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THE AMPHIBIANS AND REPTILES OF
JORULLO VOLCANO, MICHOACÁN, MEXICO

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THE University of Texas field parties to Michoacán, Mexico, directed by Dr. Donald D. Brand, have aimed at correlating the physical, biological, and anthropological features of the region. During the summer of 1951, I accompanied one of the field parties and spent July 1-3 in the vicinity of Jorullo Volcano, where I assembled a small herpetological collection and made observations on the general fauna and flora. In 1950 another field party visited the region, and between June 18 and 20 James A. Peters, Robert W. Storer, and Edward Miller made a small collection of reptiles and amphibians from the vicinity of the volcano. From October 11 to 20, 1950, Raymond A. Paynter, Jr., collected birds and reptiles in the area. All of the herpetological material has been deposited in the Museum of Zoology, University of Michigan.

I wish to thank Dr. Peters and Mr. Paynter for permission to study the material collected by them; also, to Dr. Peters I am indebted for the use of his field notes and for many suggestions concerning this study. Dr. Norman Hartweg, Dr. L. C. Stuart, and Dr. Charles F. Walker have aided with the identification of material and have offered many suggestions pertinent to this study. For this they have my sincere thanks. For the loan of material or for information concerning specimens in their care, I am indebted to Dr. Doris M. Cochran, U. S. National Museum; Dr. William B. Davis, Agricultural and Mechanical College of Texas; Miss Alice G. C. Grandison, British Museum (Natural History); Dr. Hobart M. Smith, University of Illinois; and Dr. Edward H. Taylor, University of Kansas. For providing me with working quarters in the Chicago Natural History Museum I thank Dr. Karl P. Schmidt. The drawings in Plate II are from the competent hand of Harold J. Walter, to whom I am grateful.

DESCRIPTION AND HISTORY OF THE AREA

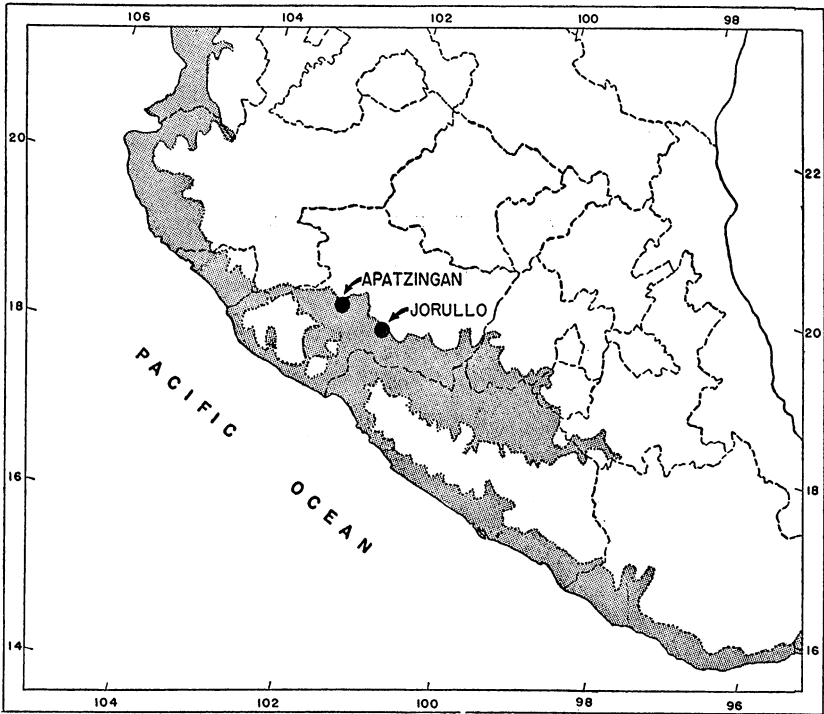
Jorullo Volcano (Map 1) is situated approximately $101^{\circ} 45'$ W. and 19° N. in south-central Michoacán at the base of the southern edge of the Mexican Plateau.¹ The area is drained by several small tributaries of the Río Pozo Real, which flows into the Río Tepalcatepec near the merger of the latter with the Río Balsas.

Prior to September, 1759, the valley now occupied by the cone and the lava fields was a rolling, fertile farmland on which indigo and cane were raised in considerable quantities. With the eruption of Jorullo in September, 1759, the landscape was drastically changed. In its initial stages Jorullo covered the surrounding country with a thick layer of ash, and there are reports that an appreciable amount fell in the village of Queratero, 125 miles away. The accounts of the early history of Jorullo are often conflicting, but Gadow (1930) concluded that the first lava flows began in 1760, and that four years later the volcano was in its most active stage, with lava spreading over an area of five square miles to depths of more than 300 feet in the middle of the flows. By 1766 the major changes in the valley had been completed, and Jorullo gradually became more quiescent, exhibiting no marked activity after 1774. There were, however, active fumaroles until the middle of the nineteenth century, and even today there are still a few weakly active steam vents in the crater.

Jorullo was visited by scientists many times before this century, but only casual attention was paid to the biology of the area. Von Humboldt, who visited the volcano in 1803, was primarily interested in the geological aspects of vulcanism. Schleiden and Peischel, in the middle of the nineteenth century, made minor observations on the flora with an occasional note on the fauna. It was nearly 150 years after the first eruption before systematic studies of the fauna were begun. In 1903 Nelson and Goldman spent two days at the volcano collecting mammals and birds. Their observations are reported briefly in *Biological Investigations in Mexico* (Goldman, 1951: 197-98). In his description of the volcano and the surrounding country as it was in 1903, Goldman stated: "A thin stand of vegetation covers the Volcán de Jorullo to the summit. At about 3000 feet on the northern slope a pine, evidently tropical in distribution (*Pinus montezumae*), was collected. Among other plants taken in the vicinity were Brazilwood

¹ The elevation above sea level at the edge of the lava flow at the village of La Playa (Hacienda de la Playa) is 2600 feet; that at the base of the cone on the west side, 3010 feet; and that at the lip of the crater, 4190 feet.

(*Haematoxylon brasiletto*), nanche (*Brysonima crassifolia*), wild fig (*Ficus padifolia*), and *Enterolobium cyclocarpum*. Many of the slopes and hills near the volcano are covered with fan palms 8–30 feet high. Immediately about the volcano was a forest of low, leguminous trees of many kinds." Unfortunately, Goldman did not mention any of the animals that were observed in the area.



MAP 1. Part of southern Mexico showing Jorullo and Apatzingán. The stippled areas are below the 1000 m. contour.

Gadow realized that Jorullo offered an opportunity for the study of recolonization. In 1908 he spent a month collecting reptiles and amphibians in the area and also made careful observations on the flora. His observations, published posthumously (1930), provide the most adequate description of the area. He described the stand of pines at the top of the cone and listed the following plants from the malpais: Parota, *Mimosa*, *Acacia*, *Arbutus*, *Opuntia*, and various kinds of grasses. He also found three palms on the rim of the crater.

My observations agree with most of Gadow's. Strangler figs and fan palms were common on the ash flats to the north and east of the cone. The vegetation on the malpais consisted mainly of thick clumps of mesquite, with *Acacia*, parotas, and a few scattered palms (Pl. I). There was a good covering of grass and, in places, thick growths of milkweed. Mosses and lichens were found on the lava flows. The vegetation of the lower slopes of the volcano was dominated by oaks, madroñas, and milkweeds. Higher on the slopes this vegetation was replaced by pines (*Pinus montezumae*). The plant life at the top of the cone consisted of a good stand of pines and scattered small bushes. Wherever there was sufficient soil there were patches of fine-bladed grass. The palms mentioned by Gadow were not seen.

