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A New Arboreal Pit Viper of the Genus *Bothrops* from the Isthmus of Tehuantepec, Mexico

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Few naturalists have gained access to the isolated cloud forest that flanks the continental divide at the Isthmus of Tehuantepec. Consequently little has been learned about the reptiles restricted to montane habitats in this portion of the state of Oaxaca. Many of the species in the lowlands occur northwest as well as southeast of the Isthmus. A few reptiles in the cloud forest have also been reported in similar habitats in the Sierra Madre del Sur to the west. The mountains along the divide in eastern Oaxaca, however, are a continuation of the Sierra Madre de Chiapas. The cloud forests on these mountains extend from Guatemala to the northwest, well into the Mexican state of Chiapas. Several elements of the cloud-forest fauna in eastern Oaxaca evidently have their nearest relatives in the cloud forests of Chiapas and Guatemala.

Nevertheless reptiles specialized for cloud-forest environments are isolated in the mountains of eastern Oaxaca, where the divide rises to elevations exceeding 2000 meters. Insofar as can be ascertained, the nearest cloud forest in Chiapas is at least 50 kilometers to the southeast. Highways cross the divide at elevations below 1000 meters in western Chiapas, where the mountains are relatively low. The cloud forest west of this gap extends northwestward along the crest of the divide to the lowlands that separate the Sierra Madre de Chiapas

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from the Sierra Madre del Sur. Further exploration of the region may reveal disjunctions, but the cloud forest that occurs on the mountain known locally as Cerro Baúl may be virtually continuous to the northwest for a distance of 50 to 60 kilometers.

Although the cloud forest on Cerro Baúl is in the state of Oaxaca, access to the area is least difficult if the area is entered from Chiapas. Travel in the mountains is slow and hazardous, particularly in the summer when torrential rains make it all but impossible to reach the cloud forest. Field investigations are less likely to be delayed or interrupted by storms during the spring, as J. Stuart Rowley¹ demonstrated when he made an ornithological reconnaissance of the Cerro Baúl area in 1966. Although Rowley was interested primarily in the avifauna of the area, this preliminary investigation convinced him that it would be rewarding to extend his survey to other groups of vertebrates. Accordingly he induced other naturalists to join him when he returned to Cerro Baúl in 1967.

Reptiles are not easily found or collected in cloud forests, and some of the species that occur in such habitats are more widely distributed in moist environments at lower elevations. The most interesting reptiles in the collection from Cerro Baúl are those restricted to cloud forests, including some members of the genus *Bothrops*, three species of which are represented in the collection. One of these, *B. nummifer*, occupies areas from San Luis Potosí southeastward to Costa Rica. The second, *Bothrops godmani*, is not often encountered, but its range extends from Panama through Central America into Mexico. There is at least one hiatus in its known distribution, between eastern Chiapas and eastern Oaxaca, where it has previously been reported near La Gloria to the northwest of Cerro Baúl.

The third species in the collection is represented by a specimen that bears some resemblance to *Bothrops bicolor*, a species unknown in Oaxaca, but reported from two localities in Mexico approximately 200 kilometers to the southeast, in the state of Chiapas near the Guatemalan border. Because it seemed improbable that such a wide hiatus existed in the distribution of *B. bicolor*, the snake obtained near Cerro Baúl was examined in detail. Comparisons with *B. bicolor*, and the related species *B. lateralis*, revealed that the snake from the mountains in eastern Oaxaca shares some of the characters of both. Nevertheless, it possesses characters that do not fall within the range of variation of either

¹ Mr. Rowley was killed when he fell from a cliff in the Sierra de Cuatro Venados in May, 1968, while this account was in press.

of these species. The differences are so marked that it can scarcely be doubted that the specimen from Oaxaca represents an undescribed species. It will bear the name of the veteran ornithologist, Mr. J. Stuart Rowley, whose competence, enthusiasm, and perseverance in the field have contributed so much to our knowledge of the fauna of southern Mexico.

***Bothrops rowleyi*, new species**

HOLOTYPE: An adult male, A.M.N.H. No. 100669, taken on April 24, 1967, on a ridge that extends northward from Rancho Vicente, Colonia Rodolfo Figueroa, approximately 5 miles west of Cerro Baúl. The site is at an elevation of approximately 1520 meters, on the headwaters of the Río Grijalva, roughly 30 kilometers to the north and slightly to the east of San Pedro Tapánatepec, in the Distrito de Juchitán, Oaxaca, Mexico.

