THE CAECILIAN FAUNA OF THAILAND WITH AN EXAMINATION OF SCALE CHARACTERS

by

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The Gymnophiona or Caecilians (a common name), one of three living orders of the Amphibia, are represented in Thailand by several species of burrowing animals, having the general form and appearance of earthworms, but unlike earthworms having a skull and a series of ribbed vertebrae as well as other organs similar to those of many vertebrate animals.

These animals occur in a band around the world chiefly in tropical countries and in certain warmer temperate regions. Seemingly they are limited in their north-south distribution by temperature, and within their zone, are limited to areas with sufficient rainfall to provide suitable habitats. In Asia they are known from between 25° north latitude to about 10° south latitude; in Africa from about 14° north to 13° south; in the Western Hemisphere from about 18° north to 35° south latitude.

Since Thailand lies within this band, species of caecilians may be expected to occur in suitable habitats throughout the country from near sea-level to near the tops of all but the higher mountains.

In Taylor's "Amphibia of Thailand" four named species were reported and in his later paper "Caecilians of the World" another species was added. Since other species are known in contiguous territory in Malaysia, Laos, and Burma, it is quite probable that still other species await discovery in Thailand.

Caecilians are usually to be found in areas where there is sufficient moisture to provide wet soil, such as the banks and edges of streams and small rivulets, about permanent ponds, about springs, in swampy areas, in moist earth, under rocks and logs, especially rotting logs, and in deep mossy areas in wet forests. It may require considerable effort in digging in the soils in these places to acquire the specimens. While there is little

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likelihood that these animals are of economic value, they are of very considerable scientific interest since, like the snakes and certain legless lizards, their ancestors doubtless had arms, legs, tails, useful eyes, all of which have been lost because they have entered a subterranean habitat.

The larvae often may be found in shallow water in rivulets or even under rocks in water, since all known Asiatic species lay eggs on land near water and the young hatchlings enter the water to live as tadpoles.

The identity of Thai forms may be determined by the following key:

Key to genera and species of Thai Caecilians

1. A series of splenial teeth present between the dentary (mandibular) tooth series in both larvae and adults. Genus *Ichthyophis*

   Splenial teeth absent in adults (may be present in young larvae). A yellow lateral stripe that may be broken on the two collars. Total body folds usually within the range 247-270, the folds incomplete anteriorly on the dorsum. The approximate adult tooth formula: premaxillary-maxillary, 27-28; prevomeropalatine 28-29; dentary, 25-25; splenial, O-O. Four to 5 scale rows in each fold posteriorly.
   Caudacaecilia asplenia

2. Body with a lateral cream or yellow stripe from head to, or near to, vent; five scale rows in each posterior body fold. 3

   Body without a lateral stripe; one or 2 scale rows in each posterior body fold. 4

3. Lateral stripe relatively narrow. Body reaching a length of about 300 mm, the width of body in length about 30 times; body folds anteriorly incomplete, from 305 to 325 (counted on a dorsal line). Tooth formula approximates: premaxillary-maxillary series, 31-32; prevomeropalatine, 27-27; dentary, 6-8; splenial, 18-18.
   Ichthyophis supachaii

   Lateral stripe relatively wide, tending to bifurcate at the mouth angle. Body reaching a length of about 400 mm, the width contained in length approximately 25 times. Scales present on collars increasing to 5 rows in each fold posteriorly. Body folds usually from 355 to 375. Tooth formula approximates: premaxillary-maxillary 23-24, prevomeropalatine 22-22 dentary, 20-19, splenial 14-13.
   Iohthyophis kohtaoensis

4. Larvae transforming to adults at a length of about 240 mm. Scales begin on the second quarter of the body. At first only a few scales are present, increasing until there is a single complete row in each fold in the posterior of the body. The folds around body usually within the range of 310-325. Tooth formula of largest specimens approximately: premaxillary-maxillary series 21-22; prevomeropalatine 21-22; dentary 20-20; splenial, 12-12. Snout terminally rounded.
Ichthyophis youngorum

Larvae transforming at a length of about 200 mm. Scales begin just before the middle of the body as a partial row, increasing posteriorly to 2 rows in each fold. Tooth formula similar to *youngorum* but splenials more numerous, 22-22. Snout somewhat acuminate.
Ichthyophis acuminatus

Since the general external characters of the Thai caecilians have been published, these are not repeated here. However scale characters are not well known since the scales are concealed beneath the body surface in the circular cavities below the folds.