ACCOUNT OF THE SPECIES

The three recent collections in the Museum of Zoology total 112 specimens, including seven species of amphibians and 20 of reptiles. In addition to these I have had access to data and specimens in the British Museum (Natural History) assembled by Gadow. His collection consists of 30 specimens including nine species. Of these nine species one amphibian (*Eleutherodactylus rugulosus*) and two reptiles (*Sceloporus gadoviae* and *Leptodeira smithi*) were not found by any of the recent field parties.

Bufo horribilis Wiegmann

Eleven specimens of this large toad were collected in the vicinity of the village of La Playa. On the night of June 19, 1950, they were collected at the hacienda, and on the night of July 1, 1951, during a heavy rain, several individuals were seen hopping about on a muddy road. None was found on the malpais. Gadow collected two specimens in the area.

Bufo marmoreus Wiegmann

Sixteen specimens were collected in or near the village. Most of these were found on the muddy road with *B. horribilis*. Individuals of this species were calling (*B. horribilis* was not heard). One was under a bush on the malpais at the base of the cone. The British Museum has nine specimens collected by Gadow.

Eleutherodactylus rugulosus (Cope)

Gadow collected three specimens of this species at Mata de Platano, a locality about one mile southeast of the cone. One of the three has a longitudinal light stripe on the head and shoulder region.

Leptodactylus melanonotus (Hallowell)

Three specimens were found near the hacienda at La Playa. One is a very small juvenile, and one is a female with a body length of 36 mm. The third, a male, with a body length of 32 mm. has two sharp, horny, black nuptial spines on the inner side of the thumb.

Tomodactylus petersi, new species

(Pl. II)

Eleven specimens of the genus *Tomodactylus* collected by Peters at La Playa, at various localities along the coast, and in the coastal sierra of Michoacán have a dorsal pattern of dark brown mottling on a greenish or brownish ground color, a bright orange patch on the posterior surface of the thigh, one on the anterior surface of the thigh, and one in the groin; the legs are relatively long; the tips of the digits are slightly expanded; and the inguinal gland is indistinct.

HOLOTYPE.—University of Michigan Museum of Zoology (UMMZ) No. 109238, an adult male collected one-fourth mile east of Coalcomán, Michoacán (elevation 3500 feet), on July 30, 1950, by James A. Peters.

PARATYPES.—All from Michoacán. UMMZ 104393 (3): Hacienda de La Playa (2600 feet); 104394 (2): one-half mile southwest of La Placita; 104395 (2): one-fourth mile east of Coalcomán (3500 feet); 104396: one mile north of Pomaro (700 feet); 104397: one-half mile east of La Placita (75 feet); and 104633: north slope of Jorullo Volcano (\pm 3000 feet).

DESCRIPTION OF HOLOTYPE.—Snout-vent length 25.5 mm.; tibia length 10.8 mm. (39.5 per cent of the snout-vent length); foot length (measured from the proximal edge of the inner metatarsal tubercle to the tip of the longest toe) 10.2 mm.; head width 8.4 mm.; head length 8.8 mm.; interorbital distance 3.0 mm.; width of the upper eyelid 1.8 mm. (60 per cent of the interorbital distance); internarial distance 2.3 mm.; diameter of the eye 3.0 mm.; diameter of the tympanum 1.5

mm. (50 per cent of the diameter of the eye). Snout short and acutely rounded; diameter of the eye nearly equal to its distance from the nostril; canthus rostralis rounded but distinct. Tympanum slightly higher than long, poorly differentiated posteriorly, and separated from the eye by a distance less than its diameter. Tongue pear-shaped, widest posteriorly, but less than half as wide as long, posterior edge free for half its length. Inner nares round and situated laterally; openings into vocal sacs are paired slits along the inner edge of the posterior half of the jaw rami. No webs connecting digits of hands or feet. Subarticular tubercles large, high, and rounded. Tips of digits slightly expanded, more so on the fingers than on the toes. Length of fingers from shortest to longest: 1-2-4-3; toes: 1-2-5-3-4. No tarsal fold. When the legs are folded at right angles to the vent, heels overlap considerably. Inguinal gland very diffuse, inconspicuous, and not elevated. Skin smooth above and below, except for scattered, small pustules on the head and just behind tympanum.

In preservative the dorsal ground color is light grayish tan. On this is an extensive marbling of dark brown. The amount of mottling decreases on the flanks, giving way to the pale cream ventral color. The lips are barred with cream. There are four transverse bands of dark brown on the forelimbs. The bands are slightly wider than the dusky cream interspaces. There are three transverse bands on the femur, three on the tibia, and three on the tarsus. These are considerably wider than the light interspaces. Proximally, the anterior surface of the thigh is pale cream. The transverse bands break down on the posterior surface of the thigh, where there is a patch of cream. The ventral surfaces are pale cream; the chest region is spotted with brown, and the anterior part of the vocal sac is gray.

VARIATION.—Of the type series eight are males and three are females. Only one individual exhibits a slight swelling of the inguinal glands. In all of the others the glands are barely discernible. The vocal sac of the males varies from light gray to almost black. The four specimens from the coastal region (La Placita and Pomaro) have narrower bands on the limbs and have a lighter snout. The amount of ventral spotting is reduced in two specimens and is absent in the others.

Peters' field notes offer the following color descriptions from life: UMMZ 104393 (3) are chocolate brown above with dark brown to black blotches on the back. The legs are tan and barred with brown. There is a cream-colored patch in the region of the inguinal gland. Anteriorly and posteriorly the thighs are bright orange, as is the groin, all of the orange surfaces being concealed while the frog is at rest. The

ventral surface is dirty white with brown and black spots. The upper lip is cream and golden. The chin and throat are purplish. One individual is lighter and has a greenish brown ground color. UMMZ 104395 (2) and 109238 lack the cream-colored inguinal spot. The ground color is greenish, and the upper lip is heavily mottled with brownish black. Peters also mentioned one individual from La Placita that was very light colored when collected, but by the next day it looked like the others.

REMARKS.—Three males were calling on the night of June 18, 1950, among clumps of grass and in piles of brambles at La Playa. Peters described the voice as a short peep rising at the end of the note. On July 5, 1950, near Coalcomán Peters found individuals calling from the tops of bushes five to six feet above the ground.

Tomodactylus petersi differs from most other known members of the genus in having orange patches on the thighs and groin. From *T. angustidigitorum* and *T. nitidus* it differs in having the tips of the toes expanded. The tympanum is rather distinct and equal to half of the diameter of the eye in *T. petersi*; in *T. nitidus* the tympanum is indistinct and equal to slightly less than half the diameter of the eye. The diameter of the tympanum in *T. angustidigitorum* equals approximately two-thirds that of the eye, whereas in *T. amulae* the diameter of the tympanum is about one-fourth that of the eye (*vide* Kellogg, 1932: 121). The legs of *T. petersi* are longer than in the other species. The ventral color of *T. angustidigitorum* is buff, in *T. nitidus* it is white with a few scattered dark flecks laterally, and in *T. petersi* it is white with heavy spotting in the chest region in most of the specimens. The throats of all of the species are light, except in *T. petersi* in which the throat is gray or black. From *T. albolabris*, which also has orange thighs, *T. petersi* differs in having longer hind limbs, bands instead of spots on limbs, and no light stripe on lips.