DIAGNOSIS: A green, prehensile-tailed species of *Bothrops* perhaps most closely related to *B. bicolor* of southeastern Chiapas and southern Guatemala, but in some respects similar to *B. lateralis* of Costa Rica and Panama. *Bothrops rowleyi* differs from both of these species in having fewer rows of middorsal scales (19 rather than 21 or 23), fewer scales between the supraoculars (four rather than from seven to 11), and a single canthal (rather than two canthals and usually one or two additional scales) between the supraocular and internasal.

Fewer supralabials, ventrals, and subcaudals are present on the holotype of *B. rowleyi* than on any specimen of *B. bicolor* examined or reported, but these differences may not prove to be dichotomous. *Bothrops lateralis* has a narrow light stripe on each side of the venter, whereas *B. rowleyi* more closely resembles *B. bicolor* in lacking any markings. Nevertheless, in some features of its scutellation, *B. rowleyi* resembles *B. lateralis* more closely than *B. bicolor*, as may be noted in table 1. Keels, readily discernible on all rows of dorsal scales but reduced on the lower row of the large male holotype of *B. rowleyi*, are absent from the scales bordering the ventrals on *B. bicolor* and *B. lateralis*, as they may prove to be on females and immature males of the species in Oaxaca.

DESCRIPTION OF THE HOLOTYPE: An adult male, with an over-all length of 875 mm., and a tail length of 146 mm. that comprises 16.7 per cent of the total length; the tail is prehensile. The head is 27.0 mm. in width, and 36.0 mm. in length, and the neck is 10.0 mm. in diameter. The length of the slightly curved fang, measured from the upper lumen to the tip, is 9.0 mm.

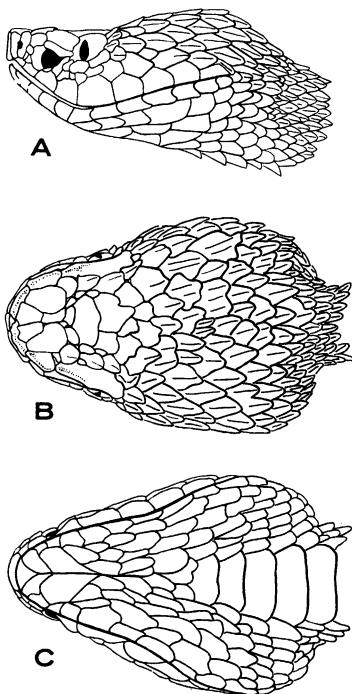


FIG. 1. Head of *Bothrops rowleyi*, holotype, A.M.N.H. No. 100669, showing arrangement of scales. A. Lateral view. B. Dorsal view. C. Ventral view. $\times 1$.

The scales are disposed in 19 rows on the anterior portion of the body, diminishing in number to 17 posteriorly, and then to 15, but increasing to 17 immediately anterior to the vent; the scales of the dorsal rows are strongly keeled, somewhat less so laterally, but keels are well developed even on the rows at the edges of the ventrals. There are 161 ventrals, and 58 subcaudals, all of which are undivided; the anal is undivided. The supralabials are 9-9 (not counting a small scale separated from the first supralabial, on the right side of the rostral); those in each series increase in size posteriorly to the fifth, which is much the largest, but behind the fifth they progressively diminish in size (fig. 1A). The infralabials are 11-11, of which four reach the chin shields; the first two infralabials meet behind the mental and thus separate it from a pair of large chin shields, each of which is almost twice as long as broad.

The rostral is wider than high, bordered laterally by the anterior nasal and the first labial, which is situated below the suture separating the anterior and posterior nasals. On each side a small loreal is followed by two preoculars. Three small prefoveals and two lacunals are present on each side, but there are two postfoveals on the right and three

on the left, followed by two suboculars, the lower of which is separated from the large fifth supralabial by a single scale. There are three postoculars, the upper one on each side projecting outward beneath the posterior end of the supraocular; the two lower postoculars are keeled, and separated from the sixth supralabial by two scales. The anterior edge of the orbit is directly above the anterior edge of the fifth supralabial. The upper preocular projects upward anteriorly, reaching the canthus rostralis lateral to the suture between the supraocular and the canthal (fig. 1B).