If the posterior part of the body (last one or two centimeters) is bent strongly downward the attachment of a fold may be broken, thus exposing the cavity wherein the scales lie, and also exposing a series of elongated glandules above and below the scales. The scales each may be in a small pocket of transparent tissue or this may not be evident (perhaps reabsorbed).

The scales if in more than one row usually are arranged like shingles on a house-top. Frequently the most anterior row is composed of small scales that may fail to touch each other, while the more posterior rows are usually larger and with the scales contiguous. The deepest series may be somewhat thinner and may lie almost directly beneath some of the intermediate rows.

The attachment of the individual scales within the fold is at the anterior edge and in removing scales for study care must be taken to avoid scratching them or tearing them as that tends to distort or destroy the arrangement of the squamulae or to tear or shred the scale.

Some scales placed in a drop of water on a slide under a binocular microscope may be teased and torn apart showing threads of the basal

scale with many of the squamulae still attached while other squamulae are displaced and floating in the water. The exact manner of scale development is at this time being studied.

Since only a single family of caecilians (Ichthyophiidae) is known in Thailand, the degree of difference in the appearance of individual scales in the various species is perhaps less than may occur between species belonging to different families. The species do vary in the number of rows of scales and their distribution on the body, thus offering further characters for the differentiation of forms.

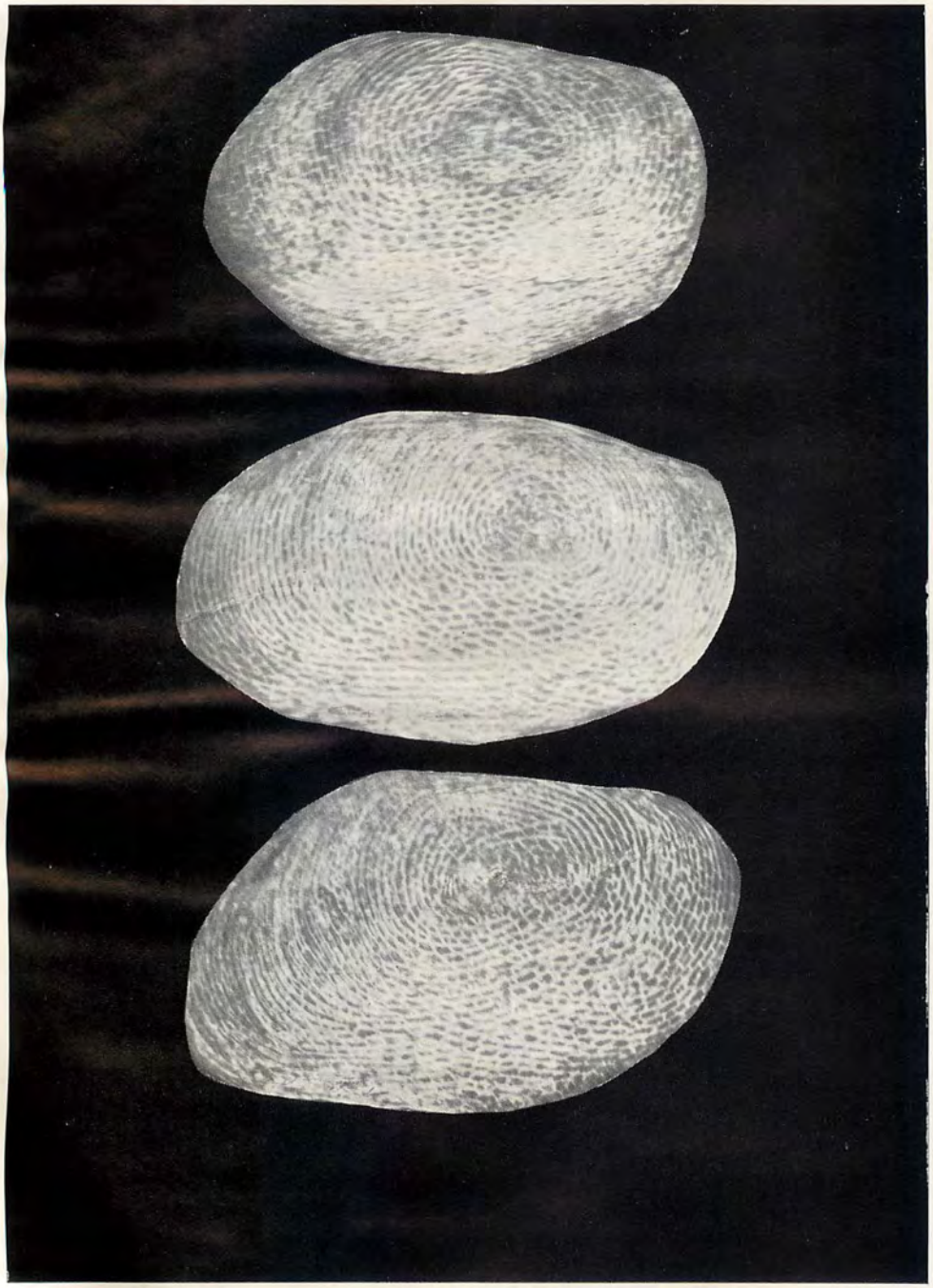
It may be well to point out the characters of the individual scale. There is a basal plate upon which appear hundreds of tiny squamulae. When viewed under a microscope the scales usually are white with the attached squamulae tending to form concentric rows around the "initium"* of the scale. It is presumed that the scale starts its growth at this point and increases its diameter or length and breadth. Many scales show what has been interpreted as an annular growth such as is evident in in many reptiles (turtles). Thai species show perhaps less evidence of annular growth than species in certain other areas where there is a greater amount of seasonal variation in temperature and moisture. Scales along the mid-dorsal line tend to be more symmetrical than those more lateral.

