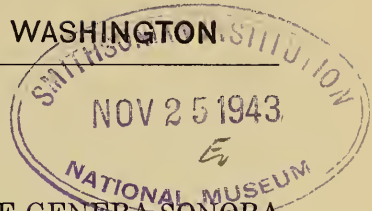


74.0673

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON



THE MEXICAN SNAKES OF THE GENERA *SONORA*
AND *CHIONACTIS* WITH NOTES ON THE
STATUS OF OTHER COLUBRID GENERA.¹

BY WILLIAM H. STICKEL,

*U. S. Fish and Wildlife Service, Patuxent Research Refuge,
Bowie, Maryland.*

The primary purpose of this paper is to present a revision of the *michoacanensis* group of the genus *Sonora* and to discuss the generic position of this group. Circumstances have made it advisable to include all projected taxonomic changes in *Sonora*, and to give ranges, and localities in Mexico, for the forms of *Sonora* and *Chionactis* occurring in that country. The concepts of several species and subspecies of *Sonora* are altered and the monotypic genus *Chionactis* is recognized for the very distinct species *occipitalis*. A new key to all the snakes of these genera is appended. Notes are given on several other colubrid genera which have been associated with *Sonora* or are believed to be related to this genus. This paper supplements my previous treatments of the *S. semiannulata* and *S. occipitalis* groups (1938 and 1941), and like them is intended as a preliminary work.

The species *michoacanensis* was placed in the genus *Contia* by the original describer, Dugès, and by Cope in two publications, but most authors have followed Boulenger (1896) in assigning it to *Scolecophis*. Dunn (1928) and Taylor (1937) allocated the species to *Sonora*, and both writers pointed out the possibility that *michoacanensis* was also congeneric with *Scolecophis atrocinctus*. If this arrangement were followed

¹ Extracted from material prepared in partial fulfillment of the requirements for the doctoral degree at the University of Michigan.

NOV 24 '43

the inclusive genus (*Sonora* plus *Scolecophis*) would take the older name, which is *Scolecophis*.

A comparative study of the *michoacanensis* and *semiannulata* groups revealed a very close agreement in scutellation, teeth, dentigerous bone structure, microscopic scale striation, and color pattern. There are hemipenial differences between the two groups, but they do not indicate relationship of *michoacanensis* to *Scolecophis*. It is evident that Dunn and Taylor were correct in assigning *michoacanensis* to *Sonora*.

In search of information on generic relationships, the maxillary, transverse, palatine, and pterygoid bones (which can be removed without injury to the specimen) of a number of genera were studied and several trenchant points of difference between *Sonora* and *Scolecophis* were found.² These characters are contrasted in the tabulation that follows.

Sonora.

1. Palatine anteriorly ends at its maxillary process. Palatine teeth 6 to 9.
2. No postdental process on maxillary, or occasionally a very small one.
3. Pterygoid broad, with abrupt, oblique end. Pterygoid toothed to end of alveolar edge.
4. Teeth not flattened, tips pointed.
5. Outer arm of transverse rod-like or flattened.
6. Three enlarged posterior maxillary teeth.

Scolecophis and *Tantilla*.

1. Palatine anteriorly extends beyond its maxillary process, bearing 2 to 4 teeth anterior to the maxillary process. Palatine teeth 11 to 16.
2. Large postdental process present on maxillary, about equal in length to the enlarged maxillary teeth (behind which it stands).
3. Pterygoid very narrow (from rather broadly saber-shaped to almost linear), tapering gradually to end. Pterygoid with long, toothless tail portion.
4. Teeth flattened anteroposteriorly (usually conspicuously so), tips appearing rounded when viewed anteriorly.
5. Ventral edge of outer arm of transverse strongly extended downward around the end of the maxillary.
6. Two enlarged posterior maxillary teeth.

Scolecophis and *Tantilla* stand out as representatives of a distinct generic group. They are apparently inseparable on jaw characters and, as previous authors have believed, they are certainly intimately related.

²The specimens of which the bones mentioned above were studied are distributed thus: *Sonora*, 17; *Procinura*, 1; *Chionactis*, 3; *Toluca*, 2; *Chilomeniscus*, 2; *Stenorhina*, 5; *Ficimia*, 1; *Scolecophis*, 3; *Tantilla*, 5 (1 each of the following species: *rubra*, *semicineta*, *boulengeri*, *coronata*, *gracilis*).

Their retention as distinct genera is justified, however, as *Scolecophis* differs from *Tantilla* by having a loreal, scale pits and angulate ventral scutes, and apparently differs from *Tantilla* (and from *Sonora*) in the possession of large hemipenial spines placed opposite the sulcus instead of occurring along the sulcus. I am not sufficiently familiar with the various groups of tantillas to know whether this penial distinction is constant.

The characters given for *Sonora* in the table above apply equally well to the closely related genera *Procinura*, *Chionactis*, and *Toluca*, and also apply to the more distantly related *Chilomeniscus*. The data of Taylor and Smith (1942) indicate that *Pseudoficimia* and *Conopsis* are other genera of this group. *Stenorhina* agrees with the characters listed for *Sonora*, but differs in its definitely opisthoglyph teeth. In the latter respect it is approached by occasional members of the other genera, so present evidence does not determine whether or not *Stenorhina* may be associated with this assemblage of genera.

The nearest relative of *Sonora* is apparently the monotypic genus *Procinura*, which has been found at only three places, all in the Rio Fuerte drainage of Sonora and Chihuahua. *Procinura aemula* is almost indistinguishable from typical *Sonora* in hemipenis, teeth, structure and shape of dentigerous bones and head scutellation. The scales of the caudal region of *Procinura* are strikingly modified by protuberant keels which have a free spinous tip near the posterior margin. The color pattern of *Procinura* is developed along a different line than that seen in any described form of *Sonora*.