The scales on the crown consist of a small postrostral that separates the suture of the paired internasals from the rostral. Behind the suture a median pair of smaller scales, followed by a single scale, separates two large scales, each of which borders laterally on the canthal. Behind these large scales, extending across the head from the suture between the supraocular and canthal on the left side to a similar suture on the right, there are six scales, including one much smaller scale on the left. At the level of the orbits the scales between the supraoculars are less symmetrically arranged, but roughly in transverse rows. Each of two large scutes is flanked by two smaller scales, the outer of which slightly overlap the inner margin of the supraocular, thus separating the supraoculars by no more than four scales. The extraordinarily long supraoculars, thrice as long as wide, terminate above the projecting upper postoculars. At this level there are five or six scales between the tips of the supraoculars. The well-developed canthal ridge, comprised of the upturned anterior margin of the supraocular, the upper margin of the preocular, and the outer edge of the canthal, extends across the internasals to the median postrostral. The enlarged scutes near the middle of the crown are relatively smooth, but keels are present on the smaller scales imbricating on the inner margins of the supraoculars. The supralabials and a few of the scales behind the lower postocular are smooth, but all other scales at the back of the head are keeled (fig. 1C).

The dorsal surfaces of the head, trunk, and tail are uniformly green. Except for the distal portion of the tail, which is approximately the same shade as the dorsum, the ventral surfaces of the trunk are pale green. The gular region is faintly yellowish, although the front of the lower jaw, the rostral, the margins of the lip, and the scales surrounding the facial pit are light green. The color of the scales behind the eye and above the supralabials is darker, of approximately the same shade of green as the dorsal scales. The iris had the color of brass before the holotype was preserved, as may be seen in a colored slide provided by



FIG. 2. *Bothrops rowleyi*, holotype, A.M.N.H. No. 100669, dead specimen, from photograph obtained by J. Stuart Rowley.

Rowley, whose photograph of the freshly killed specimen is reproduced in black and white as figure 2.

HEMIPENIS: The copulatory organ, in the retracted position in the tail, extends to the eighth subcaudal, bifurcating at the fourth. The sulcus spermaticus becomes bifurcated at the very base of the organ, above the first subcaudal. On the ventral side of each lobe (*in situ* in the tail) the sulcus is flanked on each side by two strongly enlarged basal spines, followed by approximately six enlarged spines more or less in diagonal rows. The largest spine, and the somewhat smaller spines distal to it, are nearest the sulcus, but separated from it by a row of much smaller spines. These enlarged spines diminish in size, and at the level of the sixth subcaudal on the distal end of each lobe they are abruptly replaced by coarsely reticulated calyces. Opposite the enlarged spines, on the outer side of the sulcus, the spines are appreciably smaller, but feebly enlarged distally, where they are arranged in approximately six rows. Distally these smaller spines merge with the calyces less abruptly than the enlarged spines contiguous to them on the side of the lobe opposite the sulcus. The largest spine on each lobe extends from the fifth subcaudal to its pointed terminus below the second subcaudal.

MATERIAL EXAMINED: In addition to the material in the American Museum of Natural History (A.M.N.H.), I have examined specimens lent by the Museum of Zoology, University of Michigan (U.M.M.Z.), the Field Museum of Natural History (F.M.N.H.), Louisiana State University (L.S.U.), and the United States National Museum (U.S.N.M.). Data derived from a male of *Bothrops bicolor*, No. 9566, 1a, in the collection of the Senckenberg Museum, were helpfully supplied by Mr. Hymen Marx, from the notes of the late Karl P. Schmidt.

The following specimens of *B. bicolor* have been examined: U.S.N.M. No. 46511, "Chicharras" [probably from Cerro Chicharras, a mountain near the village of San Juan Chicharras], Chiapas, Mexico; U.M.M.Z. No. 87707, taken at an elevation of 1200 meters on the slope of Cerro Ovando, Chiapas, Mexico; U.M.M.Z. No. 94644, taken at an elevation of approximately 2000 meters on the slope of Cerro Ovando, Chiapas; F.M.N.H. No. 20612, Olas de Moca, near Finca La Moka, Department of Suchitepequez, Guatemala; U.S.N.M. No. 127973, Yepocapa, Department of Chimaltenango, Guatemala; and L.S.U. No. 11638, at an elevation of 1600 meters, southeast slope of Cerro Santa Barbara, Honduras. Few well-documented specimens of *Bothrops lateralis* have reached collections; two of the specimens examined, A.M.N.H. No. 17372 and U.S.N.M. No. 37830, are catalogued only as being from

TABLE 1
VARIATIONS OBSERVED OR REPORTED IN *Bothrops rowleyi* AND CLOSELY RELATED SPECIES
(Extremes in parentheses.)