Whether it will be possible to distinguish between species on the characteristics of the scales alone, as is true of most reptiles, may be doubted. However the character of the scales together with their distribution on the body and their relative size in relation to the size of the specimen, provide a complex of characters furnishing important additional criteria for distinguishing evolutionary forms.

Thus, of two species of the same genus having the same general form and the same or similar color and markings, one may have two or three hundred scale rows about the body, the other may have as many as two thousand rows! While differences of this magnitude do not occur in Thai specimens, differences of significance do occur.

* This term is used to signify the center at which the scale presumably began its development. See Plate XV for an enlargement of the squamulae on a scale, magnified about 960 diameters.

Section of a scale from *Ichthyophis* sp. enlarged–x 960 diameters showing the arrangement of the squamulae on the surface of the scale. The area occupied by the group of squamulae on the right that are very irregular in size and shape, is designated the *initium*, since it probably represents the beginning of the scale in its development. The other squamulae tend to form concentric rows about the initium, and extend to the periphery of the scale.



Ichthyophis youngorum Taylor. Scales from the last body segment precedingthe vent of a topotype specimen (EHT-HMS No. 18410, from Doi Suthep, Chiang Mai province, Thailand). The largest (lower) scale measures 1×1.6 mm. Here the initium is near the anterior part of the scale.

Ichthyophis youngorum Taylor

Plate XVI

Ichthyophis youngorum Taylor, Univ. Kansas Sci. Bull. **40**: 89-91 figs. 24-27. 1960 (type-locality, Doi Suthep, Chiang Mai prov. Thailand); Caecilians of the World, Kansas Univ. Press, 1968, pp. 151-156, figs. 66-69.

In this species the larval life lasts for possibly two years during which time the larvae may reach fully adult size. The scales of the largest larvae (and presumably the oldest) are practically as large as the scales in the adult. Two of the largest larvae measured are between 217 and 240 mm, while the two adults at hand measure only 210 and 227 mm in length.

Scales in the type specimen appear first near the 160th fold although a few scattered scales were found anterior to this point in certain other specimens. At the middle of the body there was a single complete row in each fold and this number continued posteriorly in each fold to the terminus of the body. Those at the middle of the body measured 0.2×0.56 mm, while in the terminal centimeter scales measuring 1×1.4, and 1.2×1.6 were found. Occasional small scattered scales are under the more or less uniform scales of the row. The three scales in Figure 2 are from the left part of the middorsal region of the ultimate body segment preceding the vent.

