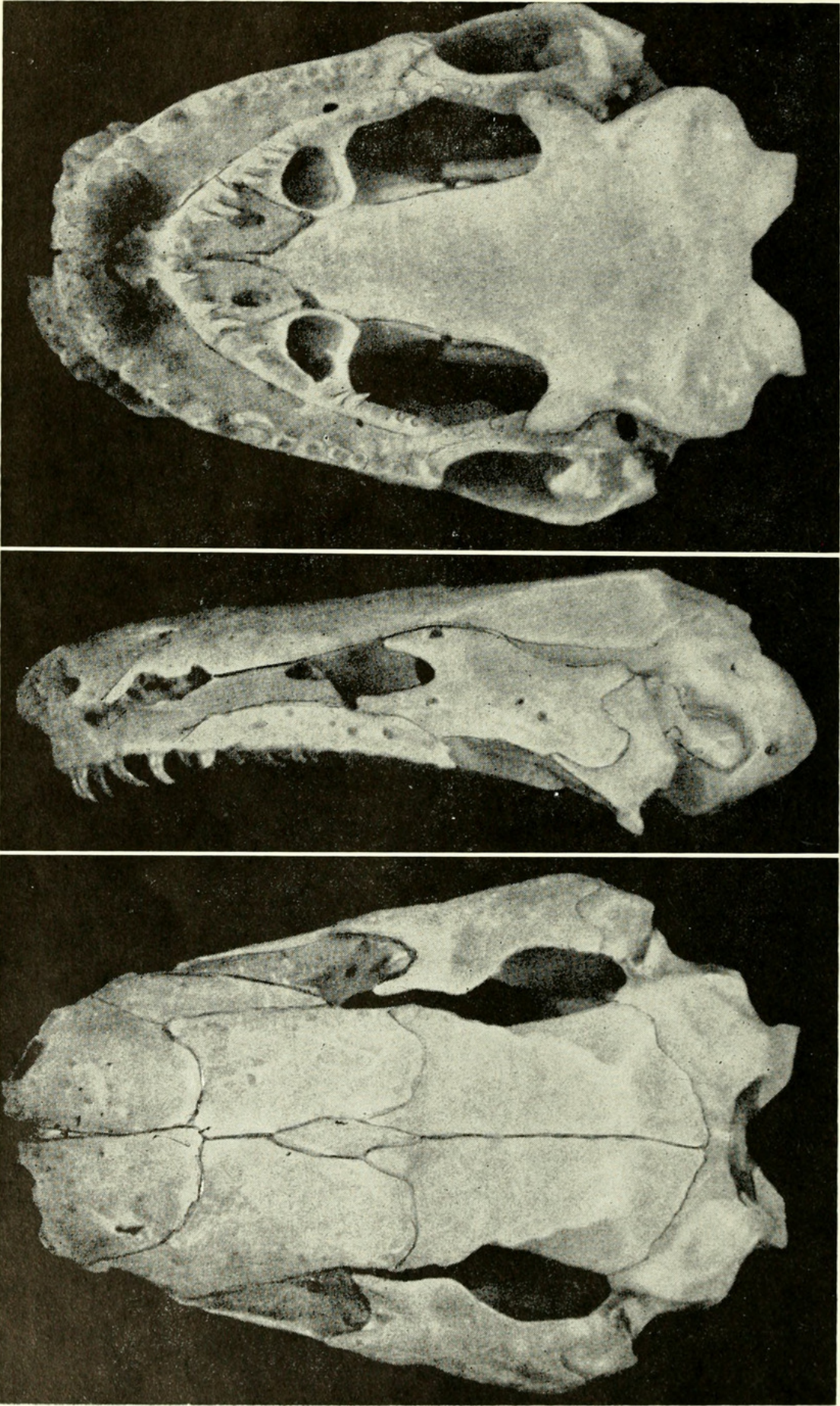


FIG. 40. *Geotrypetes seraphini seraphini* A. Duméril. MCZ No. 3424, Metet, Cameroons. Total length of specimen, 288 mm; length of skull, 9.0 mm; width of skull, 6.0 mm.

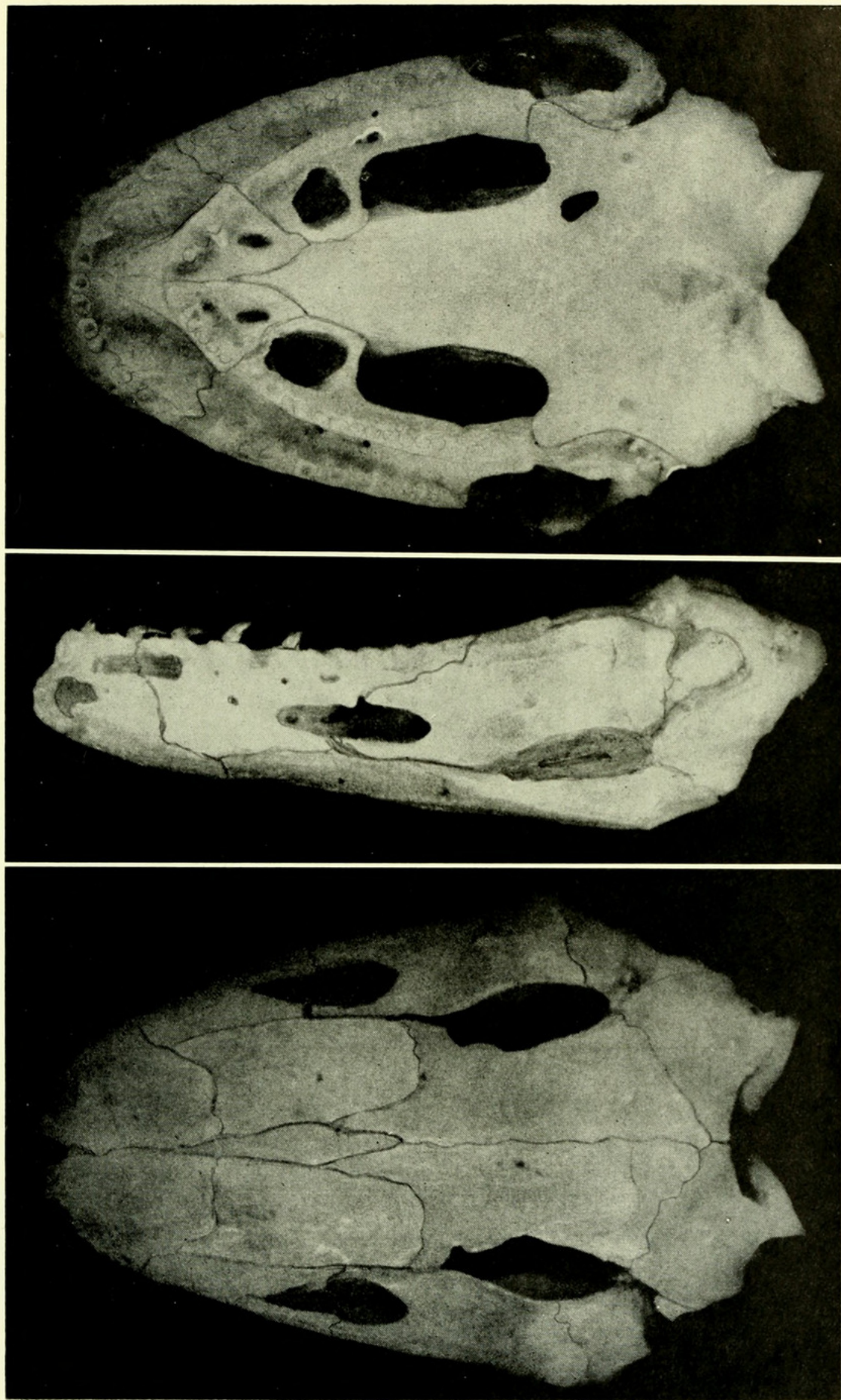


FIG. 41. *Geotrypetes seraphini occidentalis* Parker. EHT-HMS Coll. No. 4653, Tafo, Ghana, Africa. Total length of specimen, 354 mm; length of skull, 11.3 mm; width of skull, 7.7 mm.