Character	<i>B. rowleyi</i>	<i>B. bicolor</i>	<i>B. lateralis</i>
Scales between supraocular and internasal	1 canthal	2 canthals + 2-3 scales	2 canthals + 1 scale
Scales between supraoculars	4	(7)10(11)	(7)8(10)
Supralabials	9	(10)11(12)	(9)10(11)
Rows of scales at midbody	19	21	21(23)
Ventrals	161	(164)167.3(173)	(155)164.7(171)
Subcaudals	58	(59)62.8(67)	(54)59.9(63)
Light lateroventral stripe	Absent	Absent	Present
Second labial fused with lacunal	No	Rarely	Invariably
Keels on scales in outer row	Present	Absent	Absent
Maximum over-all length (in millimeters)	870	972	770

“Costa Rica.” A third specimen, A.M.N.H. No. 75636, was obtained at an elevation of 1480 meters on the slope of Volcán Chiriqui, above Volcán, Panama. The specimen from Honduras is the only male included in either sample.

The information derived from these specimens, augmented by that obtained from the literature, is summarized in table 1. Although both species have been known for at least a century, data for only seven specimens of *B. bicolor*, and scarcely a dozen examples of *B. lateralis*, have been published. Authors have seldom mentioned the sex of specimens examined, and the only reasonably complete descriptions of either of the species are those supplied by Boulenger (1896) and Mocquard (1909). Owing to the fragmentary nature of the information contained in the published accounts, the sexes cannot be dealt with separately, and at best table 1 affords only a rough index to variations that are likely to be encountered in the two species most closely related to *B. rowleyi*. The sources of information warrant a brief review.

Peters (1862) stated that his description of *Bothriechis lateralis* was based on four specimens, representing two “*Varietaeten*,” those from Costa Rica, “Vulcan Barbo” [= Volcán Barba] with 23 scale rows, and those with 21 scale rows from “Veragua.” The latter name presumably refers to Veragua, or Santiago de Veragua, now known as Santiago, the capital of the province of Veraguas, Panama. I am unable to find that the name Veragua was ever used for any region or locality in Costa

Rica. The type locality should perhaps be restricted to Volcán Barba, Costa Rica, rather than simply "Costa Rica," as authors have inferred from the description in Boulenger (1896). Peters did not mention the sex or indicate how many ventrals or subcaudals were present on any of the four syntypes. The description Boulenger (*supra cit.*) provided includes data for the ventrals, subcaudals, and measurements of but one specimen, of undetermined sex, from "Costa Rica." Mocquard (1909) based his description on a male from "Costa Rica," which he had obtained from the Berlin Museum. Taylor (1951) has supplied data for four females and one male from two localities in Costa Rica. The dimensions of the largest specimen known were obtained from Picado (1931).

Bocourt (1868) supposedly based his description of *Bothrops bicolor* on four specimens from San Agustín, Department of Sololá, Guatemala, but no variations were noted in the species until the syntypes (sex not mentioned) and one additional specimen from "Guatemala" were redescribed by Mocquard (1909). Meanwhile Müller (1878) had described *Bothrops (Bothriechis) bernoullii*, which Boulenger (1896) placed in the synonymy of *B. bicolor*. Boulenger indicated the range in the numbers of ventrals and subcaudals and provided data for one of the syntypes. One of the specimens I examined, the female from Cerro Chicharras, Chiapas, has been briefly described by Smith (1941), who noted that the second supralabial entered the pit on one side. The second supralabial is normally fused with the lacunal in *B. lateralis*, but, with the exception noted by Smith, the second supralabial is excluded from the pit on all specimens of *B. bicolor* that have been examined or reported. Mertens (1960) has depicted the head of *B. bicolor*, but he has not indicated the source of the specimen.

The ratio of the head width to head length is perhaps too variable in these pit vipers to be of diagnostic value. One female, from Cerro Ovando, has an extraordinarily slender head, 38.5 mm. in length and 22.0 mm. in width. It differs little in scutellation from a female taken at a lower altitude that is 50 mm. shorter in snout-to-vent length, whereas the head length of this individual is 32.0 mm., and the width is 22.0 mm. The slender-headed snake taken at the higher elevation is almost uniformly slate-black, with no appreciable difference between the dorsal and ventral surfaces. It is improbable that the dark coloration is attributable to the preservative; the specimen is perhaps melanistic. The other female is green, faintly mottled with yellow on the dorsum, but the uniformly green venter is noticeably paler. The distinctive stripe extending along the outer edges of the ventrals

readily distinguishes *B. lateralis* of Costa Rica and Panama from the related species in Guatemala and Mexico.