Ichthyophis acuminatus Taylor

Plate XVII

Ichthyophis acuminatus Taylor, Univ. Kansas Sci. Bull. **40**: 98-101, figs. 32-33, 1960, (type-locality, Me Wang Valley, Mae Nam Wang, northern Thailand); Caecilians of the World, Univ. Kansas Press, 1968, pp. 52-54, figs. 1-2.

This species is more closely related to *Ichthyophis youngorum* than to other Thai species. When more adult material is available it may be necessary to regard it as a subspecies of *youngorum*.

The scales begin at about the 100th fold. Anteriorly a few lateral scales are present, thereafter one complete row. Toward the latter part

of the body there are two complete rows in each fold with occasional scattered scales associated. Old specimens have nearly double the number of splenial teeth known in *youngorum*. The highest number known in *acuminatus* is 22-22; in *youngorum* 12-12.

The largest scales occur posteriorly, and the four largest measured were 1×1.4, 1×1.5, 1×1.5, 1×1.6 mm. In Pl. XVII the initium appears more nearly in the center of the scale. The largest scale (middle right) measures 1.2×1.5 mm. The others are proportional to this.

Ichthyophis kohtaoensis Taylor

Plate XVIII

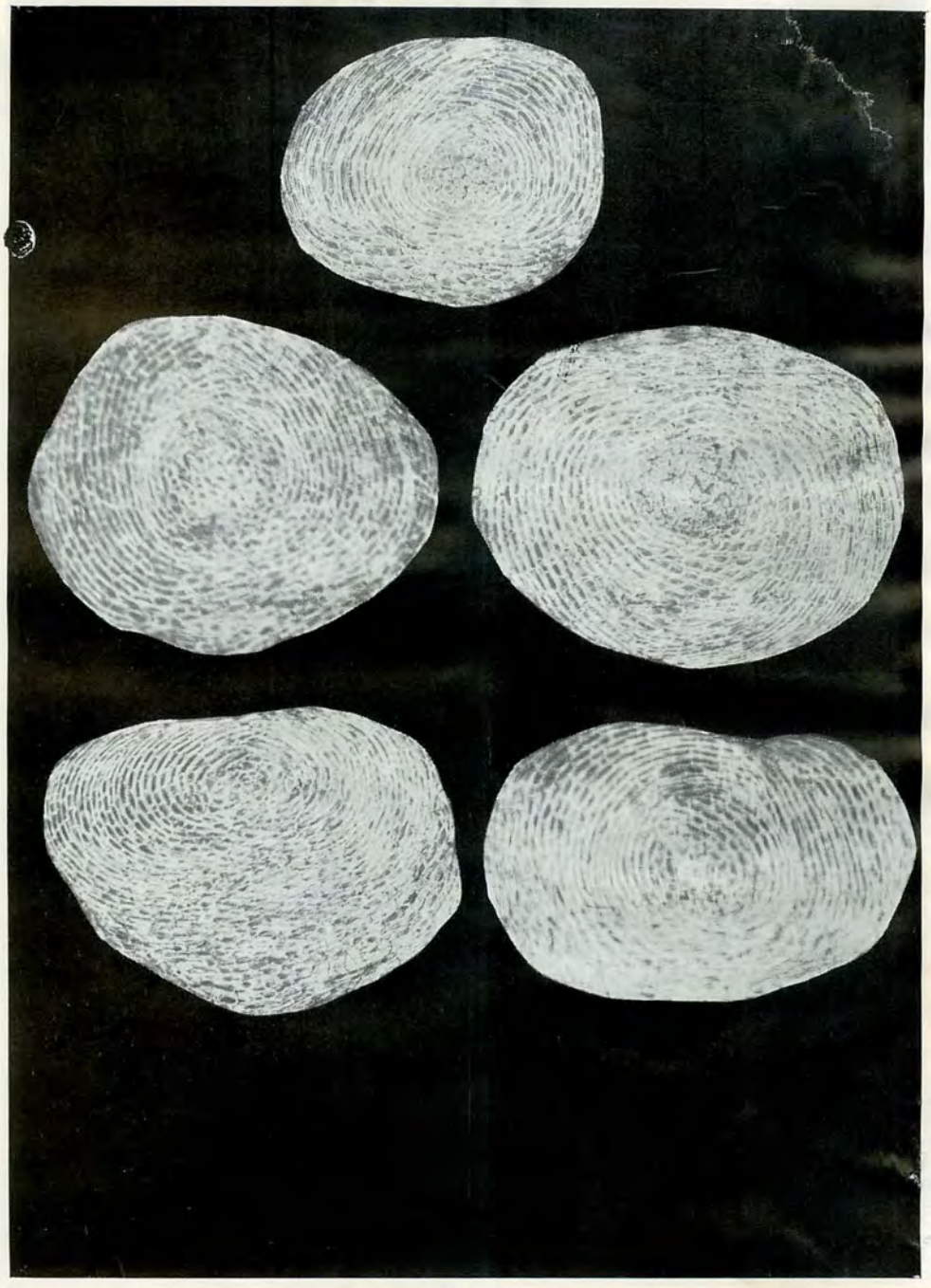
Ichthyophis kohtaoensis Taylor, Univ. Kansas Sci. Bull. **40**: 110-113, fig. 28, 1960, (type-locality Koh Tao Island, Gulf of Siam); Caecilians of the World, 1968, pp. 101-103, fig. 32.

