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A New Limbless Skink (Reptilia: Scincidae) From Thailand With Comments On the Generic Status of the Limbless Skinks of Southeast Asia

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In the course of an ecological study at the Sakaerat Experimental Station, located 250 km. NE of Bangkok, 17 specimens of a limbless skink were collected. The purpose of this paper is to compare this new series with previously known limbless skinks of the region.

METHODS AND MATERIALS

External characteristics were compared on 24, 10, and 5 alcoholic specimens of each of the three previously known species of limbless skinks from Thailand, the 17 specimens collected from Sakaerat, and on a single specimen of a limbless skink from Australia to which certain of the Thai species have been related at the generic level.

Cleared and stained individuals were compared for skeletal analysis of the Thai forms. A single individual was prepared from the Sakaerat series, a single individual was prepared for one previously known species, and two individuals were prepared for the other two species.

ACKNOWLEDGMENTS

Noel Kobayashi, Prasert Lohavanijaya, Frank Nicholls, and Sukhum Pongsapipatana, all currently or formerly of the Applied Scientific Research Corporation of Thailand, greatly aided the field work. A special acknowledgment belongs to Sukhum, whose efforts at Khao Saton produced the new series of specimens.

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Allen E. Greer, Museum of Comparative Zoology; Robert F. Inger, Field Museum of Natural History; and Jay M. Savage, University of Southern California, critically reviewed the manuscript, but the responsibility for accurate presentation and interpretation of the data is solely mine.

Without the co-operation of my colleagues in the Biology Department, Pacific Lutheran University, this report would be considerably delayed. Especially helpful were Irene Creso and Harold J. Leraas, who by taking heavier teaching loads allowed me time for research. Pacific Lutheran University provided some support moneys for the completion of the manuscript.

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HISTORICAL REVIEW OF THE LIMBLESS SKINKS OF SOUTHEAST ASIA

Boulenger (1914) described the first limbless skink collected from Thailand in the widespread genus *Lygosoma* as *Lygosoma anguinoides*. Lönnberg (1916) described a new genus and species for a large Thai limbless skink, *Isopachys gyldenstolpei*. The third species of Thai limbless skink was described by Angel (1920) also as a new genus and species, *Typhloseps roulei*. Smith (1935) placed all three known Thai limbless skinks in the Australian genus *Ophioscincus* Peters (1873), the type of which was the limbless species *australis*. Smith later (1937) placed the limbless species he had previously assigned to *Ophioscincus* in the Australian limbed genus *Rhodona*. Mittleman (1952) placed all four limbless species in the genus *Ophioscincus* again. Taylor (1963) regarded *Isopachys gyldenstolpei* as generically distinct from the remaining Thai species. Taylor further indicated that he was certain of the congenerity of *anguinoides* and *roulei* and hesitatingly associated them with the genus *Ophioscincus*.

Doubtless the cause for some of this generic confusion has been a paucity of material so that the skeletal features could not be correlated with external features. Material is now adequate so that this may be done for the Thai forms. Unfortunately, I have been able to locate only a single specimen definitely referable to *Ophioscincus australis* Peters (FMNH 97689). Dr. Cogger of the Australian Museum sent two alcoholic and two cleared and stained specimens of an Australian limbless skink referred to as *Lygosoma ophioscincus* (=*O. australis* Peters). The species Cogger sent is at least specifically distinct from the species *O. australis*. With the lack of a series of specimens clearly referable to *O. australis*, the definitive relationships among the Australian and Thai species and between the genera *Ophioscincus* and *Lygosoma* remain open to speculation.

Finally, Greer (1970), who had only two species, *anguinoides* and *roulei*, available as skeletons, placed both species in the genus *Ophioscincus*, which he previously (1967) regarded as suspect, but lacked the material to elucidate the generic relationships. Greer (1970) placed *Ophioscincus* in the subfamily Lygosominae.

CHARACTER ANALYSIS

The first objective of the study is to determine whether or not the new series of specimens is specifically distinct from the other limbless skinks of Thailand and from the single Australian limbless skink species with which the Thai forms have been included at the genus level. Twenty-three external characters were evaluated for the five samples; 19 skeletal characters were evaluated for the four Thai forms (tables 1, 2; figs. 1–5).

The Sakaerat series is unique in two external characteristics (character numbers 19 and 21) with respect to the previously known Thai forms and *O. australis*. In addition, the Sakaerat series differs from *O. australis* in five character states of external morphology (2, 5, 15, 20, 22); from the three previously known Thai species in six skeletal states (25, 27, 29, 30, 34, 39); from *anguinoides* in two external states (10, 18) and two more skeletal states (24, 26); from *gyldenstolpei* in ten external states (1, 2, 5, 7, 8, 9, 12, 17, 22, 23) and eight skeletal states (28, 31, 32, 35, 36, 37, 41, 42); and from *roulei* in nine external states (1, 5, 7, 11, 12, 18, 20, 22, 23) and seven skeletal states (26, 28, 32, 35, 36, 38, 41).

The Sakaerat series is clearly distinctive from any of the previously known Thai species as well as from *O. australis*. These differences are at least indicative of species differentiation. The problem now is to determine the relationships among the five species, and

TABLE 1.—External characteristics of five species of limbless skinks.