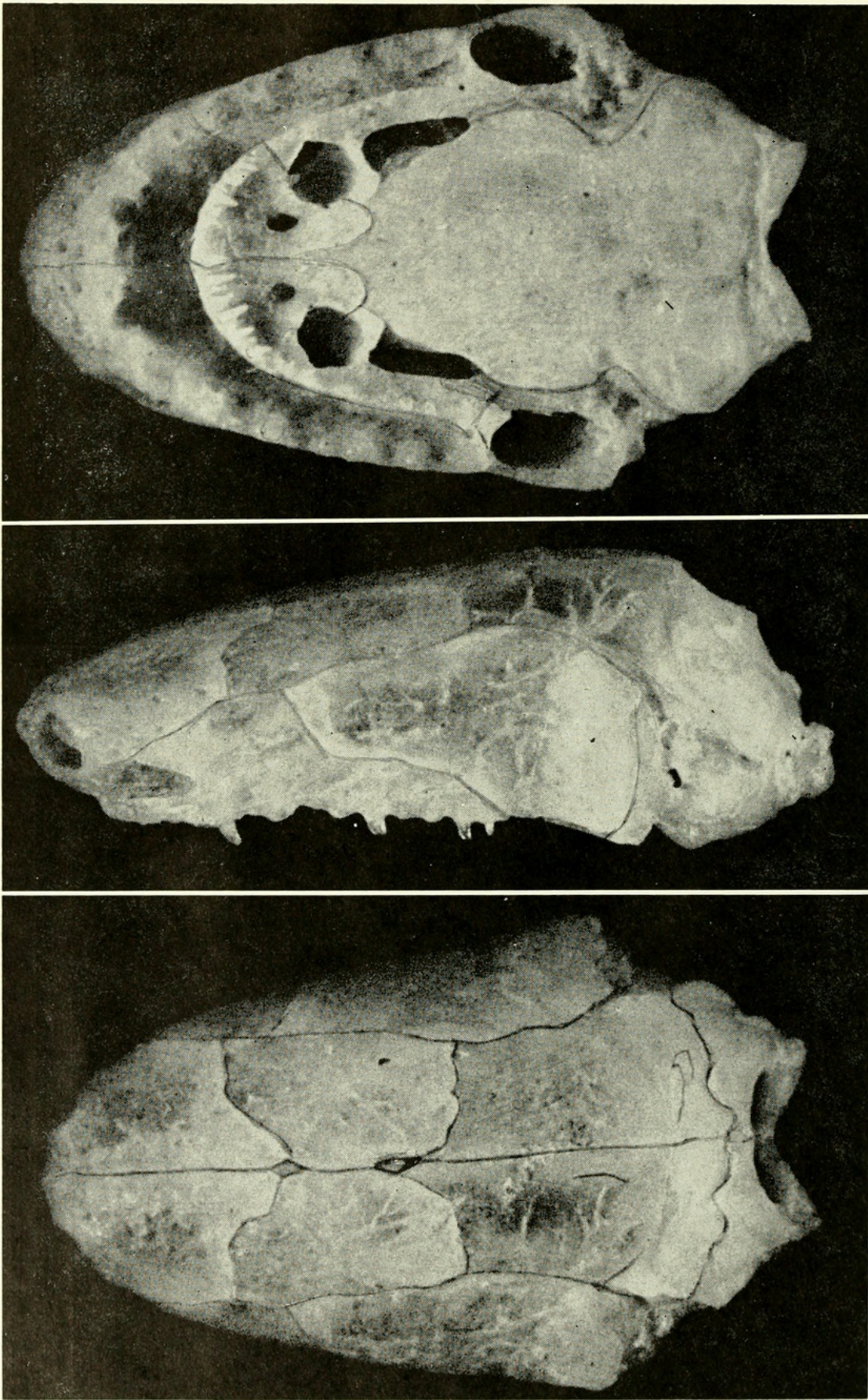


FIG. 42. *Herpele squalostoma* (Stutchbury). EHT-HMS Coll. No. 3412, Metet, Cameroons. Total length of specimen, 360 mm; length of skull, 10.7 mm; width of skull, 6.45 mm.

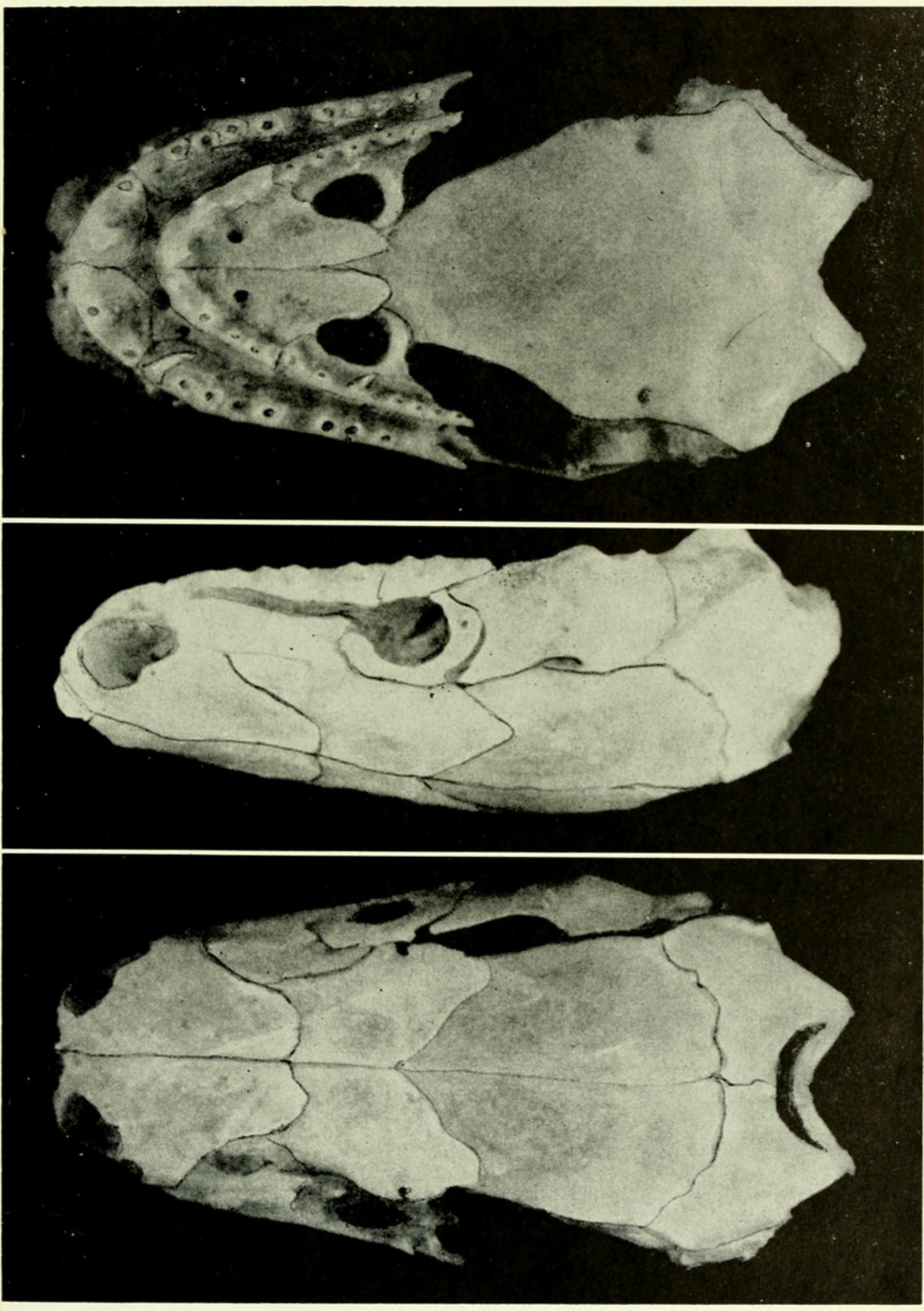


FIG. 43. *Uraeotyphlus oxyurus* (Duméril and Bibron). MCZ No. 9484, Taliparabamba Travancore, India. Length of skull, 7.8 mm; width of skull, 4.3 \pm mm.