Nineteen specimens from Taxco, Guerrero (UMMZ 99532), are intermediate in certain characters between *T. petersi* and *T. nitidus* from Cuautla and Progreso, Morelos. The tips of the digits are very slightly expanded, the heels barely overlap when the legs are adpressed behind the vent, and there are a few dark spots in the chest region. There is great variation in the degree of development of the inguinal gland, from a large, raised gland to no external visible trace. Despite the intermediate condition shown by these specimens in several characters, they do not show evidence of having had orange patches on the thighs and groin. Therefore, they are not considered to be intergrades between *T. nitidus* and *T. petersi*.

Hyla smithi Boulenger

Peters collected six specimens just north of the hacienda at La Playa. These were found in the bases of the leaves of elephant ear plants (*Xanthosoma roseum* Schott). There are five males and one female, the latter with ovarian eggs.

Smilisca baudini (Duméril and Bibron)

One specimen, UMMZ 105163, collected by Paynter at La Playa, is tentatively assigned to this species. It is a subadult female with a body length of 47 mm. and a tibia length of 24 mm. The snout is rather pointed and high; the canthus rostralis is distinct, forming a concavity in the loreal region. The tympanum is three-fourths the diameter of the eye. The color above is dull brownish lavender. The limbs are slightly lighter with three faint, darker transverse bands on the femur and three on the tibia. The venter is light buff. A dark bar extends from the eye ventrad to the mouth. This color character and the general appearance are the criteria used in assigning this individual to *Smilisca baudini*. Peters heard this species in chorus at La Playa on June 20, 1950. Schmidt and Shannon (1947: 67) recorded this species from Apatzingan. It has not been reported from farther inland in the Balsas Basin.

Rana pipiens Schreber²

Four specimens were collected in the vicinity of the village, and two were found in a grassy area at the base of the cone at an elevation of 3000 feet. Two of the specimens from La Playa have very bright yellow labial stripes extending from the snout to a point above the angles of the jaws.

Kinosternon integrum LeConte

Paynter collected two of these turtles in the arroyo at La Playa. I observed several individuals at the same locality.

² Smith (1947) resurrected two subspecific names for populations of *Rana pipiens* in Mexico. Since neither of these names is suitable for application to the Balsas Basin specimens, the binomial is used here.

Phyllodactylus lanei Smith

A male of this species measuring 68 mm. in snout-vent length was collected at the hacienda at La Playa (elevation 2600 feet). This record extends the range of the species considerably inland in the Balsas Basin.

Anolis nebulosus (Wiegmann)

Specimens from the Jorullo area have been assigned to this species rather than to *A. nebuloides* because they possess dorsal scales that are only slightly smaller than the ventral scales; the latter are moderately keeled. In two of the specimens there is an incomplete row of scales separating the supraorbital semicircle series. In the others the semicircles are in contact in the mid-line. Three of the four females have a light tan middorsal stripe from four to eight scale rows in width. This stripe begins just posterior to the interparietal scale and continues onto the proximal half of the tail. On either side of the light middorsal stripe there is a dark brown stripe three to six scale rows in width.

Two individuals were found on the malpais; one of these was crossing a path about a mile and a half west-northwest of the cone. Six other specimens were collected along the road from La Playa to Ario de Rosales at elevations ranging from 4000 to 5100 feet.

Ctenosaura pectinata (Wiegmann)

Eleven specimens were collected, but as six are now being used for anatomical studies, only five have been critically examined. Four individuals have three complete rings of small scales preceding each of the first five enlarged caudal whorls; in one specimen the anterior ring of each series is incomplete, there being only two rings dorsally separating each of the first five enlarged caudal whorls.

Many large black and orange adults were observed sunning themselves on the rock fences along the road between Vallecito and La Playa. They were very wary, diving off the fences and running to shelter while the observer was still some distance away. One large adult was basking about ten feet above the ground on the trunk of a tree. On the malpais several half-grown individuals were seen. The coloration of the adults blended so well with the lava boulders that many probably went unobserved. Half-grown specimens with snout-vent lengths of about 20 cm. are dull green with mottled brown patches

on the body and may or may not have tail bands of a dirty orange-yellow. One of the half-grown individuals was found on the side of the cone at an elevation of 3250 feet. One juvenile, the vivid green of which made it quite inconspicuous in the grass, was found scampering across a grassy area between two piles of lava boulders on the malpais.

Although there are no specimens in the British Museum from Jorullo, Gadow (1930: 58) stated that the species was present at the crest of the volcano.

Iguana iguana rhinolopha Wiegmann

Two juveniles are from the vicinity of La Playa. These have snout-vent lengths of 117 and 125 mm., the latter having a tail length of 295 mm. They possess, respectively, 60 and 65 dorsal scales counting from the most anterior enlarged scale to a point above the anal slit. Of these only the fourth through the twelfth and the fifth through the twelfth are noticeably enlarged, approaching the condition found in the adults. Three middorsal snout scales are tuberculate but not greatly enlarged as they are in the adults.

Sceloporus gadoviae Boulenger

There are six specimens in the British Museum from Jorullo, but our recent collecting did not reveal this species there.

Sceloporus horridus oligoporus Cope

Of four males and two females each has four femoral pores, dark blue lateral belly patches outlined with bluish black, and blue throats streaked with bluish black. These lizards were not abundant in the area, only four of them being found on the malpais. Two of those from the malpais were on a large block of lava at the base of the cone. A pair was interrupted during courtship on a large boulder in a palm grove between Vallecito and La Playa.

Sceloporus pyrocephalus Cope

This is the most common lizard on the malpais. A small and active animal, it climbs about on the lava boulders with great agility. It is most abundant on the malpais, although one was found at an elevation

of 3600 feet on the side of the cone, and another in the village of La Playa. The color differences between the sexes are quite striking and agree well with the descriptions given by Oliver (1937: 11) and Smith (1939: 371). Of the twelve specimens collected the largest is a male with a snout-vent length of 68 mm. and a tail length of 104 mm. The largest female measures 51 mm. in snout-vent length and 69 mm. in tail length. Two small males measuring 35 mm. in snout-vent length are colored like the adult males. Gadow collected four of these lizards on the malpais in 1908.

Uta gadovi Schmidt

Four specimens were collected in the area, one from La Playa, two from the north slope of the cone at an elevation of 3600 feet, and one from the bare lava in the crater of the volcano at an elevation of 4110 feet. Three males each have a combined femoral pore count of 18, and the single female has 17. The femoral pores in the males are very large and conspicuous, but in the female they are small and indistinct. The coloration is quite distinctive. In both sexes the belly is bright sky blue. In the middle of the throat is a bright orange spot; the rest of the throat and the lower labials are barred with black. Two specimens have a row of small orange spots dorsolaterally. The stomach of a male measuring 49 mm. in snout-vent length contained beetle remains and a red mite.