Character	Character State				
	anguinoides	*australis*	*gyldenstolpei*	*Sakaerat series*	*roulei*
	N=24	N=1	N=10	N=17	N=5
1. Auricular crease	absent	absent	present	absent	present
2. Tail tip shape	pointed	rounded	rounded	pointed	pointed
3. S V length (in mm.)	31.0–67.0	88.0	78.5–180.0	48.0–114.0	81.5–109.0
4. Total length (in mm.)	54.0–122.0	141.0	110.0–254.5	81.5–173.5	149.5–186.0
5. No. scales mental-anus	95–118	114	167–201	93–109	123–126
6. No. subcaudal scales	69–88	61+	74–91	62–101	100–166
7. No. scale rows at midbody	22–26	20	24–28	20–22	18
8. Prefrontal scale	present	present	absent	present	present
9. Frontonasal scale	present	present	absent	present	present
10. Frontoparietals in contact	yes	no	no	no(yes)	no
11. No. supraoculars	3–4	3	3	3	2
12. No. supraciliaries	4–6	4	3	4(5)	3
13. No. presuboculars	3–4	3	2–3	2–3	2
14. No. postsuboculars	2–3	3	3	3–6	2–3
15. No. primary temporals	2	3	2	2	2
16. No. secondary temporals	1	1	1	1	1
17. No. tertiary temporals	1	1	0	1	1
18. No. loreal scales	1	2	2	2	1
19. No. supralabial scales	5(6)	5	4(5)	6	5
20. No. infralabial scales	4–6	4	(4)5	5	4
21. No. supralabial under mid-eye	3	3	2	4	3
22. No. pair of chinshields	2–3	3	1	2	3–4
23. Postmental scale	present	present	absent	present	absent

TABLE 2.—Skeletal characteristics of four species of limbless skinks.

Character	Character State			
	anguinoides	*gyldenstolpei*	*Sakaerat series*	*roulei*
24. Nasals in contact	no	yes	yes	yes
25. Frontal	single	single	divided	single
26. Parietals sculptured, foramen medial to squamosal on dorsal aspect	no	yes	yes	no
27. Lateral process of parietal	broad and shallow	broad and shallow	finger shaped	broad and shallow
28. Jugal	reduced	moderately developed	reduced	moderately developed
29. Palatine relationship along midline	just separated	overlapping	widely separated	overlapping
30. Pterygoid relationship along midline	separated	in contact	widely separated	in contact
31. Basipterygoid processes of basisphenoid	reduced	well developed	reduced	reduced
32. Stapes articulating with quadrate	yes	no	yes	no
33. No. premaxillary teeth	3–4	3–4	4	4
34. No. maxillary teeth	8–9	9	12–13	8–9
35. Retroarticular process development	moderate	strong	moderate	strong
36. Interclavicle	present	absent	present	very reduced
37. Sternum	present	very reduced	present	present
38. Humeral vestige	absent	absent	absent	present
39. No. of rib pairs articulating with sternum	2	0	1	0
40. Vertebral numbers which have ribs meeting on ventral midline	9–22, 23	10–25	8–24	8–19
41. No. presacral ribs	54–55	74–75	53	63
42. Osteodermal fusion with the skull	absent	present	absent	absent

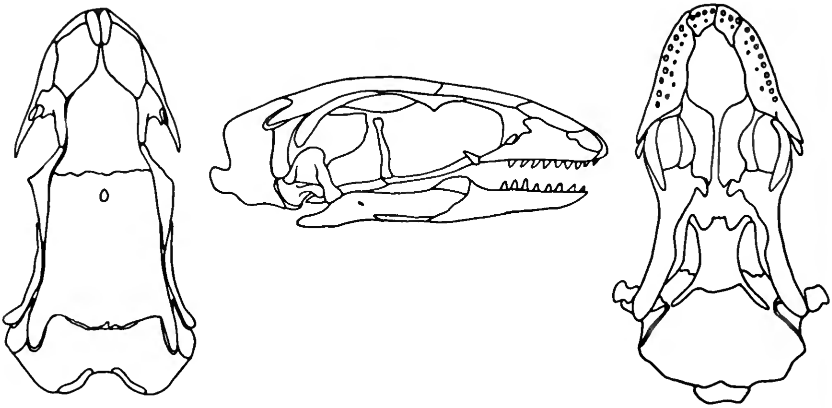


FIG. 1. Dorsal, lateral, and ventral views of the skull of *I. anguinoides*.

then determine whether generic rank is warranted. The data for deducing phologenetic relationships are based upon estimation of the direction of change among or between the character states. Phylogenies are then based upon shared patterns of the advanced character states.

Marx and Rabb (1970) discuss ten criteria of directional change in character states. To apply their criteria meaningfully, one must have data available for the central group from which the smaller study group was derived. In the case of the limbless skinks of Thailand, one must have a data set on representative members of the family Scincidae. Because of the limited nature of this study, certain of their criteria, such as ecological specialization, geographic restriction, closely related taxa, correlation of applied critera, genetic structure, and fossil record, do not apply. Other criteria, such as uniqueness, relative abundance, and morphological specialization, are applicable in this study.