It is believed that *Sonora*, *Procinura*, *Chionactis*, *Toluca*, *Conopsis*, *Pseudoficimia*, *Chilomeniscus*, and perhaps *Stenorhina* and *Ficimia*, are members of one generic group, or tribe, and that *Scolecophis* and *Tantilla* belong to another group of, at best, distant relationship to the above group. Various other genera which would probably fit into one of these two series have not been available to me for dissection.

Sonora was commonly united with *Contia* by the earlier writers and the two genera are regarded by most modern herpetologists as being closely related. Externally they are very much alike, the only constant, tangible differences being in the coloration. However, study of the skull and hemipenis proved *Contia tenuis* to be totally unrelated to *Sonora*. Contrary to previous statements, *Contia* has a sulcus which is apically forked. Cope's figure of the hemipenis, the basis of this error, appears to have been drawn from a specimen of *Sonora*. The tooth-bearing bones are all very slender and are entirely different in shape from those of *Sonora* and its relatives. The teeth are slim, isodont, ungrooved and about half as numerous as in *Sonora*. Perhaps *Contia* may best be thought of as a monotypic xenodontine genus related to *Rhadinaea*. I hope to discuss this genus in more detail elsewhere.

The three posterior maxillary teeth of *Sonora* are moderately enlarged and each bears a posterolateral flange in front of which there is a shallow but distinct groove. This groove is decidedly lateral in position and is very different from the channel of true opisthoglyphs such as *Trimor-*

phodon and *Coniophanes*. The confusion of the two types of dentition in the past has led to many mistaken ideas and groupings. Dentition extremely similar to that of *Sonora* occurs in the related genera *Chionactis*, *Toluca*, *Chilomeniscus*, and apparently in *Pseudoficimia*. *Tantilla* and *Scolecophis* have lateral grooves much as in *Sonora*, but the edge of the posterolateral flange has a slight tendency to bend forward and more or less arch around the groove. By a continuation of this line of development a truly opisthoglyph tooth might be evolved.

Posterolateral flanging and lateral grooving of the teeth may be developed in varying degrees, as in and between the very closely related genera *Conopsis* and *Toluca*, but qualitatively this type of dentition is sufficiently constant and characteristic to deserve a descriptive name. Such a designation will serve to emphasize the important distinction between snakes with teeth of this sort and those which are truly opisthoglyphous or aglyphous. As no name seems to have been previously proposed for it, this dental type may be termed pleuroglyphous.

Genus *Sonora*.

Sonora michoacanensis agrees with the genotype, *S. semiannulata*, in most essentials, and in color approaches the *semiannulata* group closely through two forms described below. However, the two groups are readily separable by the penial characters listed below. The data are based on *S. m. michoacanensis* (Field Mus. 37141), *S. m. mutabilis* (Amer. Mus. 19714 and 19716) and on numerous specimens representing most of the forms of the *S. semiannulata* group.

S. michoacanensis group.

1. Several of the lower rows of calyces with spinous papillae.
2. Calyces distinctly papillate.
3. 3 to 7 small and medium sized spines on plane of the large basal, sulcar spines and below zone of small spines.
4. Without spines alongside the large basal spines.
5. Spines in zone of small spines appearing hooked, due chiefly to the greater sigmoid curvature of the whole spine.
6. Smaller acalyculate area between apical lobes.
7. Length of hemipenis 9, 10, and 11 caudals (in 3 specimens).

S. semiannulata group.

1. One, or at the most two, of the lower rows of calyces at all spinous.
2. Calyces with short, triangular lobes (except at top of hemipenis).
3. 8 to 14 small and medium sized spines on plane of the large basal, sulcar spines and below zone of small spines.
4. Almost always with a spine beside each basal spine.
5. Spines in zone of small spines not hooked, the whole spine with only a slight sigmoid curvature.
6. Well developed acalyculate area between apical lobes.
7. Length of hemipenis 11 to 15 caudals, usually 12 or 13.

The *michoacanensis* group is remarkable for its brilliant, extremely variable, sex-correlated pattern. The males of *mutabilis* are almost as different from the females as either is from *michoacanensis*, and different regions of the body of one snake may be as diverse as distinct species usually are. These snakes are not only local in their distribution, but rare to all collectors; the three recognized forms are known from only 18 specimens.

Sonora m. michoacanensis (Dugès).

Contia michoacanensis Dugès (Cope), 1884 (1885), Proc. Amer. Philos. Soc. XXII, pp. 178–179. (Michoacan, Mexico.)

Cope, 1887, Bull. U. S. Nat. Mus. no. 32, p. 81.

Elapomorphus michoacanensis Cope, 1895, Trans. Amer. Philos. Soc. XVIII, p. 218; hemipenis pl. XXIX, fig. 6.

Homalocranium michoacanense (part) Günther, 1895, Biol. Cent. Amer. p. 150.

Dugès, 1896, La Natureza, ser. 2, vol. 2, pp. 482, 485.

Chionactis michoacanensis Cope, 1896, Amer. Nat. XXX, p. 1024.

Cope, 1898 (1900), Ann. Rep. U. S. Nat. Mus., p. 936.

Scolecophis michoacanensis (part) Boulenger, 1896, Cat. Sn. Br. Mus. III, p. 211, 212.

Cope, 1898 (1900), Ann. Rep. U. S. Nat. Mus., p. 1109.

Gadow, 1905, Proc. Zool. Soc., vol. 2, no. 15, p. 225.

Werner, 1924, Arch. Nat. IX (A12) pp. 144, 145.

do Amaral, 1929, Mem. do Inst. Butantan, tomo IV, p. 218 (92).