This species reaches a somewhat larger size than other known Thai forms, the largest known measuring 350 mm in length. Also it appears to be the most widely distributed form in the country, being known from the peninsular areas to the extreme north. When better known it may be necessary to recognize some of the populations under subspecific names. Scales begin on the body at the collars and continue to the terminus. Anteriorly the rows are incomplete. The number of rows in each fold increases so that at midbody there are four to five rows in each fold and this number continues to the last segment of the body. The largest scales of the last centimeter measured 2.1×2, 1.9×2, 2×2.3 mm. In Pl. XVIII the median scale has the first dimension given. The others are proportional. In most scales the initium is close to the forward part of the scale, and the squamulae closest to the initium are the largest.

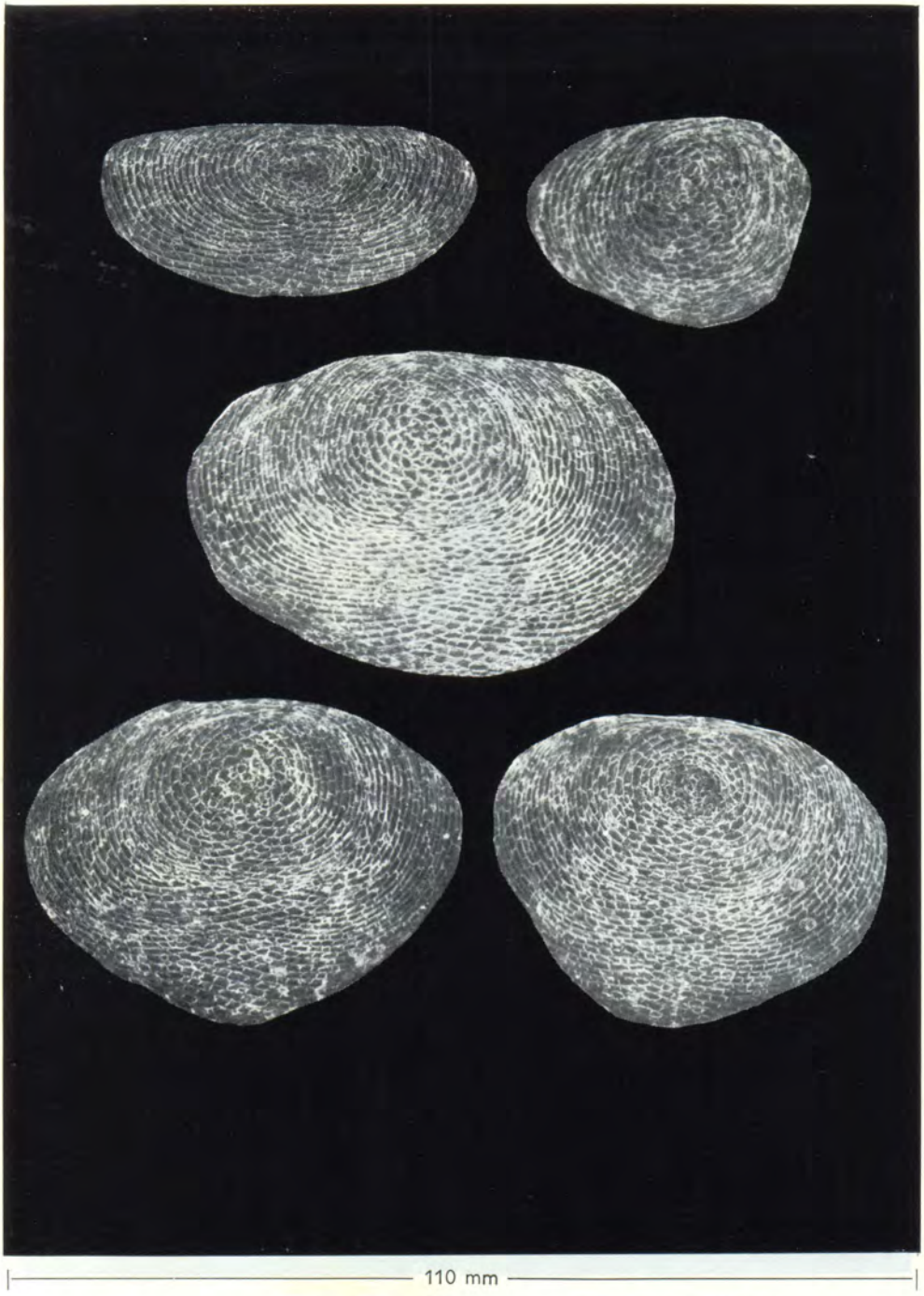
Ichthyophis supachaii Taylor

Plate XIX

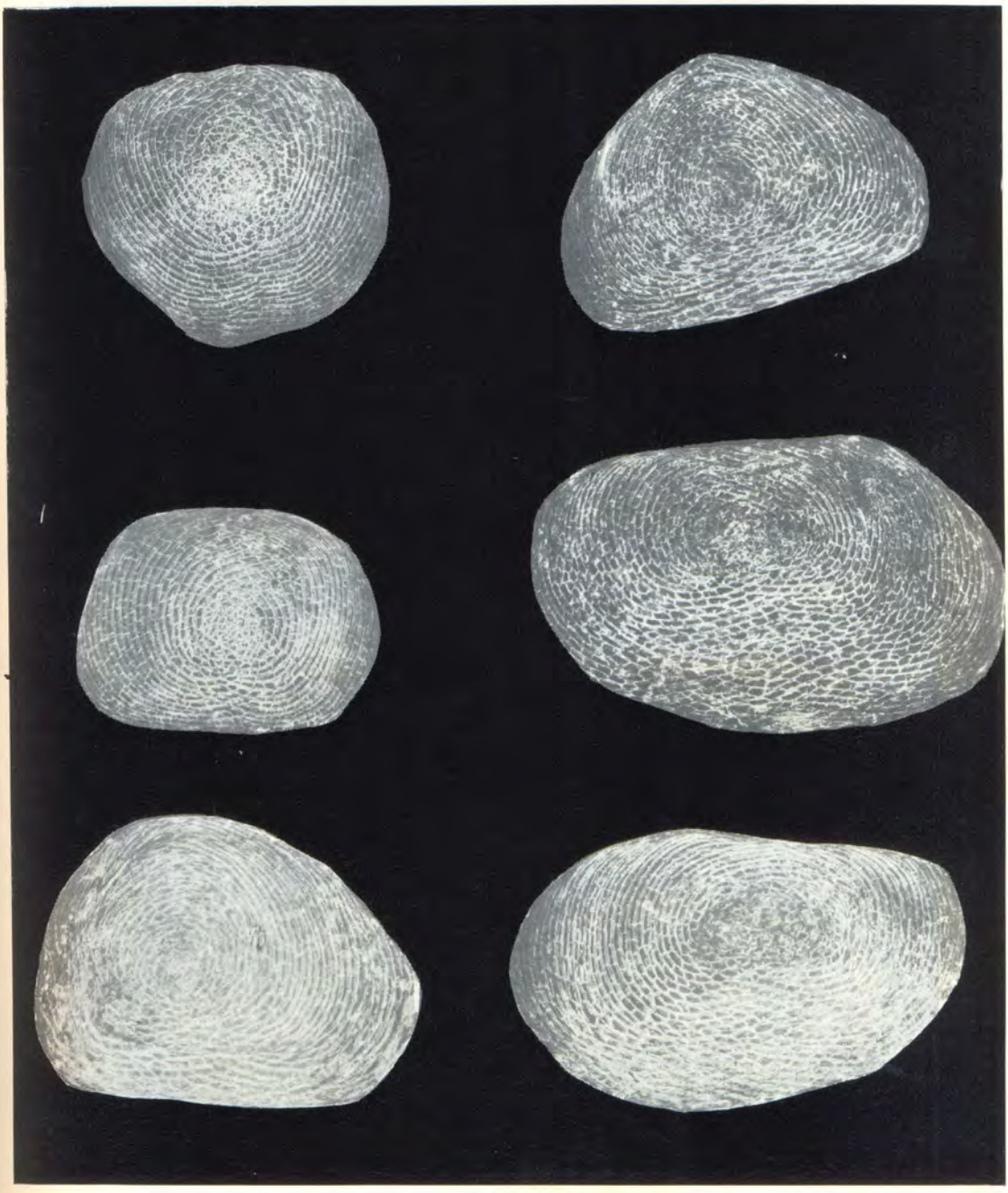
Ichthyophis supachaii Taylor, Univ. Kansas Sci. Bull. **40**: 107-110, figs. 36-37, 1960, (type-locality, 10 km west of Nakhon Si Thammarat, Nakhon Si Thammarat prov. Thailand); Caecilians of the World, Univ. Kansas Press, 1968, pp. 144-148, figs. 60-63.