Lack of knowledge of the character states exhibited by most skinks prevents analysis of the following numbers of characters listed in the tables at this time: 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 26, 33, 34, 40, 41. Discussions of the evolutionary directions of each of the remaining characters follow. Characters 1 and 32 are considered together under 32. For each character, the primitive state is given a lower case letter, the derived state a capital letter, a secondary derivation a capital letter starred, a tertiary derivation a capital letter double starred, independently derived character states are indicated by numerical subscripts.

CHARACTER 2—Tail tip shape. Most skink tails taper and end in a point. Two patterns are noted in the Thai limbless forms. The first is a tapered tail ending in a point composed of a single enlarged scale, which is interpreted as one type of specialization. Living specimens of the new species would often drive the tip into one's hand, feeling much like being pricked with a probe. The second pattern is a bluntly rounded tail. a=tail tapered, ending in a point; A_1=tail tapered, ending in a sharp scale; A_2=tail cylindrical, ending bluntly.

CHARACTER 8—Prefrontal scale. The common head scale pattern among non-burrowing skinks includes paired prefrontal scales. In *gyldenstolpei*, the only Thai limbless species that lacks prefrontal scales, the prefrontals are probably fused with the frontal scale. Fusion of dorsal head scales is a well documented phenomenon among burrowing reptiles. b=prefrontal scale present, B=prefrontal scale absent.

CHARACTER 9—Frontonasal scale. As character 8. c=frontonasal scale present, C=frontonasal scale absent.

CHARACTER 17—Tertiary temporal scale. The common skink pattern includes distinct, paired, tertiary temporal scales. In the single species, *gyldenstolpei*, within this study that does not have distinct tertiary temporals, paired parietal shields are present. The parietal shields result from the fusion of a secondary temporal with a tertiary temporal on each side of the head. d=tertiary temporal scales present, D=tertiary temporal scales absent.

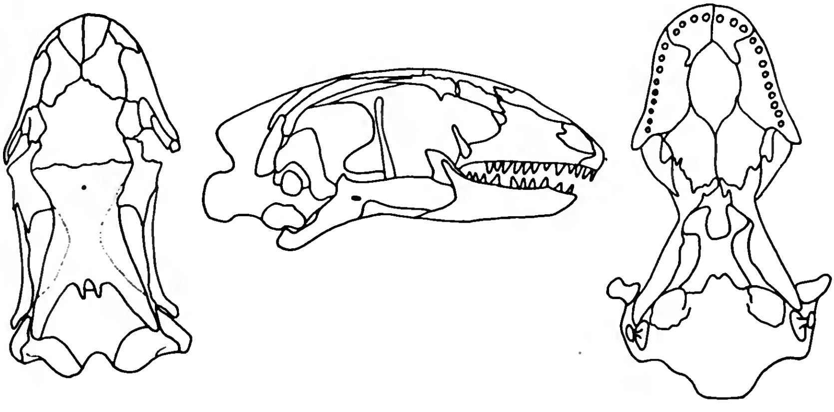


FIG. 2. Dorsal lateral, and ventral views of the skull of *I. gyldenstolpei*.

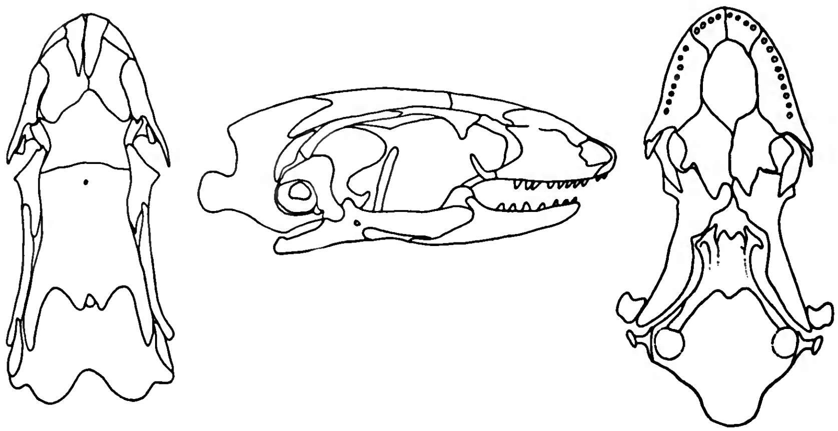


FIG. 3. Dorsal, lateral, and ventral views of the skull of *I. roulei*.

CHARACTER 23—Postmental scale. The common skink pattern is the presence of one or more postmental scales. The homologues of postmental scales may well be present in the forms not having clearly enlarged azygous scales posterior to the mental, but they are indistinguishable from the other ventral body scales. Reduction of scale size in the chin region would allow more flexibility. Combined with the specialized state of exaggerated retroarticular processes, as found in *gyldenstolpei* and *roulei*, a change of the feeding mechanism associated with the fossorial habitat is suggested. In the specimens which had food in the gut and were prepared for clearing and staining, the predominant food item was termites, which the lizards probably ate underground. e=postmental scale present, E=postmental scale absent.

CHARACTER 24—Nasal bone contact. In the common skink pattern paired nasal bones contact each other medially. Rarely, here seen in *anguinoides*, an anterior process of the frontal bone separates the nasal bones. Functionally interpreted, the anterior projection of the frontal is more efficient in handling burrowing stress applied to the dorsonasal skull region in two ways: 1) Stress applied to the nasal region spreads more posteriorly throughout the entire frontal bone, and 2) a maximum of three articulations of the nasal and frontal bones rather than four allows a stronger nasal region of the skull. f=nasal bones in contact, F=nasal bones separated.