Taylor, 1933, Copeia, no. 2, p. 97.

Sonora erythrura Taylor, 1937, Herpetologica, vol. 1, no. 3, pp. 69–71, pl. VI, fig. 1. (Taxco, Guerrero, Mexico).

Type.—The type specimen is apparently lost. Dr. Hobart M. Smith found that the supposed type specimen at present in the Museo Alfredo Dugès, Colegio del Estado de Guanajuato, not only fails to agree with the type description, but comes from Guerrero. The Dugès specimen from Michoacan, now in the British Museum (no. 1903.3.21) is the most suitable choice for neotype and is so designated.

Diagnosis.—Differs from all members of the *semiannulata* group in having a distinctly tricolor pattern, at least anteriorly, and from the other members of the *michoacanensis* group in having an unbanded tail, except insofar as the last body band may overlap the base of the tail.

Range.—Known only from Guerrero and Michoacan, Mexico. According to Dr. Smith, the three definite localities (see table of data) all lie within the Lower Balsan biotic province (Smith 1939, p. 15, 1940), although small scale maps of the biotic areas cannot show this connection.

Author of name.—Cope has always been considered the describer of this species because the name and description first appeared in one of his papers. However, in the original description the name appears, "*Contia michoacanensis* Dugès MS." In subsequent publications Cope cited Dugès as the describer. Article 21 of the International Code of Zoological Nomenclature applies to this case;

TABLE 1
DATA ON THE KNOWN SPECIMENS OF *Sonora michoacanensis michoacanensis*.

Collector,	Number of specimen.	Locality.	Sex.	Ventrals.	Caudals.	Gray body bands by red (excluding nuchal).	Black body bands not split by red (excluding nuchal).	Source of data.
? ?	?	Michoacan	♂?	152	37(+?)	8	2	Orig. desc.
Brit. Mus.	1903.3.21	Michoacan	♂	165	44	12	3	H. W. Parker.
Field Mus.	37141	Apatzingan, Michoacan.	♂	152	43	1	0	Spec. exam.
Taylor-Smith	5440	10 mi. S. of Taxco, Guerrero.	♂	163	47	15	7	E. H. Taylor, 1937.
Dugès Museo		Guerrero	♀	177	43+	21	13	H. M. Smith.
Mus. Comp. Zoology.	33650	Chilpancingo, Guerrero.	♀	175	47	18	10	Spec. exam.
Field Mus.	39128	Apatzingan, Michoacan.	♀	172	36	8	0	Spec. exam.
Field Mus.	39129	Apatzingan, Michoacan.	♀	171	39	12	1	Spec. exam.

DATA ON THE KNOWN SPECIMENS OF *Sonora michoacanensis mutabilis*.

Collection.	Number of specimen.	Locality.	Sex.	Ventrals.	Caudals.	Black body		Source of data.
						Gray body by red bands.	bands not split by red (excluding nuchal).	
Amer. Mus.....	19714.....	Federal Dist.....	♂	166	43+	15	0	Spec. exam.
Amer. Mus.....	19716.....	Federal Dist.....	♂	163	48	15	0	Spec. exam.
Taylor-Smith....	4659.....	Near Magdalena, Jalisco.	♂	162	45	17	2	Spec. exam.
Taylor-Smith....	4661.....	Near Magdalena, Jalisco.	♂	162	45	15	0	Spec. exam.
Brit. Mus.....	92.10.31.42.....	Mezquital del Oro, Zacatecas.	♂	160	45	12	0	H. W. Parker.
Brit. Mus.....	92.10.31.43.....	Mezquital del Oro, Zacatecas	♂	166	46	18	0	H. W. Parker.
Amer. Mus.....	19715.....	Federal Dist.....	♀	173	37+	31	25	Spec. exam.
Amer. Mus.....	Tied with 19714-6.	Federal Dist.....	♀	173	43	27	23	Spec. exam.
Taylor-Smith....	4660.....	Near Magdalena, Jalisco.	♀	168	40+	26	17	Spec. exam.

"The author of a scientific name is that person who first publishes the name in connection with an indication, a definition, or a description, unless it is clear from the contents of the publication that some other person is responsible for said name and its indication, definition, or description."

Since Cope has made it very clear that Dugès was responsible for the description of this species, and since there is no reason to suspect that the name itself was coined by Cope, the species should be attributed to Dugès.

Remarks.—In the snakes of the *Sonora michoacanensis* group the only units of color pattern that provide counts practical for purposes of comparison are the grayish bands. This is due to the fact that even on different parts of one individual the red bands vary in size from several scales in length to nothing, and the black bands reciprocally present all degrees of splitting or fusion.

A photograph of this subspecies appears in Taylor, 1937, pl. VI, fig. 1.

Sonora michoacanensis mutabilis subsp. nov.

Homalocranium michoacanense Günther, 1895, Biol. Cent. Amer., p. 104, 150, pl. 36, figs. B and C.

Scolecophis michoacanensis (part) Boulenger, 1896, Cat. Sn. Br. Mus., vol. 3, pp. 211–212.

Sonora michoacanensis Dunn, 1928, Amer. Mus. Novitates, no. 314, p. 2.

Taylor, 1937, Herpetologica, vol. 1, no. 3, pp. 71–72, pl. 6, fig. 2.

Holotype.—Collection of E. H. Taylor and H. M. Smith, no. 4661, male, taken near Magdalena, Jalisco, Mexico, by Dr. Hobart M. Smith, on July 29, 1935.

Paratypes.—E. H. Taylor—H. M. Smith numbers 4659 and 4660 from type locality; British Museum of Natural History numbers 92.10.31.42 and 92.10.31.43 both from Mezquital del Oro, Zacatecas (not Jalisco); American Museum of Natural History numbers 19714, 19715, 19716 from the Federal District.