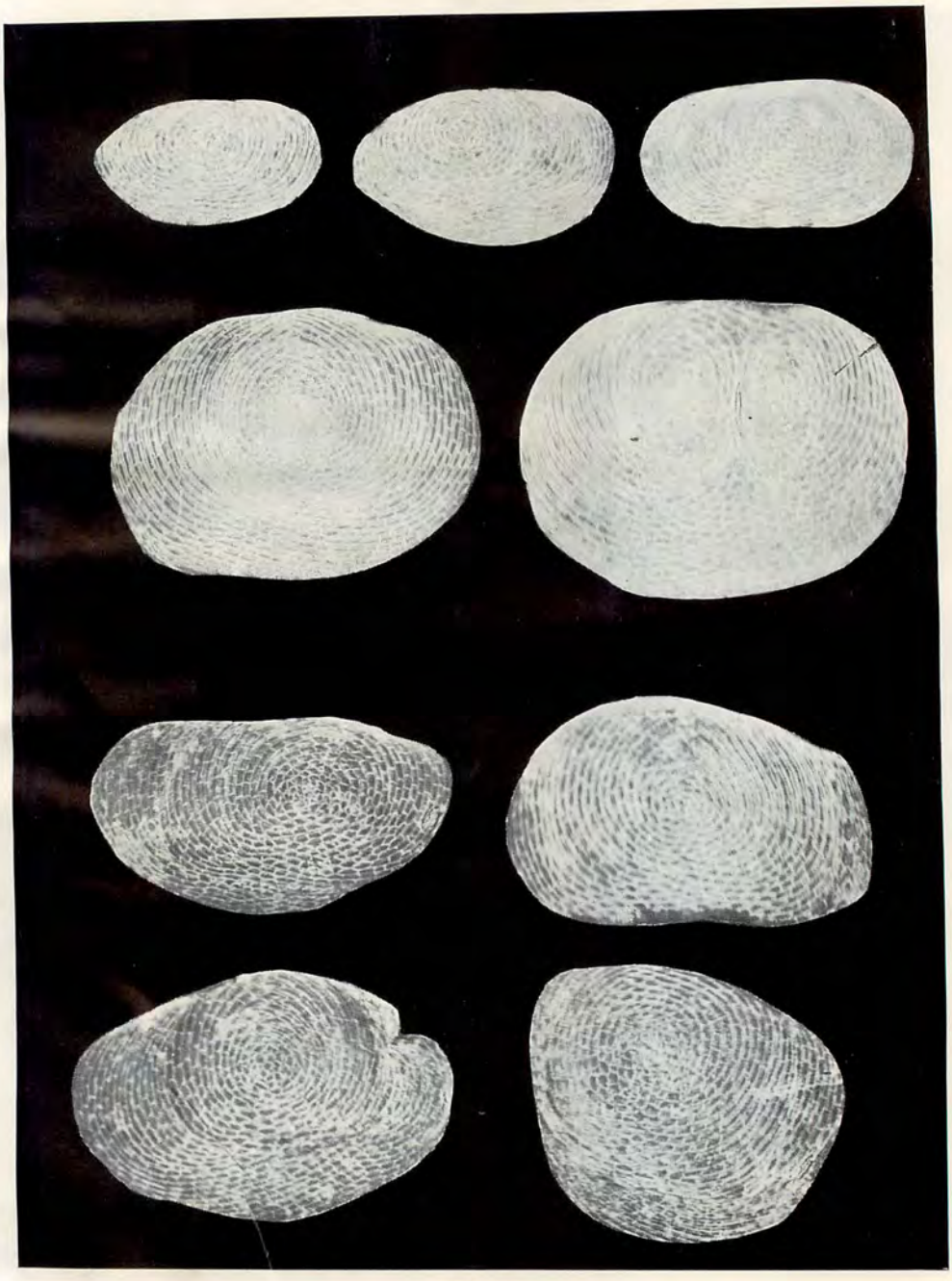
Ichthyophis acuminatus Taylor. Scales from the last segment of the body preceding the vent, from the type specimen (AMNH No. 20875, Me Wang Valley, North Thailand). The largest scale (middle right) is 1.2×1.5 mm. Here the initium is in the middle of the scale, or near it.