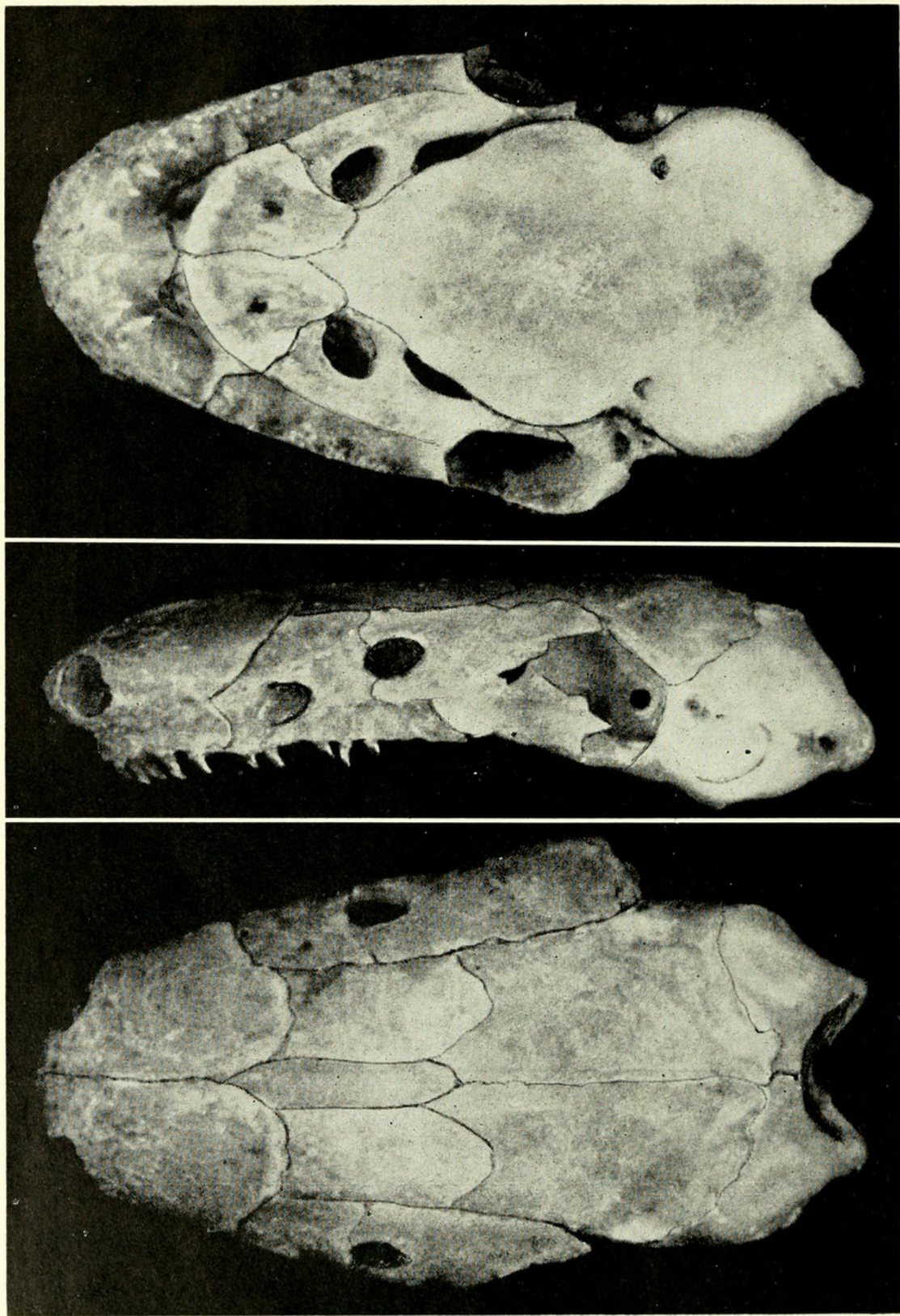


FIG. 44. *Schistometopum gregorii* (Boulenger). MCZ No. 20117, Lake Peccatoni, Kenya. Total length of specimen, 336 mm; length of skull, 10.4 mm; width of skull, 6.3 mm.

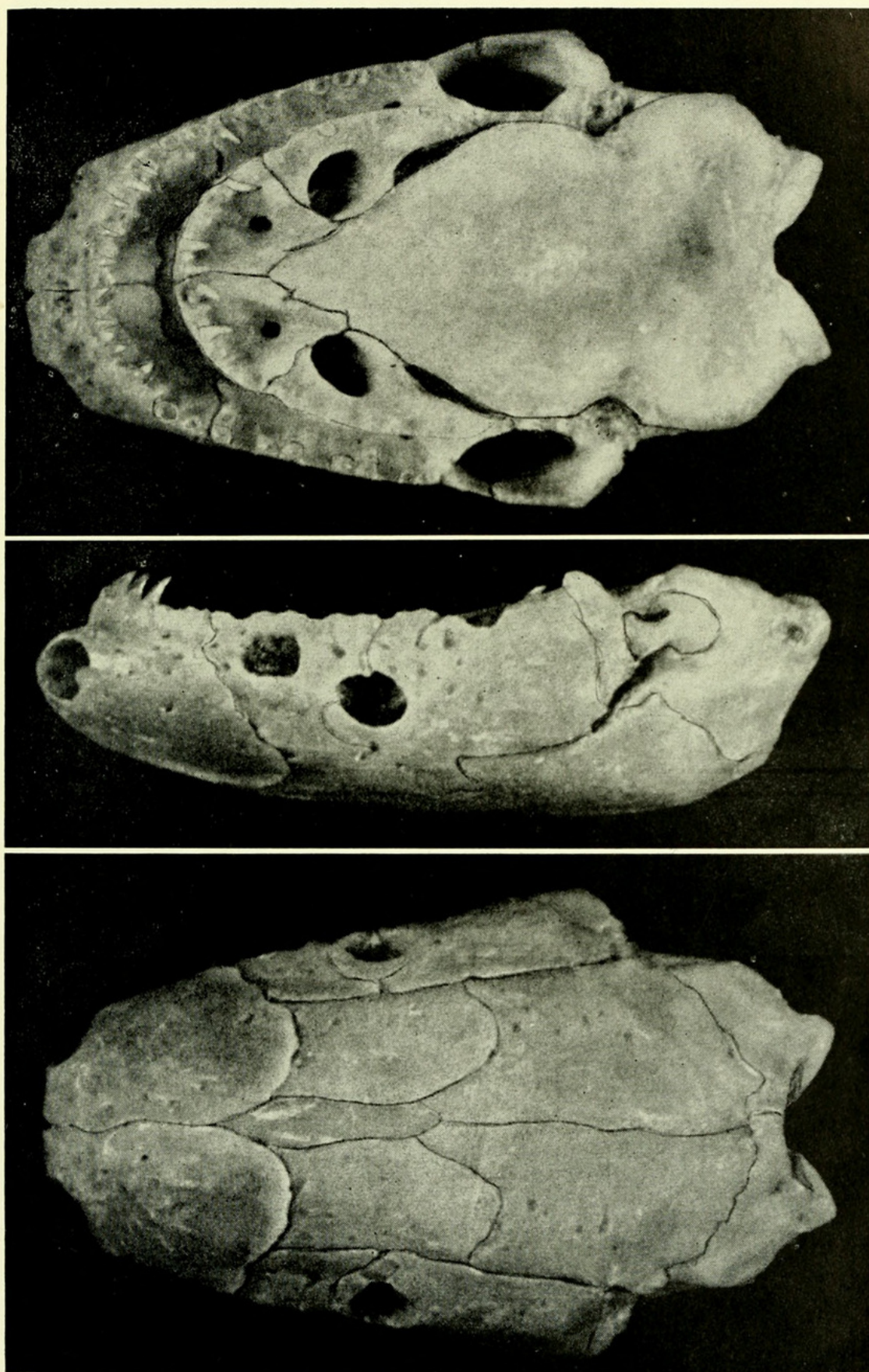


FIG. 45. *Schistometopum gregorii* (Boulenger). MCZ No. 20146, Lake Peccatoni, Kenya. Total length of specimen, 356 mm; length of skull, 10.5 mm; width of skull, 6.7 mm.