Range.—Known from Jalisco, extreme southern Zacatecas and from the Federal District of Mexico. This distribution suggests that the form is characteristic of the Austro-occidental biotic area.

Diagnosis.—Distinguished from *S. m. michoacanensis* by the banded tail, and from the following species by the narrowness of the grayish bands, which are much shorter anteroposteriorly than are the unsplit black bands.

Description of holotype.—See also table of data. Taylor, 1937, describes the type and the Jalisco paratypes.

Male; scale rows 15–15; nasals divided below; loreals nearly square; temporals 1–2; supralabials 7; infralabials 6; first three infralabials touch anterior chin shields and only the fourth touches the posterior chin shields, which are separated by a single small scale; seven rows of irregular small scales anterior to ventrals; oculars 1–2; sixth upper labials scarcely larger than fourth or fifth.

Abdomen of preserved specimen light coral, becoming light brownish coral on sides and back; chin and upper lip white; snout dark gray; black

crest from nasals around eyes and over back of head from anterior end of frontal to two-thirds of the way back on the parietals; nuchal band starting on second row of neck scales and extending backwards eight rows and downward, barely touching ventrals; rest of black bands two scales long, the second band touching ventrals, and a few posterior ones faintly reaching abdomen; light bands distinctly grayish; black bands all split by red, but least split between tenth and eleventh sets, where the red band is only one and one-half scales long as contrasted to seven between first and second sets; tail with three sets of bands separated by red areas thirteen scales long; two anterior sets of bands encircle tail.

Remarks.—A female of this subspecies is well shown by Taylor (1937, pl. 6, fig. 2). Günther (1895, pl. 36, figs. B and C) depicts two males in color. It is probable that Günther was incorrect in portraying the light bands as yellow rather than gray.

The name *mutabilis* refers to the process of pattern change of which different stages are easily visible in the contrast between the sexes, and even on different regions of a single female specimen.

Sonora, species.

?*Contia episcopa isozona* Dugès, 1896, La Natureza, 2nd ser., vol. II, cuaderno 11, p. 481. (Zitácuaro, Michoacan).

?*Scolecophis atrocinctus* Cope, 1887, Bull. U. S. Nat. Mus. 32, p. 83 (Toluca).

Günther, 1895, Biol. Cent. Amer., p. 156 (Toluca).

Gadow, 1905, Proc. Zool. Soc. Lond., p. 225 (Toluca).

?*Homalocranium atrocinctum* Gadow, 1905, Proc. Zool. Soc. Lond., p. 233 (Toluca).

An undescribed species is apparently represented by an uncatalogued specimen (bearing an old metal tag no. 6444) in the University of Michigan Museum of Zoology. The species is sufficiently distinct to be described from the single specimen, but the snake bears no acceptable locality data. I am unwilling to name the species because the type locality is unknown, and also because its diagnostic differences lie in the color pattern, which is fantastically variable in this group of the genus.

Locality.—The snake is in a bottle with two skins and a slip of paper citing W. B. Richardson as collector, Matagalpa, Nicaragua as locality, and May 6, 1893, as date of receipt. Richardson's data on collections have been proved erroneous for a variety of species. Dr. Emmett R. Dunn, who has made a study of the several Richardson collections, states that Richardson was in the Plateau region of Mexico, apparently traveling somewhat, before he settled at Matagalpa, Nicaragua. Dr. Dunn found that the 1893 consignment seemed to be entirely Mexican, but was sent from Matagalpa and became so labeled.

An *Anolis cumingii* specimen in the Stanford University Museum bearing the locality "La Paz, Mexico," was collected by "Mr. Richardson" in 1895. Dr. H. M. Smith suggests that the collector is probably the same W. B. Richardson, and that the La Paz referred to is most likely to have been La Paz, Puebla. Four other towns of this name in Mexico

he considers unsuitable ecologically for this *Anolis* and other lizards collected by Richardson. The region has been but poorly worked and may well be the source of some of Richardson's unusual specimens.

Dr. Smith informs me that there are no specimens or records of *Scolocophis atrocinctus* from Mexico except for the above-cited Toluca record of Cope, which was copied by Günther and Gadow. Dr. Smith believes that there is no known Mexican snake to which Cope might have applied this name except for the species under discussion. This Toluca record, coupled with Dugès' record of *Contia episcopa isozona* from nearby Zitácuaro, creates a probability that there is, in that region, a dark-and-light-banded snake not represented in our museums, unless by the Richardson specimen.

The two skinks that accompanied the snake were identified by Dr. Joseph R. Bailey as *Eumeces l. lynce*. According to Taylor (1936, p. 172) this lizard is a high mountain or plateau form known from the states of Vera Cruz, San Luis Potosí, Hidalgo, Puebla, Guanajuato, and perhaps parts of Guerrero and Michoacan. This region overlaps the known range of *mutabilis*, but in general lies more to the east.

We conclude that the Richardson specimen probably came from an area within or somewhat to the east of the ranges of *mutabilis* and *michoacanensis*, on the southern part of the Mexican Plateau or in the surrounding mountains.

Description.—The specimen is a female having 15–15 scale rows, 178 ventrals and 38 caudals. The nasals are divided below the nostril; the loreal is lacking on one side; preoculars 1, postoculars 2, the upper one larger; temporals 1–2; supralabials 7, infralabials uncountable; posterior chin shields in contact.