Previously, this species has been reported from Apatzingan and from Acahuato in the Balsas-Tepalcatepec Basin in Michoacán (Smith and Taylor, 1950b: 145). At those localities the species is found at elevations between 1600 and 1950 feet; the village of La Playa is about 2600 feet. The type locality of the species, La Cofradía, Jalisco, is on the plateau at an elevation of more than 5000 feet.

Cnemidophorus deppei lineatissimus Cope

Nine specimens were collected in the Jorullo area. There appears to be a distinct sexual difference in the number of femoral pores. Five males have an average combined count of 39.2, three females average 33.7. Four of the five males have black throats and bellies. The other one has a black throat, with the black extending posteriad to the hinder edge of the insertion of the forelimbs; posteriorly it is bluish gray. One female has a black throat and belly; the others have

bluish white ventral surfaces. All of the specimens have five or more relatively enlarged preanal scales.

These quick little lizards were seen scurrying about a grove of fan palms near La Playa. They took shelter beneath the dead fronds lying on the ground. Five individuals were collected on the malpais, where they were seen darting between clumps of mesquite in the grassy areas. Gadow (1930: 58) stated that he found this species at the top of the cone, but the recent collecting did not reveal it anywhere on the cone.

Cnemidophorus sacki copei Gadow³

Like Peters (1954: 18–19) I apply this name to the large race of *Cnemidophorus sacki* in southwestern Mexico. Since Gadow used the city of Colima as the type locality of *Cnemidophorus sacki copei*, Peters restricted the type locality of *Cnemidophorus sacki communis* to Guadalajara, Jalisco. This action is opposed to that of Smith and Taylor (1950a: 328), who restricted the type locality of the latter to Colima, Colima. However, Smith and Taylor did not realize the existence of a separate race of *C. sacki* in the coastal area of southwestern Mexico. At the time he resurrected the subspecies, *C. sacki copei*, Peters did not redefine the race and its range. The following description is based on a large series of specimens from southwestern Mexico in the Museum of Zoology.

Cnemidophorus sacki copei is a large form (the largest specimen is a male 130 mm. long from snout to vent and 277 mm. from vent to tip of tail) with a normal combined count of 40 or more femoral pores, usually three enlarged preanal scales plus one smaller scale in the apex of the hind limbs, dorsal coloration of young consisting of well-defined stripes that are replaced by yellowish spots in adults, yellow spots on the dorsal surfaces of the hind limbs and base of tail in adults, and no dark lateral stripe on the tail.

There are two cotypes in the Chicago Natural History Museum (CNHM 2531) from Manzanillo and Colima, Colima, and one in the British Museum (BMNH 1906.7.19.5) from Colima, Colima. The latter was designated as lectotype by Smith and Taylor (1950b: 182). I have examined the Chicago cotypes. In most respects they are identical with the specimens from the coast of Michoacán and Jorullo

³ Described as *Cnemidophorus communis copei* (Gadow, 1906: 346–52, Fig. 78 A, C, and E).

Volcano. They have femoral pore counts of 50 and 51, counts that are higher than the average for Colima specimens. In one of the cotypes there is an abnormal condition in the supraorbital semicircle series. Usually, this row of small scales extends antieriad almost to or just beyond the frontal-frontoparietal suture. In the one cotype the series extends antieriad along the inner margins of supraorbitals four, three, and two, and then turns laterad, separating supraorbitals one and two. The supraorbital semicircle series of the other cotype is normal.

Sixteen males from the coastal sierra of Michoacán have an average combined femoral pore count of $41.3 \pm .68$, and sixteen females average $41.8 \pm .57$. To the north and west in Colima eleven specimens average 44.8 ± 1.92 . Three specimens from low elevations in southern Guerrero average 41.3. The 32 specimens from Michoacán all have the supraorbital semicircle series extended to a point just posterior to the frontal-frontoparietal suture; five of the eleven specimens from Colima have the series extending to or beyond the suture. Two of the three specimens from Guerrero are like the Michoacán specimens, and the other has the series reaching the suture of the frontal and frontoparietal. Twenty-nine Michoacán specimens have three enlarged preanals, and three others have four enlarged preanals. Six specimens from Colima have three enlarged preanals, four have two, and one has one. Of the three specimens from Guerrero, two have three and one has four.

The most striking difference between *C. sacki copei* and *C. sacki communis* is in coloration. The large adults of the former have a greenish brown dorsal ground color. The stripes in the young and subadult individuals break up into round, yellowish spots. The upper surfaces of the hind limbs are spotted with yellow, and flecks of yellow are present on the dorsal surface of the base of the tail. The belly varies from pale blue to black; usually the throat is pinkish. Field notes on three specimens from the vicinity of Coalcomán, Michoacán, indicate the ontogenetic change in color pattern. (1) Snout-vent length 79 mm.; dorsal ground color dark brown, longitudinal body stripes vivid greenish yellow, belly pale blue. (2) Snout-vent length 101 mm.; dorsal ground color dark brown, dorsal longitudinal stripes indistinct, faint spots present in place of stripes, lateral stripes broken into distinct yellow spots, no spots on limbs. (3) Snout-vent length 130 mm.; ground color of back greenish extending onto base of tail and dorsal surfaces of hind limbs, rest of dorsal surfaces brownish, six rows of distinct round yellow spots on back and sides, yellow spots on upper surfaces of hind limbs and yellow flecks on base of tail, throat pink,

belly light blue anteriorly but much darker posteriorly, ventral surface of tail cream.

Specimens from Colima tend to have irregularly shaped rather than round spots. Those on the sides often vertically distended. In certain specimens from Guerrero and Oaxaca the spots are inconspicuous or absent in adults. Instead, there is a series of darker crossbands on the back. The specimens from Jorullo Volcano are similar to those from the coastal sierra of Michoacán, but a specimen from Apatzingan more closely resembles *C. sacki communis*. Individuals from the coast of Nayarit are similar to *C. sacki copei*, but they are not as large, have a blackish dorsal ground color, and have whitish dorsal spots.

Specimens from northern and western Colima appear to differ in color pattern as well as in lepidosis from the average individual from the coastal sierra of Michoacán. These specimens and the single individual from Apatzingan probably represent intergrades between *C. sacki copei* and *C. sacki communis*. Except for the Colima specimens, *C. sacki communis* appears to be restricted to higher elevations in southwestern Mexico, that is, the Mexican Plateau. The material examined indicates that the range of *Cnemidophorus sacki copei* extends from lowland areas in southeastern Colima southward and eastward at elevations less than 3500 feet along the coast and through the coastal sierra of Michoacán, as far as Acapulco and Chilpancingo, Guerrero, and inland into the Balsas Basin at least as far as Jorullo Volcano. On the basis of the ranges of other members of the herpetofauna, it would be expected to occur in the valley of the Río Tepalca-tepec in Michoacán.

The specimens from coastal regions of Nayarit and Sinaloa that are now assigned to *C. sacki communis* probably represent a separate race in a chain of subspecies occupying the west coast of Mexico and northern Central America: Nayarit form, *copei*, *australis*, *bocourti*, and *motaguae*, the last being found in Guatemala, Honduras, and El Salvador.

Of the seven specimens collected in the immediate area of the volcano, the largest is a female 115 mm. in snout-vent length. The ventral coloration is variable. One female is light cream ventrally; all of the others have some dark blue or black on the throat, belly, and ventral surfaces of the limbs. That the dark ventral coloration of this species and of *Cnemidophorus deppei lineatissimus* is associated with the black ash and lava of the area is highly doubtful, since specimens from nonvolcanic regions display similar coloration.