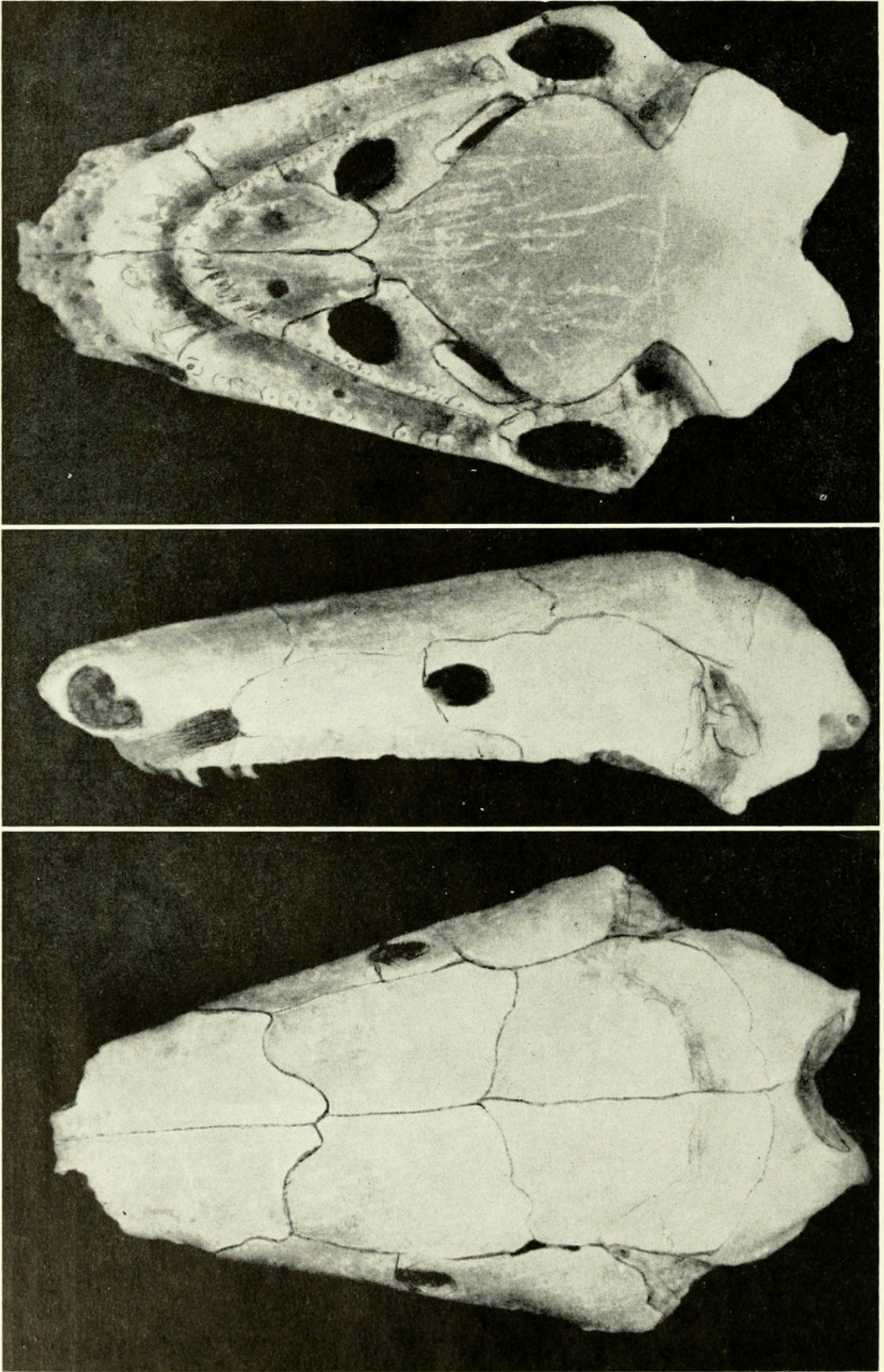


FIG. 46. *Hypogeophis rostratus* (Cuvier). MCZ No. 48935. St. Anne's Island, Mahé Coast, Seychelles Islands. Total length of specimen, 254 mm; length of skull, 8.6 mm; width of skull, 5.0 mm.

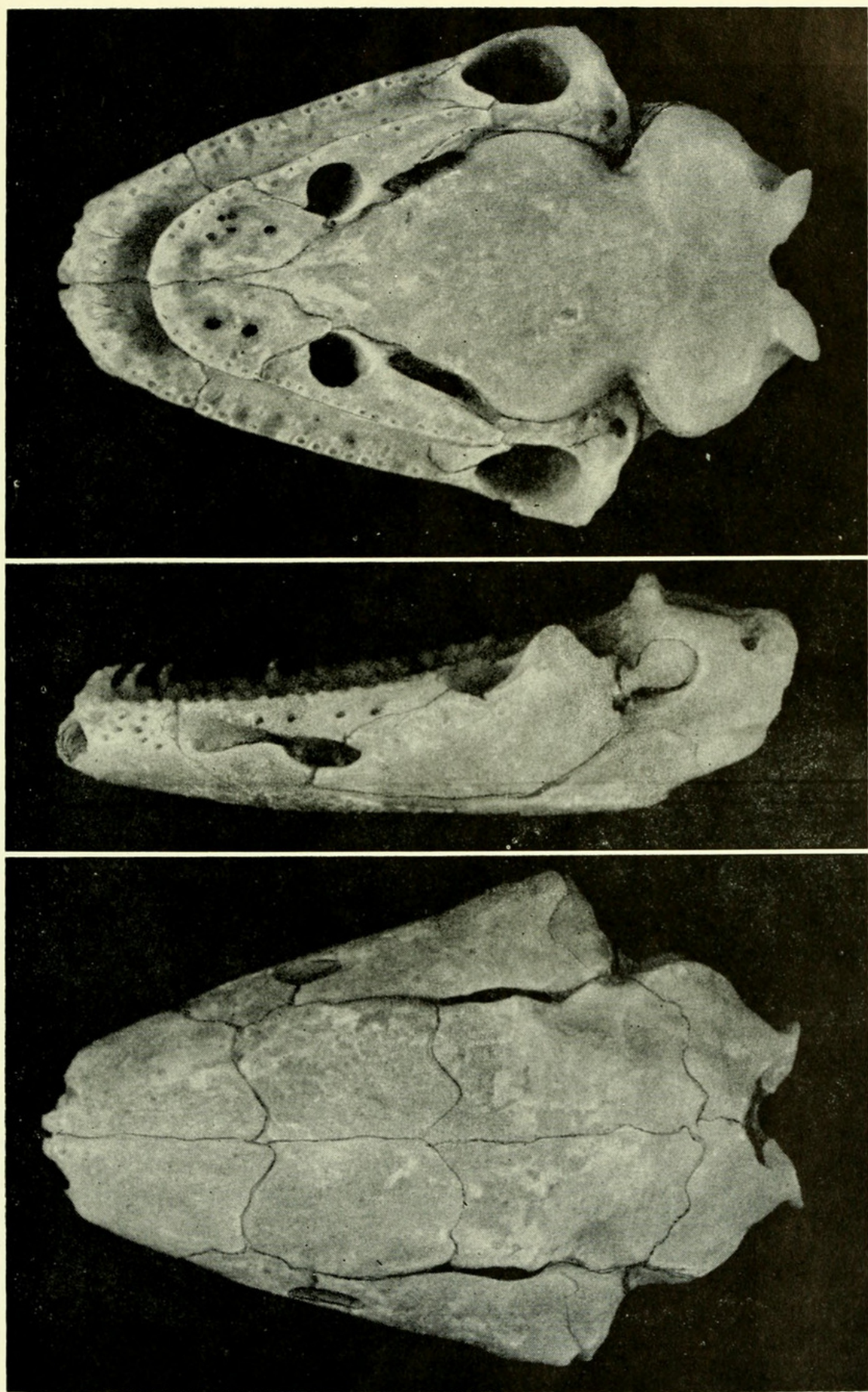


FIG. 47. *Grandisonia alternans* (Stejneger). EHT-HMS Coll. No. 4647, Mahé, Seychelles Islands. Total length of specimen, 216 mm; length of skull, 11.1 mm; width of skull, 7.0 mm.