The snake appears to be faded, and no colors other than black and white are evident. There is a distinct head crescent. The body bears 26 black bands that are about 4 scales long anteroposteriorly. None of the body bands reaches the abdomen. The second and third bands are deeply notched laterally, probably showing the beginning of the splitting process. None of the posterior body bands shows any real signs of splitting, nor does the first body band. The light bands are about equal in size to the black bands, a condition which is unknown in *mutabilis* and *michoacanensis*. The tail is banded in triads as in *mutabilis*. There are 4 primary light bands on the tail and 3 other light areas, presumably once red, which are 5 or 6 scales long. The caudal black bands are about 2 scales long; the two anterior ones encircle the tail.

Remarks.—This species is intermediate in color pattern between *michoacanensis* and *mutabilis* on one hand and the forms of the *semiannulata* group on the other. I believe that the bicolor condition is more generalized, and in *Sonora* more primitive, than the tricolor arrangement. Hence, this species may be considered as representing a stage in pattern development through which the other two races of the group must have passed. Some of the females of *mutabilis* are not greatly different from the Richardson specimen, but the known *mutabilis* specimens have at least a few of the anterior black bands split by red, and their light bands are much narrower than the unsplit black bands.

Sonora mosaueri Stickel.

Sonora mosaueri Stickel, 1938, Copeia, no. 4, pp. 189–190.

Type locality.—Comondu, Baja California.

Range.—Known only from the vicinity of Comondu (Mus. Vert. Zool. 13770–3; U. S. Nat. Mus. 67381).

Remarks.—This species is very closely related to *semiannulata*, of which it may prove to be a subspecies.

Sonora semiannulata semiannulata Baird and Girard.

Sonora semiannulata Baird and Girard, 1853, Cat. N. Amer. Rept., pt. 1, p. 117.

Type locality.—It is proposed to restrict the type locality, originally given as "Sonora, Mexico," to the vicinity of the Santa Rita Mountains of Arizona. The reasons for this change are discussed below. The holotype is U. S. Nat. Mus. no. 2109.

Range.—This form, as here defined, is known only from the region of the Santa Rita Mountains, Arizona. Its discovery in the Sierra Madre Occidental of Mexico is to be expected.

Taxonomic notes.—It has long been known that the ventral and caudal counts of the type specimen are significantly lower than those of any other specimens included in *S. s. semiannulata*, but inasmuch as the type has certain peculiarities of cephalic scutellation (i. e., symmetrically divided supraoculars) it was thought that the ventral counts might be merely a correlated abnormality. A specimen with almost identical ventral and caudal counts, but with undivided supraoculars, has now come to notice. It is number 3419 in the Royal Ontario Museum of Zoology and was collected in the Santa Rita Mountains, Arizona, by Dr. F. H. Snow in 1907. It reached the Ontario Museum via F. A. Hartman, with eight other reptiles of Snow's 1907 Santa Rita collection. This snake is very small, 119 mm. in total length, but is apparently normal in all respects. The holotype, 244 mm. long, is medium-sized for a *Sonora*.

Both specimens are males. The U. S. N. M. snake has 153 ventrals and 41 caudals, the R. O. M. Z. specimen 154 and 43. The scale rows of both are 15–14. In *isozona*, the form that occurs east, north and west of *semiannulata* and which has been lumped with it, the caudal scales of males vary from 49 to 63 in 50 specimens, averaging 53.94 (standard error of the mean 0.396, standard deviation 2.80). The ventrals of the *semiannulata* specimens are at the extreme lower end of the range of variation in *isozona*. The ventral plus caudal figure for males of *isozona* varies from 204 to 230, averaging 213.76 (standard error of the mean 0.809, standard deviation 5.726) whereas in the *semiannulata* specimens it is 194 and 197. In *Sonora* such differences are of considerable diagnostic importance.

The R. O. M. Z. specimen has three enlarged, laterally-grooved, posterior maxillary teeth as would be expected. The type has not been dissected.

It becomes important to determine within what area the type locality may lie, and whether this area includes the Santa Rita mountains. The type locality, "Sonora, Mexico," as used by Baird and Girard in connection with the Graham and Clark collection, refers almost entirely to Arizona south of the Gila River. Graham's party was in what is now Sonora only while making a hurried trip to Santa Cruz and back through the upper Santa Cruz Valley. I have studied Graham's detailed account of his trip. Certain localities mentioned by him were fixed with the help of old maps and documents in the National Archives, and his route was followed on large scale topographic maps. It was concluded that Graham's party went only as far west as the southeastern base of the Santa Ritas, which was approached from the northeast. They then headed southeast along the northern slopes of the Canelo Hills to a point where they could cut through to the headwaters of the Santa Cruz River, which was then followed southward to the town of that name. From Santa Cruz they returned directly to New Mexico by an unstated route.

Since the R. O. M. Z. Santa Rita specimen closely resembles the type specimen, while snakes from the nearby Huachuca Mountains are *isozona*, it seems highly probable that the type was collected in the region of the Santa Rita Mountains, Santa Cruz County, Arizona.

Sonora semiannulata isozona (Cope).

Contia isozona Cope, 1866, Proc. Acad. Nat. Sci. Phila., p. 304.

Sonora miniata miniata Stickel, 1938, no. 4, p. 187 (Mesa, Arizona).

Type locality.—Fort Whipple, Yavapai Co., Arizona. The holotype is U. S. N. M. no. 11417. It was collected by Dr. E. Coues in 1865.

Range.—Southern Idaho, Utah, Nevada, Arizona (exclusive of the ranges of *S. s. gloydi* and *S. s. semiannulata*), the Panamint Mountains of California, and south in Baja California at least to Santa Rosalia.