Next to *Sceloporus pyrocephalus* this is the most abundant lizard on the malpais. The large individuals were noisy as they scurried from one bush to another. These lizards were observed everywhere on the malpais, except in areas of bare volcanic ash or bare lava. They were found to the top of the cone, although they were less numerous on wooded slopes than on the more open malpais. One specimen was collected in an open rocky area at the rim of the crater at an elevation of 4190 feet. Gadow (1930: 57) found this species on the malpais but not at the top of the cone.

Constrictor constrictor imperator (Daudin)

Two specimens were obtained from the area. A native collected a female (1158 mm. total length) for Paynter. Storer collected a juvenile (420 mm. total length, tail 52 mm.) just north of the village of La Playa. It was coiled in a tight ball in the fork of a bush in a cleared area near a palm grove.

Conophis vittatus vittatus Peters

A female (420 mm. total length, tail 102 mm.) was collected in the vicinity of La Playa.

Drymarchon corais rubidus Smith

One badly mutilated specimen was brought to Paynter from the vicinity of La Playa.

Leptodeira smithi Taylor

A male collected by Gadow at La Playa has 170 ventrals, 67 caudals, and 16 dark brown body blotches.

Leptophis diplotropis diplotropis (Günther)

One male specimen with an incomplete tail was collected by Paynter near La Playa. It has a body length of 710 mm. and 177 ventrals. The scutellation agrees well with that given for this race by Oliver (1948: 208).

Masticophis flagellum lineatus (Bocourt)

Two specimens were given to Paynter by natives. One is a female (1325 mm. total length, tail 403 mm.), the other a juvenile (585 mm. total length, tail 168 mm.) similar in coloration to the adult, but with the ground color slightly darker. A faint, dark line is present posteriorly on the second scale row. The ventral surface of the tail is light pink. Gadow collected this species at La Playa.

Pseudoleptodeira latifasciata (Günther)

Paynter obtained one specimen from the vicinity of La Playa. The scale rows are 21-19, upper labials 8-8, lower labials 9-9, preoculars 2-2, postoculars 2-2. The red patch on the head includes all of the parietals and extends anteriorly to the middle of the frontal and posteriorly on the nape through four scale rows. There are nine chocolate brown bands on the body and three on the tail. The anterior body band is considerably narrower than the others. The interspaces are four scales in length and are cream; the belly is dusty cream.

Rhadinaea hesperia hesperia Bailey

Two specimens, a male (177 mm. total length, tail 61 mm.) and a female (482 mm. total length, tail 174 mm.), were collected in the area. Scale counts of the male and female are, respectively: ventrals 149, 167; caudals 127, 111; upper labials 8-8, 8-8; lower labials 10-10, 10-10; preoculars 2-2, 3-3; postoculars 2-2, 2-2. In life the male had a pink belly. The dorsolateral stripes are cream; the black lines are quite distinct. Below the dorsolateral stripes are scattered black flecks which extend onto the edge of the ventrals.

One specimen was found after a rain crawling across an ashy flat on the malpais. The other was under a log imbedded in the ash at the base of the cone. Another specimen, under a log halfway up the north slope of the cone, escaped into the loose ash and debris.

Salvadora mexicana (Duméril, Bibron, and Duméril)

Gadow collected three specimens of this species; Paynter collected one at La Playa.

Trimorphodon biscutatus biscutatus (Duméril, Bibron, and Duméril)

One male specimen (685 mm. total length, tail 125 mm.) collected by a native for Paynter is from the vicinity of La Playa. There are 25

scale rows on the anterior two-thirds of the body, but these drop sharply to 17 posteriorly. The ventrals number 256, the caudals 99, upper labials 9-9, lower labials 13-13. There are two preoculars, the upper of which is in contact with the frontal. The blotches number 20 on the body, nine on the tail. The coloration of this small specimen is considerably different from that of larger individuals. The dorsal body blotches are black, not brown as in large specimens, and are outlined in cream (Fig. 1). The dorsal ground color is light grayish tan,

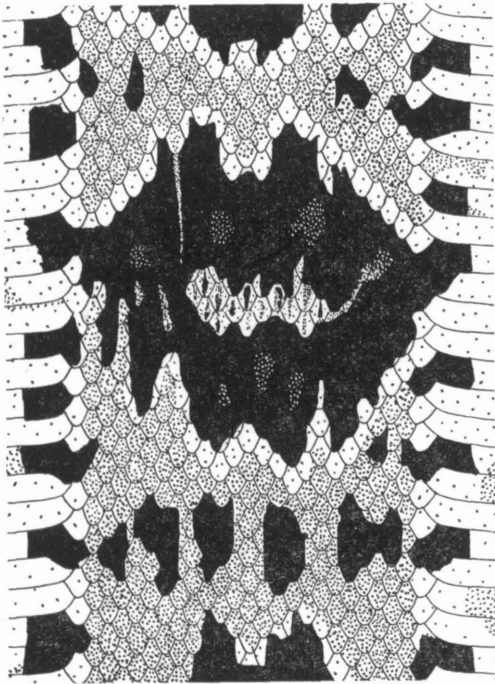


FIG. 1. Dorsal color pattern of immature *Trimorphodon b. biscutatus* from Jorullo Volcano, Michoacán (UMMZ 105154).

and the ventral surfaces are dusty cream. The interorbital band is dark brown, as is the V-shaped mark on the parietals.

Gadow collected one specimen at La Playa.

The number of ventrals and caudals (355) is low for the race *semirutus*, which supposedly occurs in this area. Smith (1943: 492) separated *semirutus* from *biscutatus* because the former has a total

ventral-caudal count of 358–376, and the latter has a smaller number, varying from 343 to 359. Four males from the Balsas-Tepalcatepec Basin in Michoacán have counts as follows: 354 and 370 from Apatzingan (Schmidt and Shannon, 1947: 82), 360 from Tafetán (Smith, 1943: 492), and 355 from Jorullo. Smith gave the range of *semirutus* as Guerrero through Michoacán to Colima. Two of the specimens from the Balsas-Tepalcatepec area have counts well within the range of variation of the race *biscutatus*; the other two fall within the range of the race *semirutus*. These data indicate that, at least in the Balsas-Tepalcatepec Basin, the character of total ventral-caudal count does not substantiate the definition of the race *semirutus* as proposed by Smith. Since there are no other characters that distinguish the two forms, *biscutatus semirutus* Smith should be considered a synonym of *biscutatus biscutatus*.

Agkistrodon bilineatus bilineatus Günther

A female (540 mm. total length, tail 106 mm.) of this species was procured by Paynter from the La Playa area. A pocket mouse, *Liomys pictus*, was removed from its stomach.

RECOLONIZATION OF THE VOLCANO

Gadow found six species of reptiles well within the limits of the lava flows and two species at the top of the cone. Recent collecting has revealed the presence of several additional species. Unfortunately, as ecological data for the specimens collected by Paynter are lacking, those specimens cannot be considered in a discussion of the recolonization.