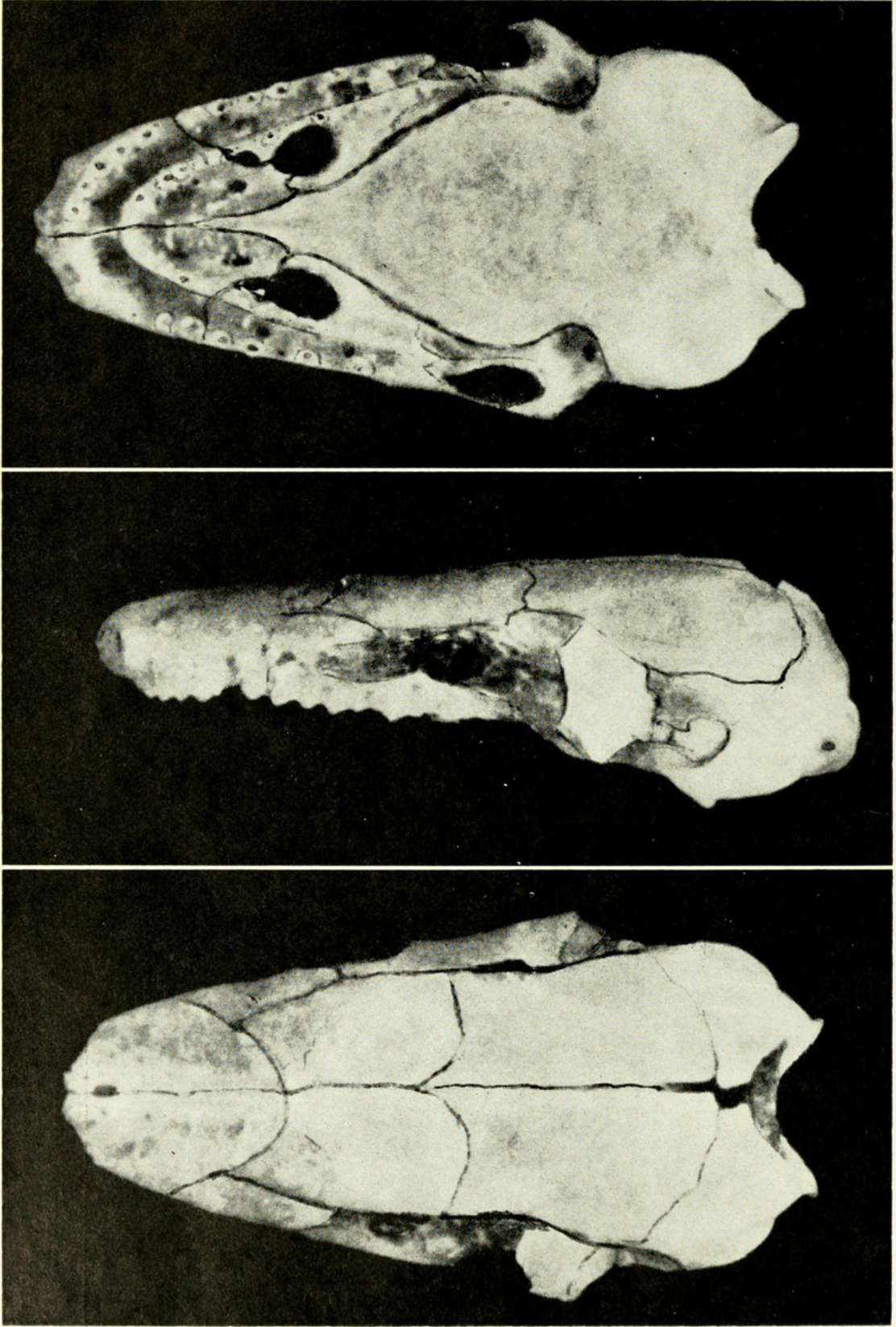


FIG. 48. *Grandisonia sechellensis* (Boulenger). AMNH No. 23673, "Seychelles Islands." Total length of specimen, ? (broken); length of skull, 5.15 mm; width of skull, 2.8 mm.

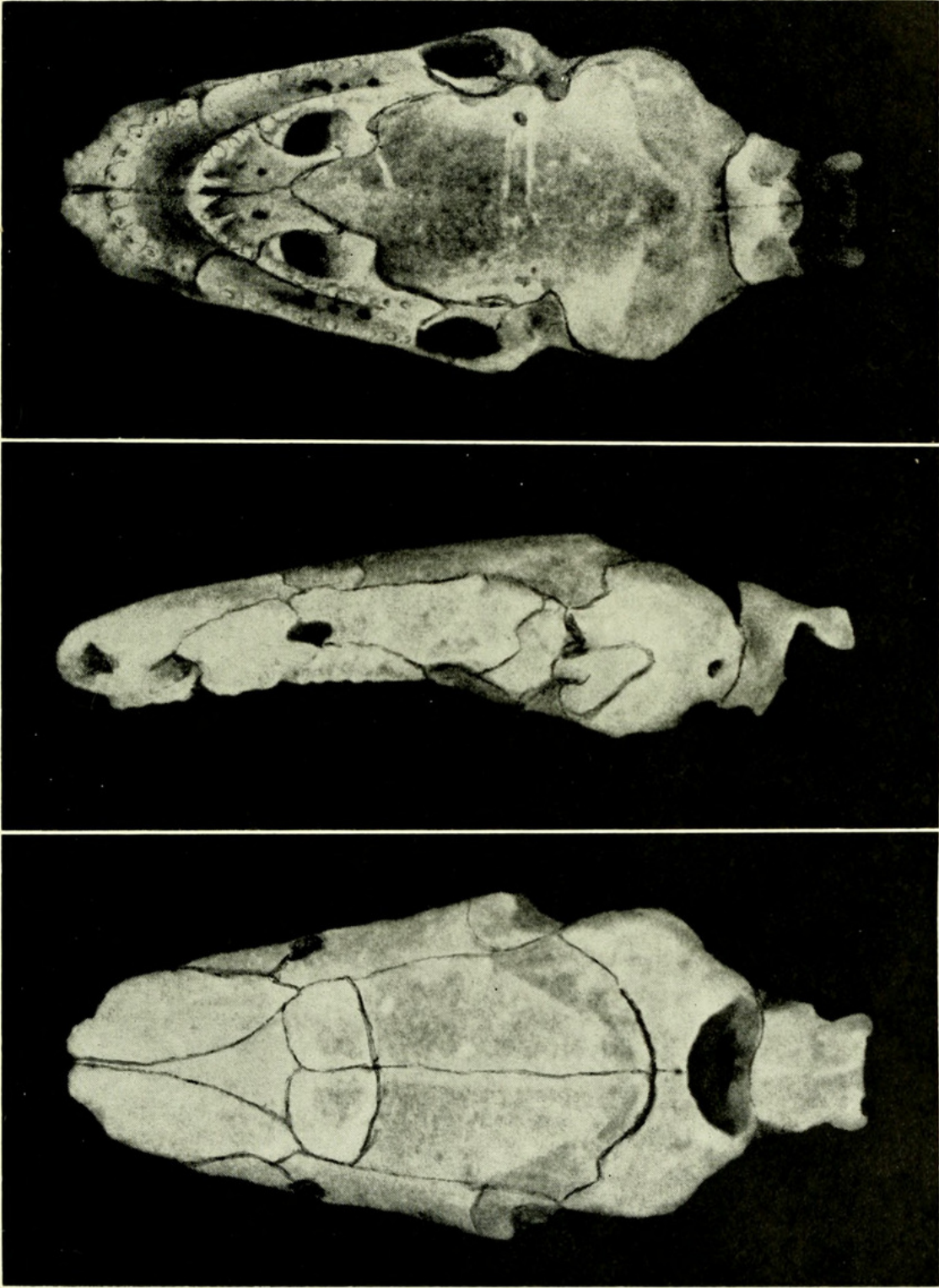


FIG. 49. *Idiocranium russeli* Parker. EHT-HMS Coll., No. 4687. Topotype, Cameroons. Total length of specimen, 102 mm; length of skull, 4.5 mm; width of skull, 2.2 mm.