Mexican localities.—The only definite Mexican station for this race is Santa Rosalia, in the southern district of Baja California (Mus. Hist. Nat. Paris). It is to be expected in Sonora and, perhaps, in western Chihuahua. The Field Museum has a specimen (no. 1541), apparently of this subspecies, which is supposed to have come from the rather unlikely locality of Jaral, Coahuila. Dr. H. M. Smith has encountered specimens of *Salvadora* and *Sceloporus* in the same collection, recorded as taken at Jaral by the same collectors, for which this locality seems improbable on both geographic and ecological grounds. Hence, this puzzling *Sonora* record may be considered as very dubious.

Taxonomic notes.—*S. m. miniata* is here synonymized with *S. s. isozona*. The form resulting from this combination may be completely patterned with cross bands and a head crescent, or entirely unbarred, with the head dusky well back onto the nape. Intermediate patterns are not known, except that the plain specimens occasionally have a nuchal band. These color phases occur together in some localities, but frequently they are segregated in local colonies of one phase. It has become increasingly clear that the best interpretation of this condition is based upon the

assumption that the character of dusky nape and head is genetically linked with the gene for unbanded body, and that the modifying genes producing intermediates between the color phases in *blanchardi* and *episcopa* are lacking in *isozona* or are suppressed by some one gene. The effect could also be produced by different alleles of the genes involved, or by several other genetic mechanisms. As regards the colonial segregation of the phases, it is a recognized fact that semi-isolated populations tend to acquire different combinations of the variable characters and become standardized for these combinations. (For a discussion of such phenomena see Dobzhansky (1937, especially pp. 47-55, 133-138, 146-148). There are several other instances of local or regional color-phase stereotypy in this genus.

Scattered throughout the range of *isozona* are individuals which are apparently, and probably genetically, indistinguishable from *linearis*. These striped specimens constitute less than 15% of the population of *isozona*. Practically all true *linearis* are readily recognizable as such. Since so large a percentage of each race is properly identifiable, recognition of both subspecies is justified.

In western Arizona and southern Nevada, where *linearis* and *isozona* intergrade, the tendency toward striping is most manifest and may even be discerned in banded individuals.

Sonora semiannulata linearis Stickel.

Sonora miniata linearis Stickel, 1938, Copeia, no. 4, p. 189.

Type locality.—Seeley, Imperial Co., California.

Range.—Extreme northeastern Baja California, southeastern California in Imperial Co., eastern San Diego Co., Riverside Co., and southeastern San Bernardino Co.

Mexican locality.—Mt. Mayor Cocopah, in Cocopah Range (Phil. Acad. 16101).

Sonora semiannulata blanchardi Stickel.

Sonora semiannulata blanchardi Stickel, 1938, Copeia, no. 4, pp. 185-186.

Type locality.—Northeastern slopes of Chisos Mountains, Brewster Co., Texas.

Range.—Known only from Brewster Co., Texas, and Chihuahua, Mexico. Specimens from the vicinity of El Paso, Texas and the upper Rio Grande Valley of New Mexico are intergrades with *S. s. isozona*.

Mexican localities.—Chihuahua: 20 miles S. of Chihuahua City (Taylor-Smith 4681), Lake Santa Maria (U. S. N. M. 46591). This subspecies must occur in Coahuila, and possibly in Nuevo Leon as well. (See note under *S. e. episcopa*).

Sonora episcopa episcopa (Kennicott).

Lamprosoma episcopum Kennicott, 1859, U. S. and Mex. Bound. Surv., p. 22, pl. 8, fig. 2.

Type locality.—Eagle Pass, Maverick Co., Texas. The type locality may prove to have been but a shipping point. The U. S. N. M. speci-

men 2042, the first specimen mentioned in the original description is now designated as lectotype.

Range.—From Nuevo Leon, Mexico, northeast to St. Clair Co., Missouri; west through Russel Co., Kansas, to southeastern Colorado; south through eastern New Mexico to the Pecos Valley of Texas.

Mexican localities.—Boulenger (1894, p. 265) lists two specimens, "a" and "b," from Nuevo Leon. The counts given for specimen "b" agree well with *episcopa*, but those given for specimen "a" are either wrong or the specimen is an odd *blanchardi*, or is an intergrade between *blanchardi* and *episcopa*. With this possible exception, no intergrades between these two forms are known.

Sonora episcopa taylori (Boulenger).

Contia taylori Boulenger, 1894, Cat. Sn. Br. Mus., vol. 2, p. 265, pl. 12, fig. 3.

Type locality.—Duval Co., Texas, and Nuevo Leon, Mexico, are both mentioned in the original description. Since the closely related form *S. episcopa episcopa* is also recorded from Nuevo Leon, the type locality may be restricted to Duval Co., Texas, where *taylori* has been taken repeatedly, but *episcopa* never. Boulenger's specimen "a," a male with 126 ventrals, may be designated the lectotype.

Range.—Nuevo Leon, Mexico, and South Texas from Cameron, Hidalgo and Webb counties north to Calhoun, Wilson and, perhaps, Bexar counties.

Mexican localities.—Nuevo Leon (Brit. Mus. Nat. Hist.). No doubt this subspecies also occurs in northern Tamaulipas.

Taxonomic notes.—This well-characterized form is now considered a subspecies of *episcopa* on the basis of intermediate specimens from Hays and Travis counties, Texas. Also, the population of Bosque and McLennan counties, 100 miles to the north, is significantly lower in its counts than are any other known *episcopa* populations, but its counts are not as low as those of Hays and Travis counties specimens. This quite possibly indicates a trend in the direction of *taylori*. Thus, the available data suggest a north to south intergradation along the east face of the Balcones Escarpment in central Texas. There are no specimens to provide information as to the relationship of the races in south-central Texas along the southern arm of the Balcones Escarpment, and the condition in Nuevo Leon is not determinable from present data.

In general, *taylori* occurs in areas lower than 500 feet in altitude, whereas the records for *episcopa* indicate that it inhabits higher terrain.