HABITAT: The holotype of *Bothrops rowleyi* was discovered coiled around the stalk of a palm, approximately 1.5 meters above the ground. A hummingbird, *Campylopterus rufus*, directed attention to the snake by frantically flying back and forth above the reptile. In the dense palm thicket the green snake might otherwise have been undetected. In the portion of the cloud forest near Cerro Baúl, small palms form a dense understory in the extremely moist, shaded slopes bordering the arroyos. Visibility in these palm thickets is often little more than arm's length in the area where the pit viper was found. Such snakes are presumably rare in the area, for this was the only member of the species encountered. Moreover, the few residents who saw this green pit viper could not recall having previously seen one like it.

There are not many ranchers or homesteaders in the vicinity of Cerro Baúl, which was virtually uninhabited until a decade or so ago. The region is becoming accessible largely because efforts are now being made to exploit the timber and other resources. Florists have supposedly created a demand for the small palms which are being exported to the United States in ever-increasing quantities. The place names used by residents, however, do not appear on maps. The area seems to have been neglected by surveyors and cartographers despite its proximity to such old, well-established villages as San Pedro Tapánatepec (the name approved by the United States Board on Geographic Names for the town that appears on most road maps as "Tapánatepec," once known also as "Tapánatepec San Pedro").

Details of the topography are shown with questionable accuracy on maps. Insofar as can be ascertained, however, the highest portion of Cerro Baúl is situated near latitude 16° 37' N., longitude 94° 10' W. The ridge extends northward from the continental divide, which is drained by tributaries of the Río Ostuto on the Pacific slope. On the Atlantic side, Cerro Baúl is flanked by two streams that converge at the north end of the mountain as one of the western tributaries of the Río Pueblo Viejo, which in turn flows into the Río Grijalva. The highest elevation attained is uncertain, but portions of Cerro Baúl rise to elevations exceeding 2000 meters.

DISTRIBUTIONS AND THEIR IMPLICATIONS

The most widely distributed member of this small group is *Bothrops lateralis*, the syntypes of which, as noted above, came from Volcán Barba,

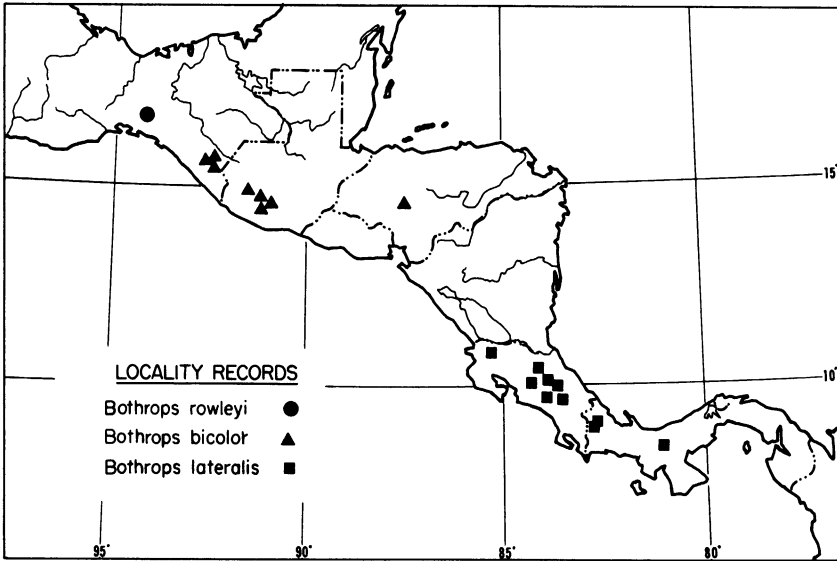


FIG. 3. Southern Mexico and Central America, showing the type locality of *Bothrops rowleyi* and the localities where members of the two most closely related species have been obtained.

