

**Article X.—THE AMPHIBIANS COLLECTED BY THE
AMERICAN MUSEUM EXPEDITION TO
NICARAGUA IN 1916**

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PLATES XIV TO XIX

INTRODUCTION

The collections of reptiles and amphibians in the American Museum from southwestern United States and the West Indies have been rapidly growing during the past five years. As the work on these collections progressed, the need for material from related faunal areas was keenly felt. Small collections from Mexico and Costa Rica had been received through purchase or gift, but there was no extensive collection with which to trace out the many problems of zoogeographical relationships which arose in connection with the other work. In May 1916, through the kindness of Dr. Bashford Dean, a generous grant from the Cleveland H. Dodge Fund was made available to the Department. Nicaragua was selected as the region which would yield the best results for intensive study. Nicaragua had not been visited by a herpetologist for a long time. It was perhaps the least known of the large republics of Central America. The types of most of the species described from Nicaragua were in the United States, and would be available for comparison with fresh material. It was felt that a study of the herpetological fauna of Nicaragua would be the most satisfactory not only to the American Museum, but to other museums as well.

The work of the expedition was primarily herpetological and ichthyological. Mr. Clarence R. Halter, assistant in herpetology at the American Museum, and Mr. L. Alfred Mannhardt, assistant in zoology at Yale University, were given charge of the expedition. These men made extensive field notes, and took many photographs, some of which are published here. After the expedition had been in the field several months, the Department decided to extend its activities to a more complete survey of the Republic. The additional expenses involved were met by a special appropriation. The success of the expedition was due largely to the untiring efforts of the collectors during their stay in Nicaragua.

The present paper deals with the amphibians collected by the expedition. It is only a preliminary report. The larger problems of zoogeographical distribution have been left for a later paper, in which the distribution of the

reptiles also will be discussed. This paper is, however, complete, in that it considers all of the species of amphibians collected.

While few generalizations have been made, the remarks on the distribution of some of the species are intended to suggest the larger problems of zoogeography. Several species are reported from Nicaragua for the first time. At least one of these species, *Leptodactylus albilabris*, may have been introduced. Two species are described as new. Many of the species are rare in collections. *Hyla boulengeri* was formerly known only from the type specimen. Some mention has been made of the breeding periods of the batrachians. The breeding period of several of these has been determined by an examination of the genital organs of a large series of specimens. This work would have been useless if the collectors had not given exact dates. In herpetology it is just as important as in ornithology to record the date of collecting, but many collectors in the past have failed to realize this.

No attempt has been made to give complete synonymies. For each species a reference to the original description and another to the Biologia Centrali-Americana are given. Günther has been accepted as the most recent reviser, and it is only when material changes are made in his work that additional references are mentioned. References to the literature which Günther has apparently overlooked are included in the synonymies. References are also given to all very recent literature bearing on the Central American amphibians discussed.

I take pleasure in acknowledging the kind assistance of Dr. Leonhard Stejneger who gave me every facility for studying the Central American amphibians at the National Museum. To Mr. H. W. Fowler I am indebted for the opportunity of examining the Central American amphibians at the Philadelphia Academy of Natural Sciences. I am also obliged to Dr. A. G. Ruthven of the University of Michigan for the loan of a series of *Leptodactylus albilabris*. Dr. William M. Wheeler, Dean of the Bussey Institution, has kindly identified the ants which made up a large part of the stomach contents of the various amphibians collected. Dr. J. Bequaert of the American Museum has examined other insects at my request.

Itinerary

A complete account of the region traversed by the expedition will be given in a later paper. In order to make clear the localities in which amphibians were taken, an itinerary has been extracted from the field notes of the collectors. In this brief outline of the trip references to life zones have not been given, and mention of habitats and amphibian associations have been left for another part of the paper.

On May 31, 1916, the expedition left New York for Bluefields, Nicaragua, via New Orleans. The members reached Bluefields June 17, and four days later left the town for the nearby Maselina Creek, where they hoped to secure better collecting facilities than were available in the immediate environs of Bluefields. By July 1 preparations were complete for a collecting trip into the interior. Both Mr. Halter and Mr. Mannhardt went north as far as the Rio Grande and continued up that river one hundred and twenty-five miles until they reached Sioux Plantation on Sixicuas Creek. They spent from July 4 to 10 at this locality and then dropped down the river to Cooley Plantation. They returned to Bluefields July 28 and made arrangements for a trip to the region just north of that town. On August 1, the expedition started for Cukra. Several days were spent in collecting at Kanawa and Wholesome Creek, but most of the time was spent at Cukra proper. On August 22, the party returned to Bluefields, and on August 27 started south again to Maselina Creek. The expedition remained in this vicinity until September 27, although different members made a number of short trips back to Bluefields.