Genus *Chionactis*.

The differences between *Sonora occipitalis* and the rest of the genus are of such variety and magnitude that generic segregation is necessary. The name *Chionactis* of Cope (1860) is available for *occipitalis*. The writer is averse to the generic separation of rather closely related species, particularly when one of the resultant genera is monotypic, but the dif-

ferences between *Chionactis* and *Sonora* are such that the retention of both groups in the same genus would be contrary to all ordinary standards of generic characterization. Deviations may be observed in all parts of the body, and only the major ones are listed in the tabulation that follows.

- | | |
|---|---|
| <p><i>Sonora</i> (and <i>Procinura</i>).</p> <ol style="list-style-type: none"> 1. No nasal valve. 2. Abdomen rounded. 3. Snout normal, rounded. 4. 1, occasionally 2, maxillary foramina. 5. Maxillary teeth 11 + 3 to 13 + 3. 6. Sulcus terminating in a bare area between the lobes. 7. 3 to 14 small and medium sized spines on the plane of the large basal spines and below the zone of small spines. 8. Spines in upper part of zone of small spines not or but little enlarged just beneath the surface of the hemipenis. | <p><i>Chionactis</i>.</p> <ol style="list-style-type: none"> 1. Nasal valve present. 2. Abdomen angled. 3. Snout flattened, spade-like. 4. 3 maxillary foramina. 5. Maxillary teeth 8 + 3 or 9 + 3. 6. End of sulcus surrounded by calyces, no bare area present at top of penis. 7. No spines below zone of small spines except the two large basal spines. 8. Spines in upper part of zone of small spines much enlarged just beneath the surface of the hemipenis. |
|---|---|

Chionactis occipitalis annulatus (Baird).

Lamprosoma annulatum Baird, 1859, U. S. Mex. Bound. Surv., p. 22.

Type locality.—Colorado Desert.

Range.—Imperial Co. and eastern San Diego Co., California, and southwestern Arizona.

Mexican localities.—This snake has not yet been recorded from Mexico, but it undoubtedly occurs in both northern Baja California and northwestern Sonora.

Chionactis occipitalis palarostris (Klauber).

Sonora palarostris Klauber, 1937, Trans. San Diego Soc. Nat. Hist., vol. 8, p. 363–365.

Type locality.—Five miles south of Magdalena, Sonora (Klauber 26771).

Range.—Known only from the type locality and from Costa Rica Ranch (50 miles west of Hermosillo, Sonora) (Mus. Comp. Zool. 36890).

KEY TO THE SNAKES OF THE GENERA *Sonora* AND *Chionactis*.¹

- 1a Abdomen rounded; snout normal, rounded, not spade-like; no nasal valve; scale rows various (*Sonora*).....5

¹Where there is no gap between contrasted figures in this key it may be assumed that a separation was made between overlapping curves of variation. In arriving at each such point of separation the actual and theoretical dispersions for the character were carefully considered. The key should correctly identify about 85% to 90% of the specimens.

- 1b Abdomen angled; snout flattened, spade-like; a nasal valve present; scale rows 15-15 (*Chionactis*).....2
- 2a Total number of bands on body and tail plus the number of body bands not entirely encircling the body equals 52 or more; bands usually brown; interspaces without reddish saddles.....
C. occipitalis occipitalis
- 2b Total number of bands plus number of incomplete body bands equals 51 or fewer; bands usually black, widened on the abdomen; interspaces, at least in life, with ill-defined reddish saddles on light ground color (except in *C. o. klauberi*).....3
- 3a Total number of bands 22 or more.....4
- 3b Total number of bands 21 or fewer.....*C. occipitalis palarostris*
- 4a No definite, secondary, brown crossbands present between the primary dark bands, although there may be dark edging and speckling on the scales of the interspaces in occasional specimens.....*C. occipitalis annulatus*
- 4b Definite, secondary, brown crossbands present between the primary darker bands; pigmentation of the secondary bands arising at the bases of the scales rather than at their edges.....
C. occipitalis klauberi
- 5a Pattern either without crossbands or with one to many black crossbands on a variously pigmented ground color, but pattern neither based on nor including 3 different colors of crossbands; nasal usually entire, seldom sutured; color pattern without sexual variation; scale rows various (*Sonora semianulata* group).....8
- 5b Pattern tricolor, with black, grayish and reddish crossbands on body or tail or both, or the reddish may cover most of the body and tail, in which case black and grayish bands persist only on the nuchal region; nasal plates sutured below nostril in most specimens, but frequently entire; color pattern with marked sexual variation; scale rows 15-15 (*Sonora michoacensis* group).....6
- 6a Tail reddish, unbanded.....*S. michoacensis michoacensis*
- 6b Tail with triads of black, grayish, and reddish bands.....7
- 7a Unsplit black bands much longer (anteroposteriorly) than grayish bands, or else all black bands split by red; at least some of the anterior body bands always split by red.....
S. michoacensis mutabilis
- 7b Unsplit black bands approximately equal in length to the grayish bands; in the single known specimen (a female) none of the body bands is split by red.....*Sonora*, species
- 8a Anterior scale rows 15, rarely 14 or 16; temporals generally 1-2 (1-2 or higher on both sides in 96% of specimens).....9
- 8b Scale rows 13-13, rarely 14-13 or 14-14; temporals generally 1-1 (1-1 on one or both sides in 87% of specimens); color brownish, unbanded; ventrals of males 126 to 142, of females 136 to 151.....*S. episcopa taylora*