CHARACTER 25—Frontal bone. Greer (1970) indicates that a paired condition of the frontal bone is a primitive condition. g=paired frontal bones, G=single (fused) frontal bone.

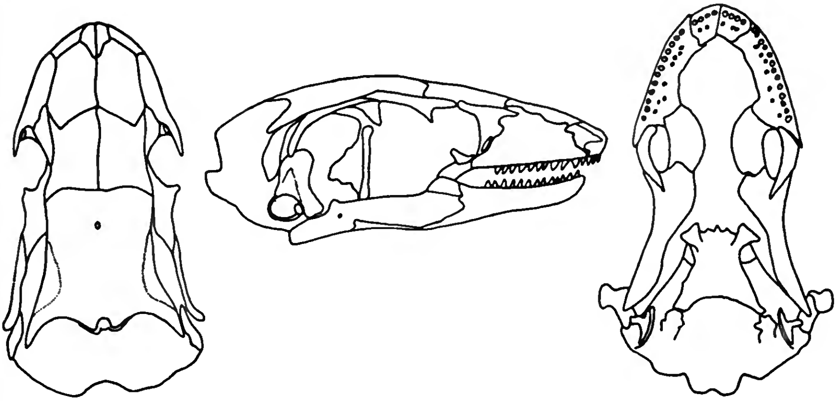


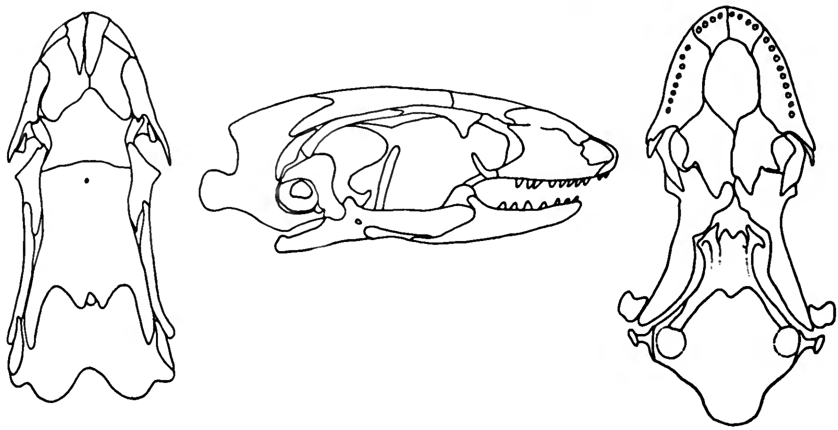
FIG. 4. Dorsal, lateral, and ventral views of the skull of the Sakaerat series.

CHARACTER 27—Lateral process of parietal. Greer (1970) indicates that a finger-shaped lateral process of the parietal is found only within the subfamily Scincinae. As the subfamily Scincinae is the primitive subfamily of skinks, it is logical to assume that a finger-shaped process is a primitive character state. h=lateral process of parietal finger shaped, H=lateral process of parietal broad and shallow.

CHARACTER 28—Jugal. A complete postorbital arch is the commonest pattern among skink genera, with burrowing forms showing a reduction of the arch. The functional diminution of the eye combined with a streamlining of the skull for more efficient burrowing apparently provides the selective pressure to reduce the postorbital arch. All the Thai species have incomplete arches. In addition, two species have greatly reduced jugals. i=complete postorbital arch, I=incomplete postorbital arch, moderately developed jugal, I*=incomplete postorbital arch, reduced jugal.

CHARACTER 29—Palatine bones. Greer (1970) indicates that widely separated palatine bones represent a primitive condition among skinks. He is uncertain whether the condition of narrowly separated palatines, as seen in *anguinoides*, is primitive with respect to palatines meeting on the midline or is a secondary derivation. j=palatines widely separated, J=palatine bones in contact, or just separated.

CHARACTER 30—Pterygoid bones. As pointed out by Greer (1970), the evolutionary trend within the skinks is toward a greater development of a secondary palate. The pterygoids, when in medial



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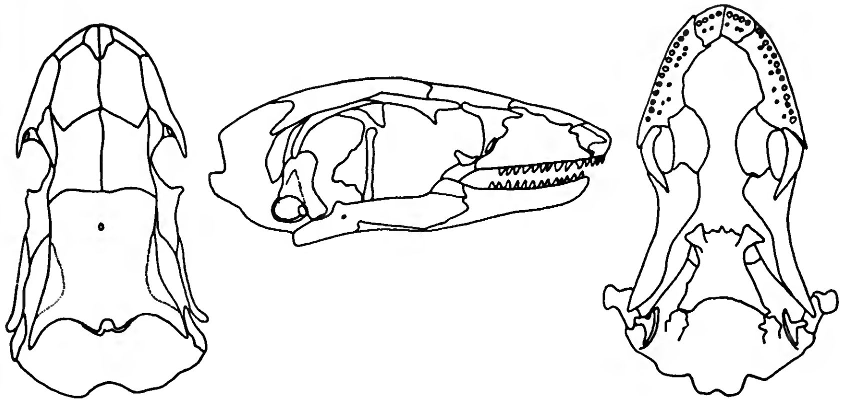