Costa Rica, and Santiago, Panama. Villa (1962) cited no specimens or localities for Nicaragua, although he reported that the species occurs "south of Managua." Picado (1931) listed three areas in Costa Rica from which he had presumably seen specimens, the uplands of [Volcán] Orosi, Navarro, and Santa María de Dota. Taylor (1951) reported specimens from *B. lateralis* from two additional localities in Costa Rica, at elevations between 5000 and 6000 feet on Volcán Poas at Isla Bonita, and 2 miles above Santa Cruz, on Volcán Turrialba, at an elevation between 6500 and 7000 feet. Specimens from Panama were examined by Dunn (1947), who reported 18 from Lérída and one from El Volcán (Volcán or El Hato on some maps). An additional specimen, A.M.N.H. No. 75636, from El Volcán, was obtained by Frank A. Hartman, who found it at an elevation of 4500 feet. It may be inferred from these records that *B. lateralis* is largely if not wholly restricted to cloud-forest environments closely approximating those inhabited by the two species to the northwest (see map, fig. 3).

Insofar as can be ascertained from the meager information available, *Bothrops bicolor* is discontinuously distributed from southeastern Mexico through the mountains of southern Guatemala into western Honduras.

The original description of *Bothrops bicolor* was based on specimens from the "forêts de Saint-Augustin, département de Solola (Guatemala), sur le versant occidental de la Cordillère. 610 mètres d'altitude." The snake described by Müller (1878) as *Bothrops (Bothriechis) bernoullii* was from an unspecified altitude on the "cuesta de [Volcán] Atitlán," Guatemala. Smith (1941), who first reported the species in Mexico, described the specimen, U.S.N.M. No. 46511, that was probably obtained on Cerro Chicharras, Chiapas. The other record for the state, listed by Smith and Taylor (1945) as "Mount Ovando," was based on the two specimens U.M.M.Z. Nos. 87707 and 94644, which I have examined.

The only definite records for the occurrence of the species, therefore, seem to be the forests of San Augustin, Volcán Atitlan, Olas de Mocá, and Yepocapa in Guatemala, and Cerro Chicharras and Cerro Ovando in Chiapas. Stuart (1963) defined the range of *Bothrops bicolor* as "Moderate and intermediate elevations of the Pacific versant of eastern Chiapas and western Guatemala." Through the courtesy of Dr. Douglas A. Rossman, I have examined a specimen from Cerro Santa Barbara, Honduras, the only record for this country.

Thus far the fossil record sheds little light on the origin and diversification of the genus *Bothrops*. The distributions of *B. rowleyi* and the two Central American species most closely related to it, however, suggest that three populations became isolated following the northwestward dispersal into Central America of an ancestral population derived from arboreal members of the group in South America, where the adaptive radiation of the genus *Bothrops* had already permitted considerable diversification.

It can scarcely be doubted that *B. rowleyi*, *B. bicolor*, and *B. lateralis* were derived from an ancestral population once more widely distributed, presumably when cooler, more humid climatic conditions prevailed. Reversal of the trend, with a reduction in the precipitation and the advent of warmer climates, presumably led to unfavorable conditions in the lowlands. Snakes adapted to cool environments, therefore, have survived only where they could retreat to (or remain in) hospitable habitats in the mountains. Thus *Bothrops rowleyi* and its relatives are essentially relicts. They have survived as remnants of the ancestral stock that diverged after populations had become restricted in distribution and ecologically isolated. Presumably they have been isolated for a long period of time, as indicated by the levels of their divergence.

ACKNOWLEDGMENTS

Field investigations in Oaxaca were authorized by Sr. Dr. Rodolfo

Hernández Corzo, who graciously issued permits on behalf of the Mexican Government as Director General of the Departamento de Conservación y Propagación de la Fauna Silvestre, Secretaría de Agricultura y Ganadería. Dr. Charles F. Walker, Museum of Zoology, University of Michigan, Dr. Robert Inger and Mr. Hymen Marx, Field Museum of Natural History, Dr. Douglas A. Rossman, Museum of Zoology, Louisiana State University, and Dr. James A. Peters, United States National Museum, Smithsonian Institution, all lent specimens in their charge that greatly facilitated the preparation of diagnoses. Mrs. Ellen Bowler made the drawings illustrating this report and assisted in tabulating data. Mrs. Margaret Shaw was immensely helpful in assembling titles for the bibliography and typing the manuscript.

Mr. J. Stuart Rowley not only supplied photographs but shared his knowledge of the Cerro Baúl region. Much of the information in this account stems from the investigations that Mr. Rowley and his assistants have carried out in the mountains at the Isthmus of Tehuantepec. I am deeply grateful to all these individuals, as well as to many friends in Oaxaca de Juárez, who have expedited my work in Oaxaca or broadened my knowledge of the amphibians and reptiles inhabiting the mountains of the state.

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