Gadow (1930: 57–58) recorded *Cnemidophorus deppei lineatissimus* and *Ctenosaura pectinata* from the top of the cone, and these species and *Cnemidophorus sacki copei*, *Sceloporus pyrocephalus*, “*Uta irregularis*,” and “*Zamenis*” from the malpais. As the British Museum has no specimens of *Uta irregularis* from the vicinity of Jorullo Volcano, this record is questionable. Most probably it applies to *Uta gadovi*. Since Gadow did not consider *Masticophis* and *Salvadora* as genera separable from *Zamenis*, it is impossible to determine the identity of his “*Zamenis*” from the malpais.

Recent collecting indicates that there are two species at the top of the cone, *Cnemidophorus sacki copei* and *Uta gadovi*. *Sceloporus*

pyrocephalus, *Ctenosaura pectinata*, and *Rhadinaea h. hesperia* were found at various elevations on the wooded slopes of the cone. In addition to the above species, *Anolis nebulosus*, *Cnemidophorus deppei lineatissimus*, *Sceloporus horridus oligoporus*, *Bufo marmoratus*, *Rana pipiens*, and *Tomodactylus petersi* were on the malpais. Thus, 11 species are now definitely recorded from the malpais. Five of the 11 have been found on the slopes of the cone, and four at the top. This is a considerable increase over the number reported by Gadow.

One cannot definitely say that the preceding data conclusively demonstrate that certain species of reptiles and amphibians have entered the volcanically destroyed area since Gadow collected there in 1908. It is possible that Gadow merely missed collecting certain forms. However, he spent a month in the area, whereas the combined time spent there by Paynter, Peters, and myself amounted to only 14 days. It seems justifiable to assume that during the intervening 42 years certain species of reptiles and amphibians were able to enter the area and to establish themselves there.

The four species at the top of the cone are all lizards. Three of these, *Ctenosaura pectinata* and the two species of *Cnemidophorus*, are capable of rapid movement and should have had little trouble re-entering the area and making their way to the top of the cone. The small *Uta* is closely associated with a rocky habitat, one which is common in the form of volcanic boulders and lava outcrops on the malpais as well as on the slopes of the cone. The two species of *Sceloporus* on the malpais have a natural habitat in the large volcanic boulders and lava outcrops, and it is to be expected that both species will be fairly abundant on the slopes of the cone. The thick clumps of bushes on the malpais form a natural habitat for *Anolis*. As *Bufo* and *Rana pipiens*, notable for their ability to resist desiccation, are often found considerable distances from water, their presence on the malpais is not surprising. The leptodactylid frogs do not pass through an aquatic stage in their life history, and this phenomenon allows them greater freedom from water. Thus, as *Tomodactylus angustidigitorum* is very abundant near the edge of the lava flows at Parícutín Volcano, the presence of *Tomodactylus* on the malpais was not unexpected. Likewise, *Leptodactylus* and *Eleutherodactylus* probably occur there. The small, forest-dwelling snake *Rhadinaea* was not foreseen on the malpais. The presence of these snakes offers the probability that other similar snakes may also be there and even on the slopes of the cone. Snakes that are capable of moving considerable distances and that are found in brushy habitats would be expected to occur on the malpais.

TABLE I

Comparison of the Herpetofauna of Jorullo Volcano, Apatzingan Region,
and the Michoacán Coast (not including marine species)

Species	Jorullo	Apatzingan	Coast
<i>Rhinophrynus dorsalis</i> . . . . .	..	..	X
<i>Bufo horribilis</i>	X	X	X
<i>Bufo marmoratus</i>	X	X	X
<i>Eleutherodactylus occidentalis</i> . . . . .	..	..	X
<i>Eleutherodactylus rugulosus</i>	X	..	X
<i>Leptodactylus labialis</i> . . . . .	..	X	..
<i>Leptodactylus melanonotus</i>	X	X	X
<i>Tomodactylus petersi</i>	X	..	X
<i>Acrodytes inflata</i> . . . . .	..	..	X
<i>Agalychnis dacnicolor</i> . . . . .	..	X	X
<i>Diaglena reticulata</i> . . . . .	..	..	X
<i>Hyla smithi</i>	X	X	X
<i>Hylella azteca</i> . . . . .	..	..	X
<i>Smilisca baudini</i>	X	X	X
<i>Rana pipiens</i>	X	X ^a	..
<i>Kinosternon integrum</i>	X	X ^a	X
<i>Geoemyda rubida perixantha</i> . . . . .	..	X	X
<i>Crocodylus acutus</i> . . . . .	..	..	X
<i>Phyllodactylus lanei</i>	X	..	X
<i>Phyllodactylus tuberculatus</i> . . . . .	..	X	..
<i>Anolis nebulosus</i>	X	X	X
<i>Anolis schmidti</i> . . . . .	..	..	X
<i>Basiliscus vittatus</i> . . . . .	..	X	X
<i>Ctenosaura pectinata</i>	X	X	X
<i>Iguana iguana rhinolopha</i>	X	X	X
<i>Phrynosoma asio</i> . . . . .	..	X ^b	..
<i>Sceloporus asper</i> . . . . .	..	X ^c	..
<i>Sceloporus gadoviae</i>	X	X ^c	..
<i>Sceloporus horridus oligoporus</i>	X	X	X
<i>Sceloporus melanogaster calligaster</i> . . . . .	..	X	X
<i>Sceloporus pyrocephalus</i>	X	X	X
<i>Sceloporus siniferus siniferus</i> . . . . .	..	..	X
<i>Sceloporus utiformis</i> . . . . .	..	..	X
<i>Uta bicarinatus tuberculatus</i> . . . . .	..	..	X
<i>Uta gadovi</i>	X	X	..
<i>Heloderma horridum</i> . . . . .	..	X	X
<i>Eumeces colimensis</i> . . . . .	..	..	X
<i>Eumeces parvulus</i> . . . . .	..	..	X
<i>Lygosoma assatum taylori</i> . . . . .	..	..	X
<i>Mabuya mabouya alliacea</i> . . . . .	..	..	X
<i>Ameiva undulata sinistra</i> . . . . .	..	X	X
<i>Cnemidophorus deppei lineatissimus</i>	X	X	X
<i>Cnemidophorus guttatus immutabilis</i> . . . . .	..	..	X

TABLE I (Cont.)

Species	Jorullo	Apatzingan	Coast
<i>Cnemidophorus sacki</i>	X	X	X
<i>Leptotyphlops phenops bakewelli</i> . . . . .	..	..	X
<i>Constrictor constrictor imperator</i>	X	X	X
<i>Loxocemus bicolor</i> . . . . .	..	..	X
<i>Loxocemus sumichrasti</i> . . . . .	..	X	..
<i>Conophis vittatus vittatus</i>	X	..	..
<i>Dryadophis melanolomus stuarti</i> . . . . .	..	..	X
<i>Drymarchon corais rubidus</i>	X	X	X
<i>Drymobius margaritiferus fistulosus</i> . . . . .	..	X	X
<i>Hypsiglena torquata torquata</i> . . . . .	..	X	..
<i>Imantodes gemmistratus oliveri</i> . . . . .	..	..	X
<i>Leptodeira maculata</i> . . . . .	..	..	X
<i>Leptodeira smithi</i>	X	X	..
<i>Leptophis diplotropis diplotropis</i>	X	..	X
<i>Manolepis putnami</i> . . . . .	..	..	X
<i>Masticophis flagellum lineatus</i>	X	X	X
<i>Natrix valida valida</i> . . . . .	..	..	X
<i>Oxybelis aeneus auratus</i> . . . . .	..	..	X
<i>Pseudoficimia pulcherrima</i> . . . . .	..	X	..
<i>Pseudoleptodeira latifasciata</i>	X	X	..
<i>Rhadinaea hesperia hesperia</i>	X	..	..
<i>Salvadora mexicana</i>	X	X	X
<i>Sibon nebulatus</i> . . . . .	..	..	X
<i>Sonora michoacensis michoacensis</i> . . . . .	..	X	..
<i>Tantilla calamarina</i> . . . . .	..	X	X
<i>Thamnophis cyrtopsis postremus</i> . . . . .	..	X	..
<i>Trimorphodon biscutatus biscutatus</i>	X	X	X
<i>Micrurus diastema michoacensis</i> . . . . .	..	X	..
<i>Agkistrodon bilineatus bilineatus</i>	X	X	..
<i>Crotalus basiliscus</i> . . . . .	..	X	X

a. - Reported as *Kinosternon cruentatum cruentatum* (Schmidt and Shannon, 1947:69).