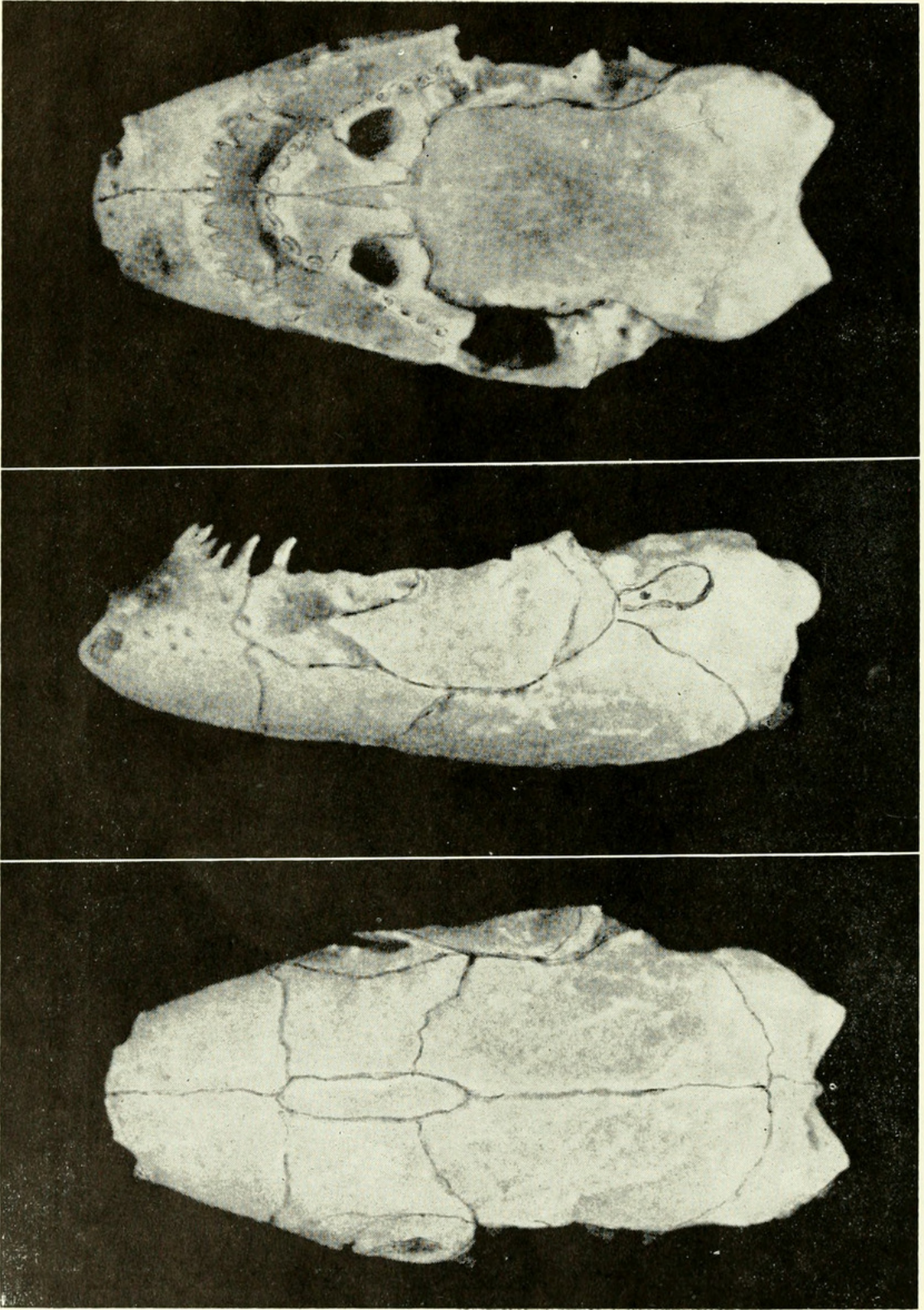


FIG. 50. *Boulengerula boulengeri* Tornier. MCZ No. 12309, Amani, Usumbara Mts., Tanganyika (Tanzania), Africa. Total length of specimen, 178 mm; length of skull, 4.7 mm; width of skull, 2.3 mm.

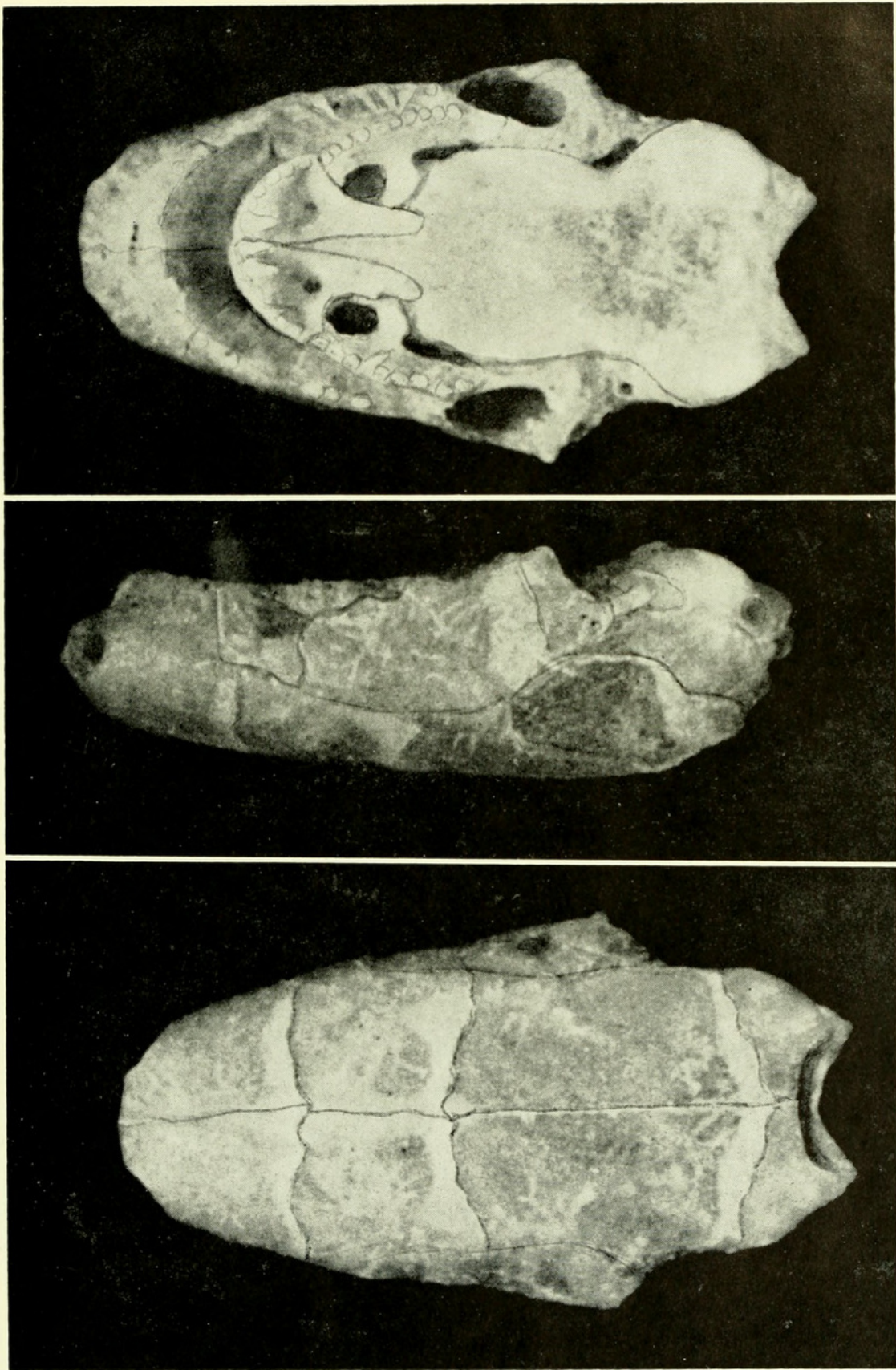


FIG. 51. *Afrocaecilia uluguruensis* (Barbour and Loveridge). EHT-HMS Coll. No. 4649, Vituri (2000 ft. elev.), Uluguru Mts., Tanganyika, Africa. Total length of specimen, 232 mm; length of skull, 5.8 mm; width of skull, 3.2 mm.