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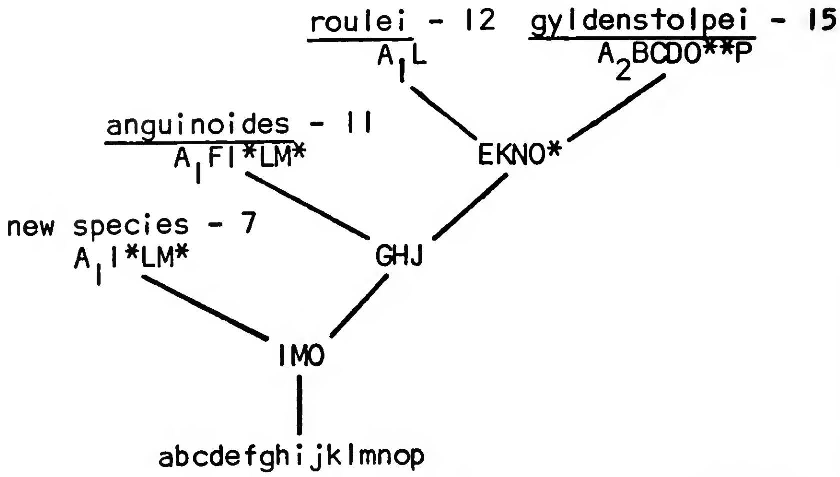

FIG. 6. Proposed phylogenetic relationships among the four Thai limbless skinks. See text for details.

ary trends seem apparent in the Thai forms in addition to the basic reduction displayed by all. o=functional pectoral girdle, O=reduced pectoral girdle, with at least one pair of ribs attaching to the sternum, O*=reduced pectoral girdle with sternum well developed, no rib attachment, O**=extremely reduced pectoral girdle, interclavicle and sternum almost gone, no rib attachment to sternum.

CHARACTER 42—Osteoderms. Most skinks have osteoderms, but they are rarely fused together or co-ossified with the skull. This latter condition correlates with a more rigid skull for burrowing. p=osteoderms present, P=osteoderms fused over head and co-ossified with the skull.

The four taxa for which both external and skeletal data are available may be compared with respect to evolutionary specialization by assigning the following numbers to the character states: 0=lower case letter, 1=capital letter with or without subscript, 2=capital letter with one star, 3=capital letter with two stars. The maximum index of specialization is 20. The actual totals for the taxa are: new species—7, *anguinoides*—11, *roulei*—12, *gyldenstolpei*—15.

PHYLOGENETIC RELATIONSHIPS

In constructing a hypothetical phylogeny for the limbless skinks, the character states were listed in rows by species for those characters which were analyzed with respect to evolutionary direction. The rows of character states were then examined for shared advanced states. Each step in the phylogeny (fig. 6) represents the maximum number of shared advanced character states for the maximum number of species. For example, all four Thai species share three advanced character states. An assumption made for purposes of the analysis is that once a specialization has occurred, it does not reverse itself.

The available data on *australis* is too limited to include in the phylogenetic analysis. Of the characters analyzed, it has two advanced character states; a rounded tail-tip which it shares with *gyldenstolpei* and no indication of an auricular crease which it shares with *anguinodes* and the new species. Discussion of the relationships of *australis* to the other species is deferred to the next section.

The hypothetical phylogeny, once constructed, should then be examined for common character state clusters and independently derived characteristics.

All four species share three advanced character states: an incomplete postorbital arch, loss of the external ear, a reduced pectoral girdle. Because the study is based on looking for characteristics that differentiate the taxa, two characters have not been mentioned previously of which all specimens examined have advanced states: a lower eyelid composed of a thickened scale and a snout covered by a thickened cuticle. The combination of the five characteristics apparently defines the minimum adaptations necessary in order to lead a burrowing life. This appears true at least for the forms studied herein. It would be interesting to see whether the character states are of value in predicting basic adaptations to burrowing in other skinks.

The maximum number of derived character states shared by any combination of three species is three: a fused frontal bone, broad and shallow lateral process of the parietal, and palatine bones overlapping or just separated. The maximum number of derived character states shared by any two species of the characters not previously used is four: postmental absent, pterygoids in contact, well-developed retroarticular process, reduced pectoral girdle lacking rib articulations.

CHARACTERISTICS DERIVED IN PARALLEL AND THE GENUS CONCEPT

Basically, I am considering the shift to a completely fossorial habitat, roughly indicated by complete loss of limbs, to be an evolutionary shift worthy of generic recognition if no closely related forms show a gradation of limbs to limblessness such as is demonstrated by the genus *Brachymeles* in the Philippines. The only likely candidates in Southeast Asia are the genera *Lygosoma* and *Saiphos.*

As mentioned previously in the character analysis, the new species shares certain character states which Greer (1970) uses to define the subfamily Scincinae. The advanced character states of these same characters are used to define the subfamily Lygosominae, which appear as the step containing GHJ in the phylogeny. Put in accordance with Greer's (1970) findings, the new species belongs in the subfamily Scincinae, and *anguinodes, gyldenstolpei,* and *roulei* belong in the subfamily Lygosominae, as do the genera *Lygosoma* and *Saiphos.*

The only scincine previously known in Southeast Asia is the genus *Eumeces,* composed of species with relatively well-developed limbs. Thus I consider the new species to be representative of a distinct genus.