b. - Based on UMMZ 85399 from 4 km. east of Apatzingan.

c. - Based on UMMZ 81957 from Hacienda El Sabino.

Among these could be included *Drymarchon*, *Masticophis*, and *Salvadora*, also possibly *Leptodeira* and *Trimorphodon*. The semiarboreal forms such as *Constrictor* and *Leptophis*, and arboreal forms such as *Oxybelis*, probably do not occur on the malpais because of the absence of a suitable habitat. *Iguana*, *Agkistrodon*, and *Kinosternon* appear to be too dependent upon an aquatic habitat to enter the malpais. The soil there apparently will not support the elephant ear plant (*Xanthosoma roseum*); *Hyla smithi*, its ecological associate, is likewise absent.

ZOOGEOGRAPHY

Of the 30 species of reptiles and amphibians in the vicinity of Jorullo Volcano, all but four are essentially of lowland distribution. Three of the four, *Rana pipiens*, *Sceloporus horridus oligopus*, and *Kinosternon integrum*, are found at high as well as low elevations. *Rhadinaea h. hesperia* is usually at elevations higher than Jorullo. The greatest part of the herpetofauna of the Jorullo area appears to have been derived from the fauna of the Pacific Coast of Mexico. Twenty-six of the 30 species found at Jorullo are also on the coast of Colima, Michoacán, and Guerrero. Of the four exceptions, *Sceloporus gadoviae* and *Pseudoleptodeira* are restricted to the Balsas Basin; *Uta gadovi* appears to be restricted to the lower reaches of the edge of the Mexican Plateau; and *Rhadinaea h. hesperia* is found on the edge of the plateau and in the Sierra del Sur of Guerrero.

As would be expected, the herpetofauna of Jorullo shows a great deal of similarity with that of Apatzingan in the Tepalcatepec Basin. Twenty-three of the 30 species present at Jorullo are also at Apatzingan, and 27 of the 44 species at Apatzingan are also on the coast of Michoacán. Records from Apatzingan (Schmidt and Shannon, 1947), from the coast of Michoacán (Peters, 1954), and from Jorullo Volcano show the relationships of the herpetofaunas (Tables I and II). Many other species are found in the coastal sierra at higher elevations. Obviously, some species were missed at certain localities; for example, *Agkistrodon b. bilineatus* from the coast of Michoacán.

A total of 73 species is recorded from these lowland regions. Of these only 30 (41 per cent) are present at Jorullo, whereas 44 (60 per cent) occur at Apatzingan and 55 (75 per cent) on the coast. There are fewer coastal species inland in the Balsas Basin. *Crocodylus* is found only on the coast. Of the two turtles there, *Geoemyda* and *Kinosternon*, both occur at Apatzingan, but only *Kinosternon* at Jorullo. Of the snakes and lizards on the coast slightly more than 50 per cent of the species occur at Apatzingan, and less than 40 per cent are at Jorullo. Approximately 50 per cent of the amphibian fauna ranges inland to Apatzingan and Jorullo. Genera absent in the Balsas Basin but found on the coast of Michoacán are, for the most part, more southern (tropical) in distribution: *Acrodytes*, *Hylella*, *Rhinophrynus*, *Crocodylus*, *Mabuaya*, *Loxocemus*, *Dryadophis*, *Imantodes*, *Oxybelis*, and *Sibon*. Other genera, such as *Diaglena* and *Manolepis*, are essentially coastal in their distribution and are not expected in the Balsas Basin.

On the basis of the great similarity of their herpetofaunas and their few endemics, the lower Balsas Basin and the Pacific Coast of southwestern Mexico comprise but a single biotic province within the Neotropical Region. Various names have been proposed for all or parts of this region: Lower Balsas Province (Smith, 1939: 15; 1940: 101), Nayarit-Guerrero Province (Goldman and Moore, 1946: 349), and

TABLE II

Comparative Numbers of Species of Reptiles and Amphibians
Recorded from Jorullo Volcano, Apatzingan, and Coastal Michoacán

	Frogs	Turtles	Crocodilians	Lizards	Snakes	Total
Jorullo . . .	8	1	0	10	11	30
Apatzingan	8	2	0	16	18	44
Coast	13	2	1	21	18	55

Acapulcan Province and Balsas Province (Smith, 1949: 226). The description of the region given by Goldman and Moore (1946: 355) is more applicable to the area than are those by Smith. Goldman and Moore include the upper reaches of the Balsas Basin in their Nayarit-Guerrero Province. Actually, too little is known of the herpetofauna of the middle and upper Balsas Basin to determine its relationships with the coastal regions. Nevertheless, it seems best to consider the coastal regions of Michoacán and the lower Balsas Basin as part of the Nayarit-Guerrero Biotic Province and to make no assertion at this time as to the biotic position of the upper Balsas Basin.

LITERATURE CITED

GADOW, HANS

1906 A Contribution to the Study of Evolution Based upon the Mexican Species of *Cnemidophorus*. Proc. Zool. Soc. London, pp. 277-376, Figs. 61-83, Pl. XX.

1930 Jorullo. Cambridge: University Press. Pp. i-xviii, 1-100, 2 pls., 1 map.

GOLDMAN, EDWARD A.

1951 Biological Investigations in Mexico. Smithsonian Misc. Coll., 115: i-xiii, 1-477, 71 pls., 1 map.

GOLDMAN, EDWARD A., and ROBERT T. MOORE

1946 The Biotic Provinces of Mexico. Journ. Mammalogy, 26 (4):347-60, 1 fig.

KELLOGG, REMINGTON

1932 Mexican Tailless Amphibians in the United States National Museum. Bull. U.S. Nat. Mus., 160: i-iv, 1-224, Figs. 1-24, Pl. I.

OLIVER, JAMES A.

- 1937 Notes on a Collection of Amphibians and Reptiles from the State of Colima, Mexico. *Occ. Papers Univ. Mich. Mus. Zool.*, 360: 1-28, Fig. 1, Pl. I, Map 1.
- 1948 The Relationships and Zoogeography of the Genus *Thalerophis* Oliver. *Bull. Amer. Mus. Nat. Hist.*, 92 (4): 157-280, Figs. 1-13, Pls. 16-19.

PETERS, JAMES A.