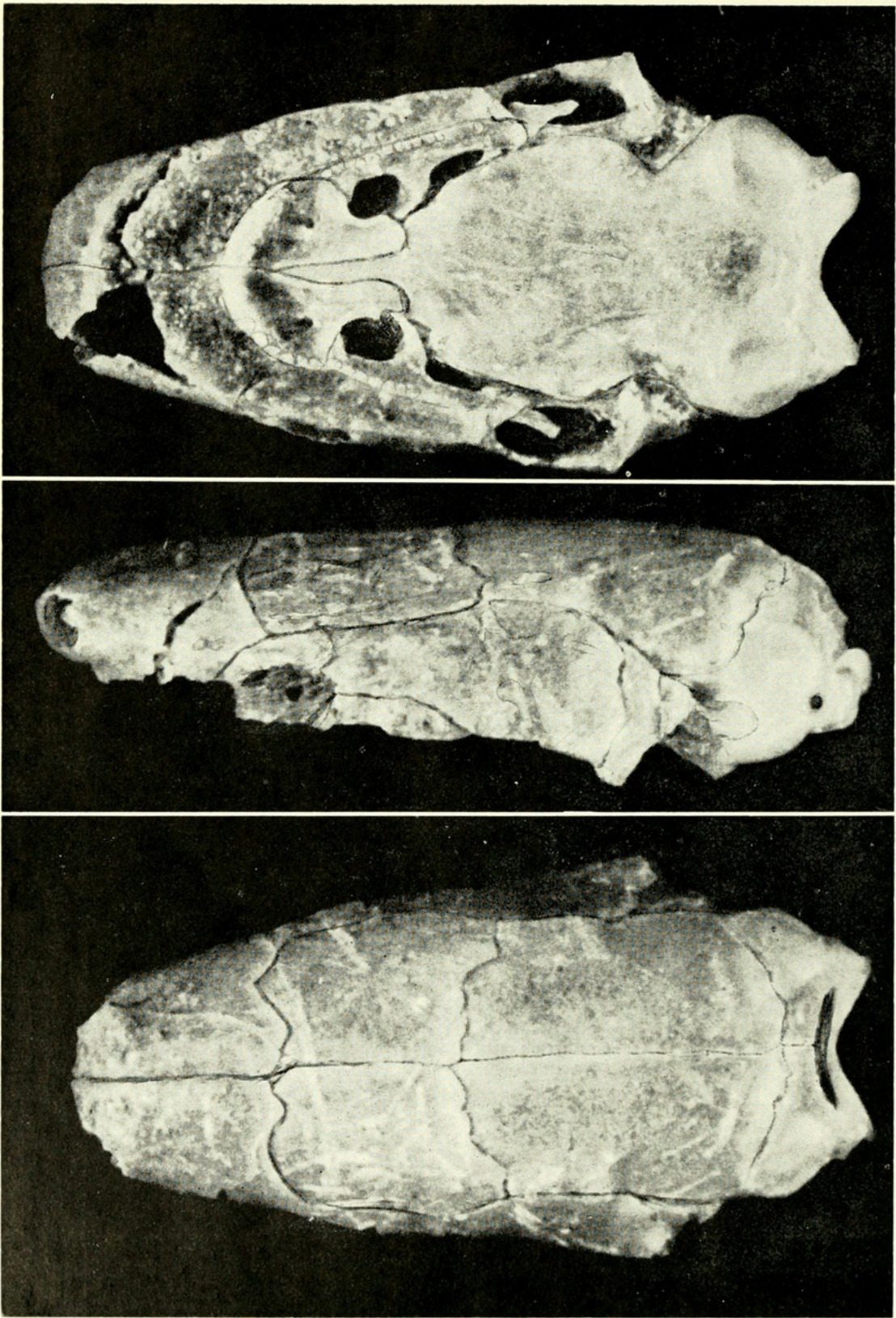


FIG. 52. *Afrocaecilia taitana* (Loveridge). MCZ No. 20021. Topotype. Teita Hills, Kenya. Total length of specimen, 234 mm; length of skull, 7.3 mm; width of skull, 3.6 mm.

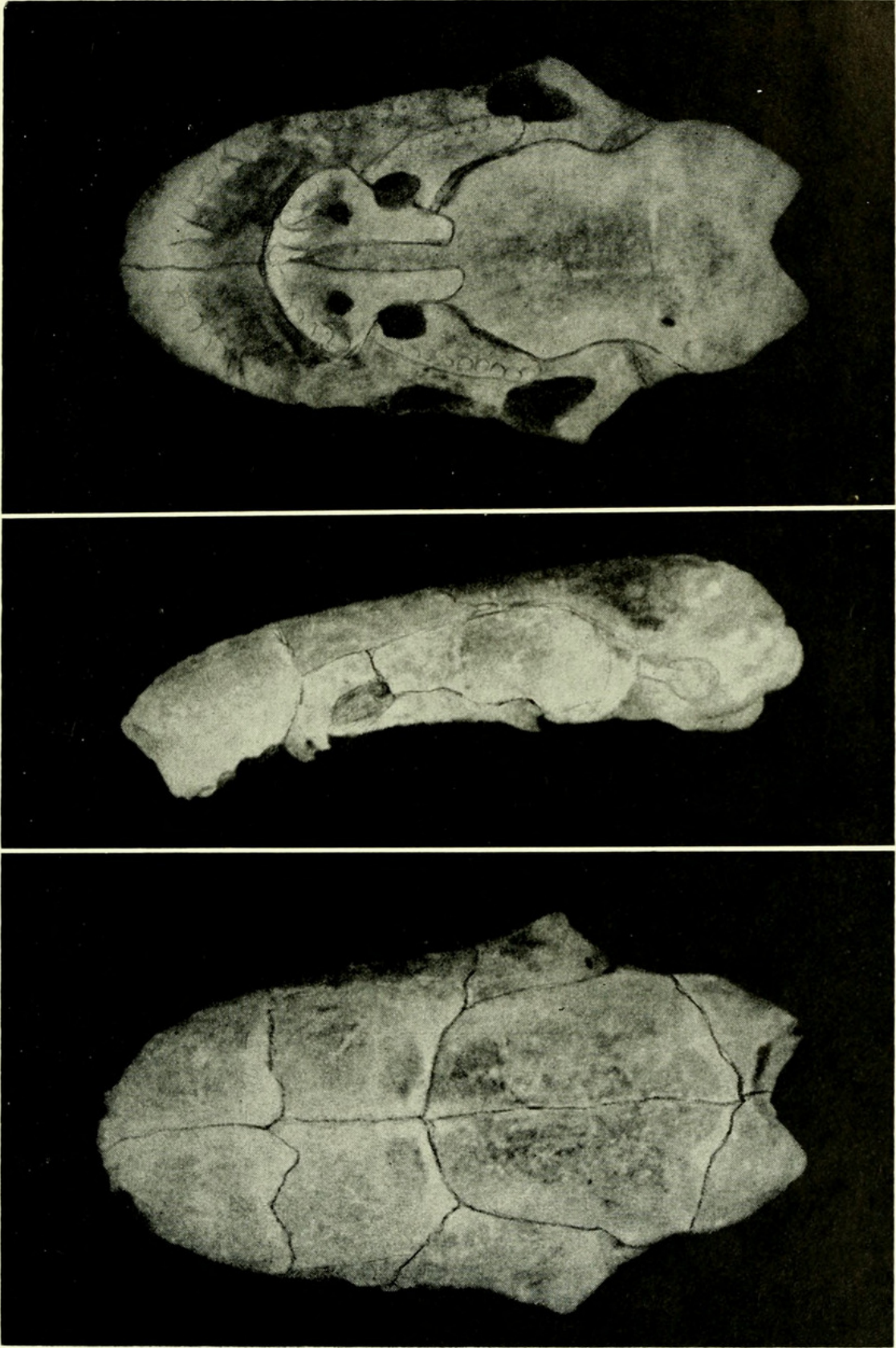


FIG. 53. *Afrocaecilia changamwensis* (Loveridge). EHT-HMS Coll. No. 4651, Changamwe, Kenya (192 ft. elev.). Total length of specimen, 234 mm; length of skull, 5.7 mm; width of skull, 3.25 mm.