Because two subfamilies are represented by the Thai limbless skinks, the following character states have been derived independently in the two subfamilial burrowing stocks: AI*LM*. This matter of independent character state derivations has bearing on the generic status of the three Thai lygosomine limbless species.

The problem with the other three Thai species, then, is to determine 1) whether they represent a single invasion of the fossorial habitat by a common ancestor which then speciated (all three species belonging to a single genus), or 2) whether the species represent two or three independent entries into the fossorial habitat (two or three genera) and 3) what the relationships are to the genera *Lygosoma, Ophioscincus,* and *Saiphos.*

In order to determine whether the three species could be accounted for by a single invasion, it is necessary to ignore any advanced characteristics dealing with specializations to a burrowing way of life. These would be expected to be important as far as the speciation process is concerned, but, as seen above, many of the characteristics associated with burrowing have been derived independently in the two subfamilies. In other words, a single lygosomine ancestor could have made the initial shift to a burrowing life-style, fragmented into three populations, and the three populations could have then diverged, if the only types of characteristics that differentiate the three populations have to do with further adaptations to an underground existence. The following advanced character states are represented in the three species: A_1A_2BCDEFI*KLM*NO*O**P. This grouping does not include the character states used in the phylogeny up to this point. Of these advanced states, only one does not correlate with burrowing specializations in my opinion: K. Two species, *gyldenstolpei* and *roulei*, share the characteristic—the pterygoid bones in medial contact. On the basis of this one characteristic together with the confusion regarding the generic limits of many lygosomines, I think it best at this time to be nomenclaturally conservative and regard the three Thai limbless lygosomine species as representing the same genus. Using this interpretation, each of the species is quite specialized, but it is easiest to envision a common ancestor for *gyldenstolpei* and *roulei* within the genus.

Until the lygosomine genera are redefined, it seems best to call attention to the extreme specializations demonstrated by the three limbless Thai skinks, *anguinoides*, *gyldenstolpei*, and *roulei*, by placing them into a genus, *Isopachys* Lönnberg, 1916, distinct from *Lygosoma*, *Saiphos*, or *Ophioscincus*.

Because the species here included in *Isopachys* have previously been included in the genus *Ophioscincus*, further comment on their relation to *O. australis* is warranted, although any decision is tentative due to lack of skeletal material at this time. *Ophioscincus australis* has one unique scale-field difference in comparison with the three Thai lygosomines: three primary temporals. This character state is shared with the other species of Australian limbless skink examined. In addition, the other Australian limbless skink has several more head scales and a proportionately larger pectoral girdle than any of the other limbless skinks examined, suggesting a relatively more recent entry into the fossorial habitat. It is possible that when further material is available, the Australian limbless skinks may prove the endpoints in a degenerative cline paralleling *Brachymeles*. These bits of morphological data, combined with the zoogeographic improbability of congeneric burrowers in Southeast Asia and Australia (unless burrowers are man-carried, they are usually not zoogeographically vagile forms) lead to the conclusion that the three Thai species do not belong in the genus *Ophioscincus*.

The purpose of the paper was to compare the new series of specimens from Sakaerat with the other known limbless skink species from Thailand. The taxonomic conclusion has been reached that the Sakaerat specimens represent a new genus and species, which are now described.

Davewakeum, new genus. Figures 4, 5.

Type species.—*Davewakeum miriamae*, new species.

Diagnosis.—The only scincine genera in which some or all of the species are limbless are: *Barkudia, Brachymeles, Cryptoposcincus, Davewakeum, Grandidierina, Malacontias, Melanoseps, Nessia, Ophiomorus, Paracontias, Pseudoacontias, Scelotes, Scolecoseps, Sepsophis, Typhlacontias, Voeltzkowia*. *Barkudia* and *Sepsophis* differ from *Davewakeum* in having an external ear. The remainder of the genera either lack an external ear or the character is variable among species within a genus. *Ophiomorus* has a transparent disk in the lower eyelid, *Davewakeum* has a thickened, opaque lower eyelid. *Brachymeles, Melanoseps, Scelotes, Scolecoseps*, and *Typhlacontias* have supranasal scales: *Davewakeum* lacks supranasal scales. *Cryptoposcincus, Grandidierina, Malacontias, Nessia, Paracontias, Pseudoacontias*, and *Voeltzkowia* lack prefrontal scales, *Davewakeum* has prefrontal scales.

Definition.—Nostril pierced in a single nasal scale; upper eyelid absent, lower eyelid composed of one thickened scale; tympanum absent, no indication of external ear; no supranasal scales; single frontonasal scale present; prefrontal scales paired; frontoparietal scales paired; parietal scales paired; interparietal scale present; limbless.

Nasal bones in contact medially; four teeth per maxilla; no pterygoid teeth; palatine and pterygoid bones well separated medially; basipterygoid process of basisphenoid reduced; frontal bone divided; stapes articulating with quadrate; pectoral girdle reduced, all elements present, one pair of ribs attaching to the sternum; no indication of limb bones; osteoderms not noticeably fused or co-ossified with the skull.