Ichthyophis kohtaoensis Taylor. Scales from the type specimen (USNM 2293 from Koh Tao Island, Gulf of Siam). The two upper scales are from a fold near the middle of the body. The three lower scales are from the last segment preceding the vent. The largest scale (median) is 2.1×2.7 mm. The others are proportional.



Ichthyophis supachaii Taylor. Scales from the type specimen (EHT-HMS No. 35498, Nakhon Si Thammarat, Thailand.) Scales from the last body segment preceding vent. The largest scale is 1.2×1.9 mm. The others are proportional.



Caudacaecilia asplenia Taylor. Scales from a specimen from Ladoo Tin Mine, Yala prov. Thailand. The upper scales are from near the middle of the body. Others from the last segment. The largest scale, a "twin," is 1.2×1.9 mm.

This species is proportionally more slender than other Thai species, the body width being contained in the length approximately 30 times. The largest known specimen reaches a length of 306 mm. Scales appear farthest anteriorly at about the tenth fold where they are very small (0.3 to 0 5 mm in greatest measurement). Somewhat farther back there are 2 rows in each fold, which are confined to the sides since in much of the body the folds are incomplete dorsally. Farther back where they become complete there are 5 scale rows in each fold with some scattered scales. The largest scales found in the last centimeter of the body preceding the vent level measure 1×1.5, 1×1.7, 1.2×1.9 mm. Their greatest dimension is usually transverse as is typical of most Thai species.

In Pl. XIX the largest scale measures 1.2×1.9 mm, the others being proportional.

Caudacaecilia asplenia (Taylor)

Plate XX

Ichthyophis asplenius Taylor, Univ. Kansas Sci. Bull. 46: 278-283, figs. 14-15, 1965, (type-locality, upper Mahakkam River, Kalimantan, Borneo).

Caudacaecilia asplenia (Taylor), Caecilians of the World, Kansas Univ. Press, 1968, pp. 167-171, figs. 75-77.

This striped form, reaching a known length of about 236 mm, lacks all trace of splenial teeth in the adult. The body folds are incomplete on the anterior part of the body.

Scales begin anteriorly at about the 30th fold although there may be a few scattered scales preceding this. At the middle of the body 2 or 3 rows of scales are present in each fold. Posteriorly there are at least 4 in each fold with some scattered scales tending to form a fifth row.

The largest scales taken from the body segment preceding the vent measure 1.2×1.6, 1.15×1.75, 1.2×1.6 mm. The largest scale in Pl. XX measures 1.2×1.9 and is anomalous in being a "twin" showing two initii. The other scales are proportional.