- 1954 The Amphibians and Reptiles of the Coast and Coastal Sierra of Michoacán, Mexico. *Occ. Papers Univ. Mich. Mus. Zool.*, 554: 1-37.

SCHMIDT, KARL P., and FREDERICK A. SHANNON

- 1947 Notes on Amphibians and Reptiles of Michoacán, Mexico. *Fieldiana-Zoology*, 31 (9): 63-85, Fig. 8.

SMITH, HOBART M.

- 1939 The Mexican and Central American Lizards of the Genus *Sceloporus*. *Zool. Ser. Field Mus. Nat. Hist.*, 26: 1-397, Figs. 1-59, Pls. 1-31.
- 1940 An Analysis of the Biotic Provinces of Mexico, as Indicated by the Distribution of the Lizards of the Genus *Sceloporus*. *Anal. Esc. Nac. Cien. Biol.*, 2 (1): 95-110, 1 map.
- 1943 Summary of the Collections of Snakes and Crocodilians Made in Mexico Under the Walter Rathbone Bacon Traveling Scholarship. *Proc. U.S. Nat. Mus.*, 93: 393-504, Pl. 32.
- 1947 Notes on Mexican Amphibians and Reptiles. *Journ. Wash. Acad. Sci.*, 37 (11): 408-12.
- 1949 Herpetogeny in Mexico and Guatemala. *Ann. Assoc. Amer. Geog.*, 39 (3): 219-38, Fig. 1.

SMITH, HOBART M., and EDWARD H. TAYLOR

- 1945 An Annotated Checklist and Key to the Snakes of Mexico. *Bull. U.S. Nat. Mus.*, 187: i-iv, 1-239.
- 1948 An Annotated Checklist and Key to the Amphibia of Mexico. *Ibid.*, 194: i-iv, 1-118.
- 1950a Type Localities of Mexican Reptiles and Amphibians. *Univ. Kans. Sci. Bull.*, 33, Pt. 2 (8): 313-80.
- 1950b An Annotated Checklist and Key to the Reptiles of Mexico Exclusive of the Snakes. *Bull. U.S. Nat. Mus.*, 199: i-v, 1-253.

TAYLOR, EDWARD H., and HOBART M. SMITH

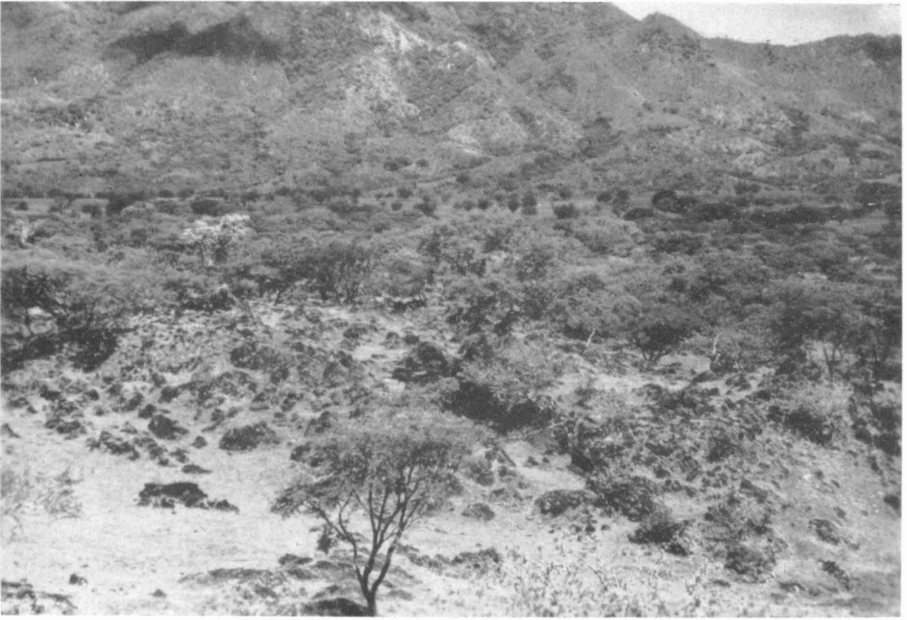
- 1945 Summary of the Collections of Amphibians Made in Mexico Under the Walter Rathbone Bacon Traveling Scholarship. *Proc. U.S. Nat. Mus.*, 95: 521-613, Figs. 58-61, Pls. 18-32.

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PLATE I

Across the malpais to the western slope of the cone, Jorullo Volcano. July 2, 1951.

PLATE I

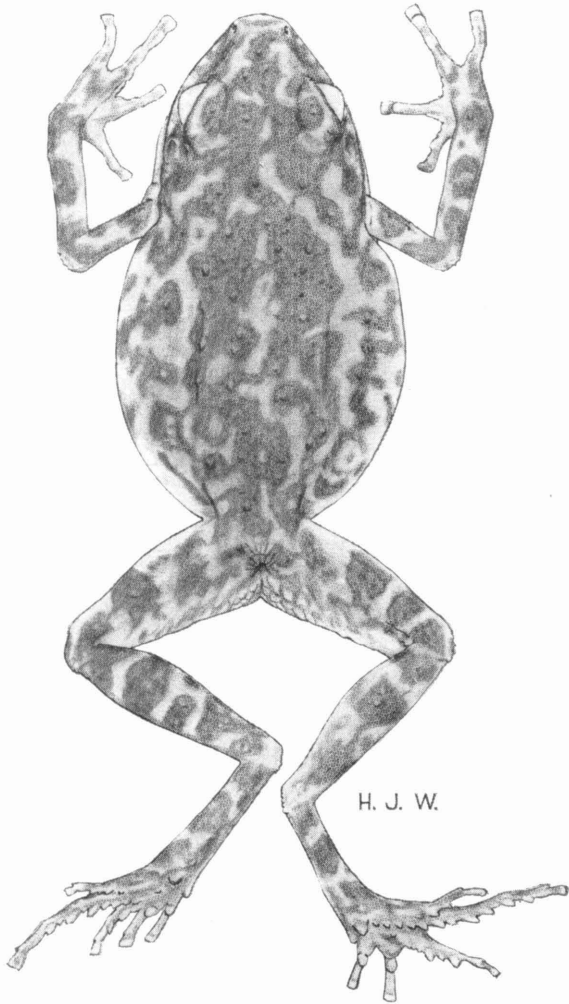
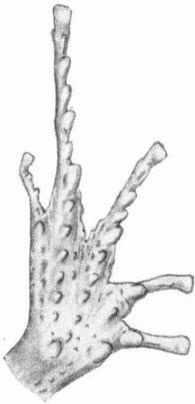
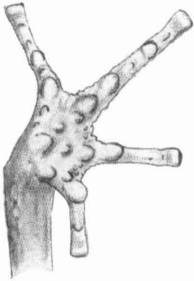
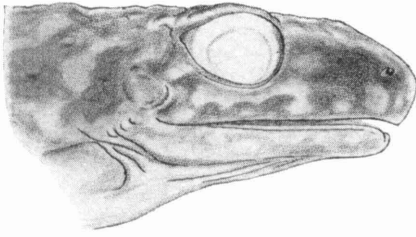


William E. Duellman

PLATE II

Holotype of *Tomodactylus petersi*, new species. (UMMZ 109238) from Coalco-
mán, Michoacán. Actual length of specimen 25.5 mm.

PLATE II



H. J. W.