Range.—Known only from a restricted region on the edge of the Khorat Pleateau, 60 km. S of the provincial capital of Nakhon Ratchasima, Thailand.

Etymology.—The genus, masculine in gender, is named for Dr. David B. Wake, to whom I owe much professional and personal gratitude.

Davewakeum miriamae, new species. Figure 7.

Holotype.—Field Museum of Natural History number 182550. An adult female from Khao Saton, 300 m. above the Kasetsart University Forestry Station, 60 km. S of Nakhon Ratchasima on Highway 304, Amphoe Pak Thong Chai, Changwat Nakhon Ratchasima, Thailand, collected August 27, 1969 by Sukhum Pongsapipatana.

Diagnosis.—Same as for genus.

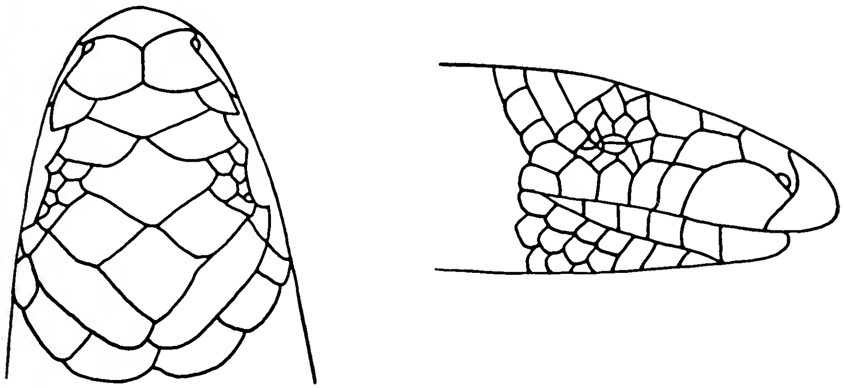

FIG. 7. Dorsal and lateral views of head of *Davewakeum miriamae*, new species.

Description of holotype.—Body slender, head not differentiated from body; scales smooth; rostral large, its apex prolonged backward onto top of head forming an angle; nostril pierced in nasal scale, bordering first supralabial; nasals forming broad median suture, scale slightly broader than long; no supranasals; frontonasal about two-thirds as broad as long, barely contacting frontal; prefrontals well developed, not quite in contact medially; frontal largest scale on head, almost diamond shaped, three-fourths as broad as long; 3 supraoculars, 2 contacting frontal; frontoparietals separate, not in contact on the midline, just shorter than interparietal; interparietal just longer than broad, barely contacting the frontal anteriorly; parietals meet behind interparietal, greatest length less than twice width; 1 pair nuchals.

Two loreals; 4 supraciliaries, 2 presuboculars, 4 postsuboculars; 2 primary temporals; upper temporal borders parietal, third supraocular, posterior supraciliary, posterior postsubocular, lower primary temporal and secondary temporal; lower primary temporal borders upper primary temporal, posterior postsubocular, fifth and sixth supralabials, and secondary temporal; 1 secondary temporal, about equal in size to lower primary temporal; 1 tertiary temporal, broader than long; 6 supralabials, the first much enlarged, the fourth under the eye, not contacting the eyelid.

Mental large, posterior edge straight; 5 infralabials; azygous postmental, 3/7 as broad as long; 2 pairs of chinshields, second longest, each pair separated by one scale.

Rostral, nasal, first supralabial, and mental with much thickened cuticle, first two infralabials with noticeably thickened cuticle.

Twenty-two scale rows at mid-body; dorsal scales smooth, just broader than ventrals; 107 scales between mental and vent; 5 slightly enlarged preanal scales, 4 bordering vent; 101 subcaudal scales, proximal two rows slightly smaller; subcaudal and dorsal caudal scales slightly larger than lateral caudals; tail tip a blunt point terminating in a single, pointed scale.

Coloration in life and preservative tan with darker brown spots on each scale forming a series of lines. Pattern is uniform over entire body and tail except the belly and sides of the body are lighter, and the dark lines are somewhat indistinct.

Measurements (mm.).—Snout-vent, 90.0; total, 160.5; headwidth 5.0.

Paratypes.—FMNH 182535–45, 182546 (cleared and stained), FMNH 182547–49 from the type locality; FMNH 182534 from the Sakaerat Experiment Station, Amphoe Pak Thong Chai, Changwat Nakhon Ratchasima. A sample will be deposited in the Thai National Reference Collection, Applied Scientific Research Corporation, Thailand.

Variation.—The paratypes range in snout-vent length from 48.0 to 114.0 mm., the largest total length is 173.5 mm. The frontoparietal scales are in contact in two specimens, separated in the rest. Nine specimens have an additional single enlarged nuchal scale, one specimen has two pairs of nuchals. One specimen has 5 supraciliaries, the remainder 4. Two specimens have 3 presuboculars on one side of the head, one specimen has 3 on both sides, the remainder have 2 on both sides. The number of postsuboculars ranges from 3 to 6. The fourth supralabial often contacts the lower eyelid. The number of scalerows around mid-body is either 20 (2 individuals) or 22. The number of ventral scales between the mental scale and the anus ranges from 93 to 113. The number of subcaudal scales ranges from 79 to 101. There are from 0 to 5 slightly enlarged preanal scales.