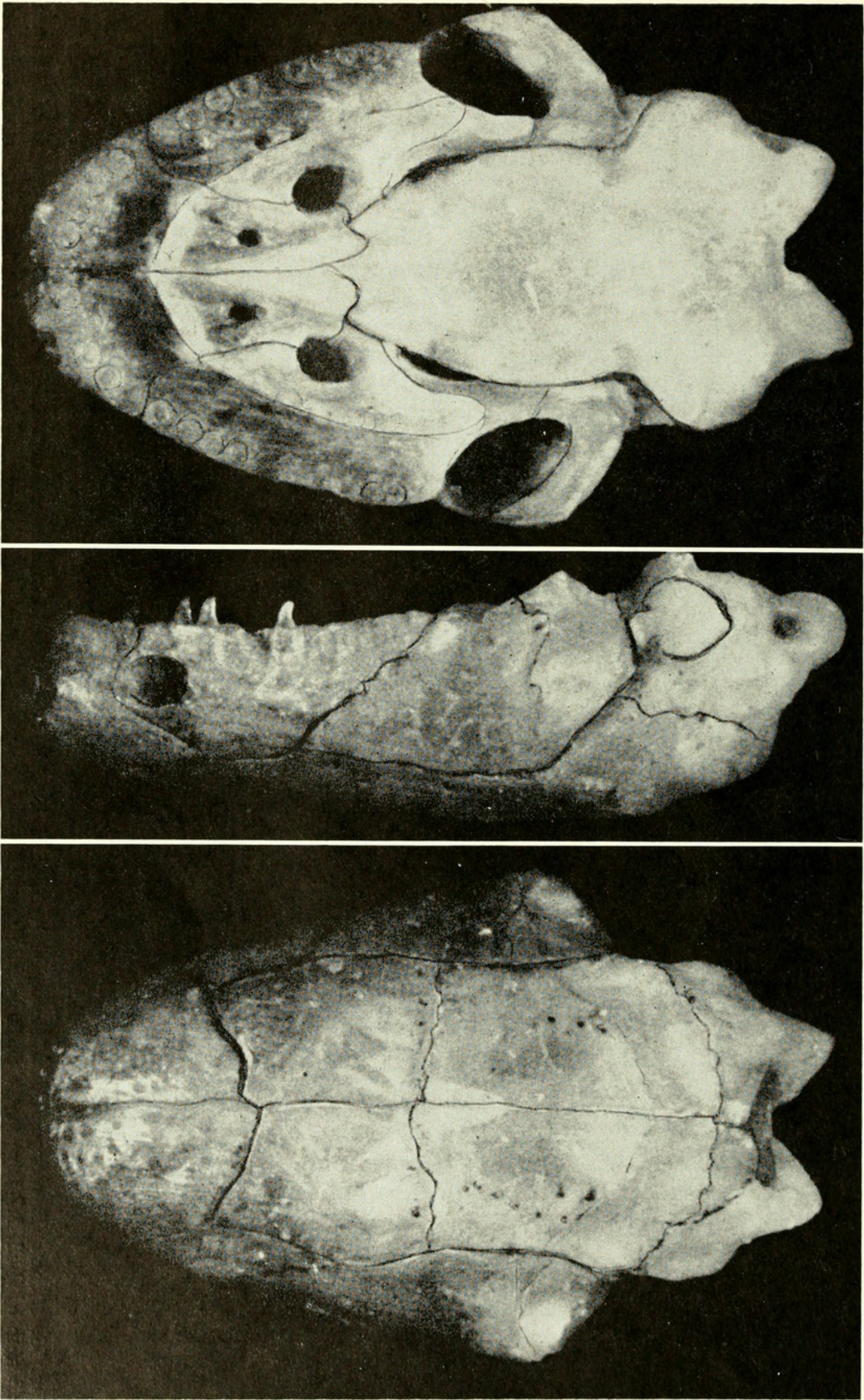


FIG. 54. *Gegeneophis ramaswamii* Taylor. MCZ No. 29454, Tenmalai Forest, Kerala, Southern India. Total length of specimen, 263 mm; length of skull, 9.05 mm; width of skull, 4.95 mm.

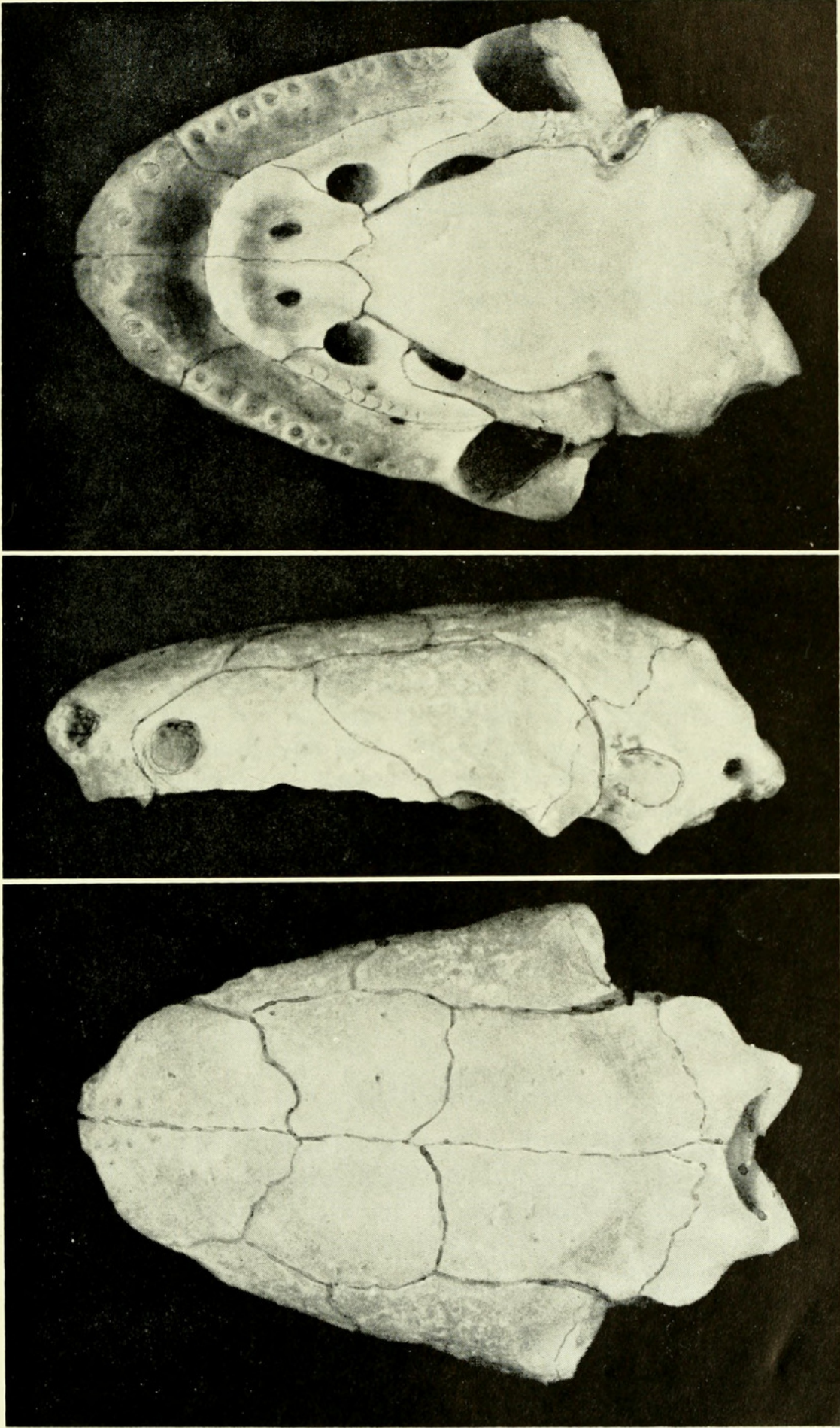


FIG. 55. *Gegeneophis ramaswami* Taylor. MCZ No. 29452, topotypic paratype, Tenmalai Forest, Kerala, Southern India. Total length of specimen, 305 mm; length of skull, 10.0 mm; width of skull, 6.0 mm.



Taylor, Edward Harrison. 1969. "Skulls of Gymnophiona and their significance in the taxonomy of the group." *The University of Kansas science bulletin* 48, 585–687.

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