- 9a Caudals 53 or more in males, 45 or more in females; scale rows 15–14 (posterior scale rows counted in reference to scale row reduction in the middorsal region, disregarding lateral irregularities).....10
- 9b Caudals 52 or fewer in males, 44 or fewer in females; scale rows various.....13
- 10a Ventrals minus caudals 97 or fewer in males, 115 or fewer in females; tail 23% to 25.2% of total length in males, 20.3% to 21.6% in females (in preserved specimens); known only from Chihuahua and the Big Bend region of Texas.....
S. semiannulata blanchardi
- 10b Ventrals minus caudals 98 or more in males, 116 or more in females; tail 19.4% to 23.3% of total length in males, 16.4% to 20.0% in females.....11
- 11a Pattern of crossbands, with most of the body bands entirely crossing the abdomen; known only from the Grand Canyon of the Colorado River, Arizona.....*S. semiannulata gloydii*
- 11b With or without crossbands, but if banded, few or none of the body bands cross the abdomen.....12
- 12a Without crossbands, but with a distinct, rather sharp-edged dorsal reddish stripe that contrasts in color with the bluish-gray to brownish-gray sides; known only from southeastern California and adjacent Baja California.....*S. semiannulata linearis*
- 12b With or without crossbands, but if bands are lacking the color of the back is the same as, or changes gradually into, the gray, reddish, or brown of the sides.....*S. semiannulata isozona*
- 13a Ventrals plus caudals 202 or fewer in males, 206 or fewer in females.....14
- 13b Ventrals plus caudals 203 or more in males, 207 or more in females.....Return to 11
- 14a Ventrals minus caudals in males generally more than 109, in females presumably averaging over 127 (no females known); scale rows 15–14; pattern consisting of dark crossbands; known only from the vicinity of the Santa Rita Mountains of Arizona
S. semiannulata semiannulata
- 14b Ventrals minus caudals in males generally less than 109, in females generally less than 127; scale rows and color as above or otherwise.....15
- 15a Scale rows typically 15–15, occasionally 15–14; ventrals plus caudals in males 195 or less in 82% of specimens (av. 191.1), in females 200 or less in 92% of specimens (av. 194.4); color highly variable (but often brown and unbanded); a species of the Great Plains.....*S. episcopa episcopa*
- 15b Scale rows 15–14–13 in the four known males and 15–14 in the single known female; ventrals plus caudals in three males 196 to 200 (av. 198.6), in the female 203; color unbanded, all brown; known only from the vicinity of Comondu, Baja California.....*S. mosaueri*

Acknowledgments.—Dr. Edward H. Taylor and Dr. Hobart M. Smith have very kindly permitted me to study and describe specimens in their private collection and have supplied many pieces of information. Dr. Smith also furnished the description of the specimen in the Dugès Museo and criticized the manuscript. Dr. Emmett R. Dunn took additional data on the type of *Procinura aemula* and provided the results of his analysis of the perplexing Richardson collections. Mr. H. W. Parker sent me much valuable data on the specimens in the British Museum. Information on the specimens in the Muséum National d'Histoire Naturelle was obtained through the courtesy of M. F. Angel. For the loan of specimens with which this paper is particularly concerned I am indebted to Dr. Leonhard Stejneger and Dr. Doris M. Cochran of the U. S. National Museum, Mr. Charles M. Bogert of the American Museum of Natural History, Mr. Arthur Loveridge of the Museum of Comparative Zoology, Mr. Clifford H. Pope and Mr. Karl P. Schmidt of the Field Museum, Mr. E. B. Shelley Logier of the Royal Ontario Museum of Zoology, Mr. Francis M. Uhler of the U. S. Fish and Wildlife Service, and to Mrs. Helen T. Gaige and Dr. Norman Hartweg of the University of Michigan. Dr. Carl L. Hubbs criticized the manuscript and made several valuable suggestions. To each of these individuals I wish to express my sincere appreciation.

LITERATURE CITED.

- Boulenger, G. A., Catalogue of the snakes in the British Museum. Vol. II, 1894, Vol. III, 1896.
- Cope, E. D., Catalogue of the Colubridae in the Museum of the Academy of Natural Sciences of Philadelphia, with notes and descriptions of new species. Part 2. Proc. Acad. Nat. Sci. Phila., 1860 (1861).
- Dobzhansky, T., Genetics and the origin of species. Columbia U. Press, 1937.
- Dunn, E. R., New Central American Snakes in the American Museum of Natural History. Amer. Mus. Novitates No. 314, 1928.
- Graham, J. D., Report of Lieutenant Colonel Graham on the subject of the boundary line between the United States and Mexico. Senate Document No. 121, 1853.
- Smith, Hobart M. The Mexican and Central American lizards of the genus *Sceloporus*. Zool. Ser. Field Mus. Nat. Hist. Vol. 26, 1939: 1-397.
- An analysis of the biotic provinces of Mexico, as indicated by the distribution of the lizards of the genus *Sceloporus*. Anales Esc. Nac. Cien. Biol. Vol. II, No. 1, 1940: 95-110.
- Stickel, W. H., The snakes of the genus *Sonora* in the United States and Lower California. Copeia, 1938: 182-190.
- The subspecies of the spade-nosed snake, *Sonora occipitalis*. Bull. Chi. Acad. Sci. Vol. 6, No. 7, 1941: 135-140.

- Taylor, E. H., A taxonomic study of the cosmopolitan scincoid lizards of the genus *Eumeces*. U. Kas. Sci. Bull. Vol. XXIII, No. 1, 1936: 1-643.
- Taylor, E. H., and Smith, H. M., Concerning the snake genus *Pseudoficimia* Bocourt. U. Kas. Sci. Bull. Vol. XXVIII, Pt. II, No. 12, 1942: 241-251.
- The snake genera *Conopsis* and *Toluca*. U. Kas. Sci. Bull. Vol. XXVIII, Pt. II, No. 15, 1942: 325-363.