Some individuals are almost uniform brown with tan venters.

Ecological notes.—All the Khao Saton specimens were taken in dry evergreen forest. The Sakaerat specimen was taken in partially cleared dry evergreen forest. Specimens were collected on March 9,

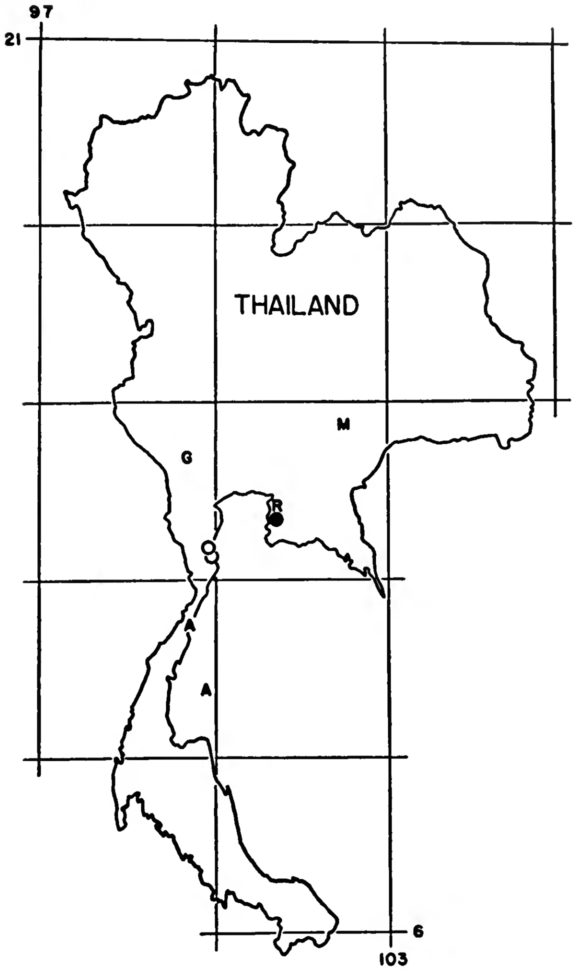

FIG. 8. Map of Thailand showing localities for four species of limbless skinks. A=*Isopachys anguinoides*, G=*Isopachys gyldenstolpei*, Open circles=*I. anguinoides* and *gyldenstolpei* in sympatry, R=*Isopachys roulei*, Solid circle=*I. anguinoides* and *roulei* in sympatry, M=*Davewakeum miriamae.*

1969 (1), March 18, 1969 (1), August 27, 1969 (10), October 3, 1969 (1), November 6, 1969 (1), December 8, 1969 (1), January 1, 1970 (2). There does not appear to be any correlation with the collections and the rainy season. The first specimen was collected at Sakaerat at 21:40 hours, active on the surface of the ground 0.75 m. from a small stream. All the Khao Saton specimens were caught under cover in the daytime. Two specimens were taken from under rocks 30 cm.

in diameter, the rest were collected from 1 to 15 cm. underground. Of the 14 specimens taken underground, six were found between tree buttresses. On August 27, 1969, Mr. Sukhum Pongsapipatana dug up ten individuals in a 4 $m.^2$ area. This area of high skink density (two *Riopa bowringi* were also dug up) was not obviously differentiated from surrounding areas of the forest.

Distribution.—The species is only known from the two adjacent localities listed above. This region is at the eastern edge of a low montane region separating the Khorat Plateau from the Central Valley of Thailand (fig. 8).

Etymology.—The species is named after my wife Miriam, whom I thank for her unbelievable patience and understanding. She discovered the first specimen while helping with field work one evening

An Artificial Key to the Limbless Skinks of Thailand

1A. Second supralabial under middle of eye............*Isopachys gyldenstolpei*
1B. Third or fourth supralabial under middle of eye......................2.
2A. Fourth supralabial under middle of eye..........*Davewakeum miriamae.*
2B. Third supralabial under middle of eye..............................3
3A. 18 scale rows around midbody..........................*Isopachys roulei.*
3B. 22–26 scale rows around midbody.................*Isopachys anguinoides.*

Localities and Specimens Examined of *Isopachys*

Isopachys anguinoides (fig. 8): Thailand—Chon Buri: Bang La Moung, TNRC 522:653; Prachuab: Nong Kae, TNRC 522:2–8, 522:9 (cleared and stained), 522:10–13, 522:161–2, 522:188–192 (1 of this untagged series cleared and stained), 522:651–2; Prachuab Khiri Kahn: Bangtaphan, type locality; Hua Hin, FMNH 177487–88, 177521; Gulf of Siam: Koh Tao.

Isopachys gyldenstolpei (fig. 8): Thailand—Kanjanaburi: Approx. 6 km. from Kanjanaburi, TNRC 522:1, 522:14–15, 522:122–124, 522:125 (cleared and stained); Prachuab: Nong Kae, TNRC 522:169; Prachuab Khiri Kahn: Hua Hin, FMNH 178323, 178324 (cleared and stained); Koh Lak Paa, type locality.

Isopachys roulei (fig. 3): Thailand—Chon Buri: Ang Hin, FMNH 177265–66, 177267 (cleared and stained); Bang Lamung, TNRC 522:495, 522:653, Bang Saen, FMNH 177268.

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