Arrangements were at last complete for a more extended investigation. On September 27 the expedition divided, Mr. Halter going at once south to the San Juan River, and Mr. Mannhardt, after a week's delay, starting north for the Prinzapolka River. Mr. Halter reached Barra del Colorado on September 28 and made large collections in the vicinity until October 17, when he was able to engage a boat to take him west across Nicaragua. In the meantime, Mr. Mannhardt was progressing slowly up the Prinzapolka toward Eden Mine. He collected on many of the affluents of that river, but chiefly on the Cupitna and Pia Creeks. Consequently, he did not reach the headwaters of the river system until November 10. It is there that Eden Mine is located. Mr. Mannhardt made it his base and began an intensive study of the fauna in this mountainous part of Nicaragua.

By November 10 Mr. Halter had reached Tuli Creek, which flows into the southeastern part of Lake Nicaragua. He had reached San Carlos October 30, the mouth of Tuli Creek on November 3, and by November 10 had started up the creek toward the Chontales Mountains. Mr. Halter did not return to the mouth of the creek until December 4. He then proceeded to San Miguelito and collected in the vicinity until January 4. Then followed a hasty trip to Managua and the western bank of the lake. The return trip across the lake and down the river San Juan allowed few opportunities for study, and no amphibians were collected. Mr. Halter reached Bluefields January 31, to find that Mr. Mannhardt had completed his survey of northern Nicaragua and had returned to the States on December 11. Mr. Halter left for New York on February 3, 1917.

Topography and Vegetation

Most of the localities visited presented a complex of habitats and amphibian associations. The most striking features of the habitats are given below under their respective localities, but a consideration of special habitats has been left for the annotated list of species.

MASELINA CREEK meanders through a flat coastal plain which is nearly at sea-level. The region is a vast mangrove swamp with here and there islands of dry land in which palms and huge trees take root. The creek partly overflowed its banks during the collector's stay, for it rained nearly all of the time.

SIoux PLANTATION, on the Rio Grande, presented a very different appearance. Its altitude is only about seventy-five feet, but savannahs instead of lowland forests prevail. Some patches of bamboo occur along the river, and a few flamboyants and other conspicuous trees are present. The soil contains much clay. Outcroppings of rock are rare. The temperature averaged about 85° during part of July. There was little rain, and all the vegetation showed signs of drought. The thatching of the native huts retained a little moisture and afforded a retreat for some of the amphibians, chiefly for *Hyla baudinii*.

COOLEY PLANTATION, on the same river, is about twenty-five feet lower in altitude than Sioux Plantation. The vegetation was much the same in the two regions, but at Cooley Plantation scrub growth prevailed instead of savannahs.

CUKRA is a village near Kanawa and Wholesome Creek. The elevation of the region is about one hundred feet. No swamps occur, although there are several streams. The savannah grasslands are broken by clumps of forests and thickets. Many of the latter are probably of second growth. It rained considerably during the collector's stay in the region, and a number of shallow savannah ponds were formed.

CUPITNA CAMP is a lumber base on one of the affluents of the Prinzapolka. The camp is situated in the heart of a mahogany forest. The dense jungle of this region is similar to that of most of the upper Prinzapolka. Some patches of grass occur along the river banks, but there are no savannahs.

EDEN MINE is situated in the hilly country of northern Nicaragua. The region varies in altitude from six hundred to over a thousand feet above sea-level. The valleys about Eden Mine are filled for the most part with shady, open woods. There are some wet forests, but very few swamps occur. A large part of the woods in the vicinity of the mine has been destroyed to form artificial clearings, which support a poor amphibian fauna.

COLORADO BAR is in northeastern Costa Rica at sea-level. A dense

jungle of large trees extends almost to the water's edge. Many swamps wind tortuously through the jungle. The faunal and floral life is typical of a tropical forest.

SAN CARLOS, on Lake Nicaragua, is surrounded by extensive swamps. Its altitude is about one hundred and ten feet, but there are many knolls and small hills which rise to a greater height above sea-level. Lowland forests and forest ponds support a fauna which is not unlike that of the adjacent region to the north.

SAN MIGUELITO, on Lake Nicaragua, was used as a base for exploration in the west. The altitude is about one hundred and ten feet. Many hills arise behind the town. These finally unite to form the low range known as the Chontales Mountains. The sides of the hills near San Miguelito are bare. A desert vegetation made up chiefly of cacti abounds. Some bamboo occurs on the river banks, but no forest trees are found. The Chontales Mountains are covered with dense forests similar to those of Tuli Creek.

TULI CREEK, to the south of San Miguelito, supported a large amphibian fauna. The stream has its headwaters in a series of swamps. Dense tropical forests extend for about fifteen miles on either side of the creek. It rained considerably during the collector's stay in the region, and the swamps encroached widely upon the forests.

ANNOTATED LIST OF SPECIES

1. *Rana austriicola* (Cope)

Plate XV, Fig. 1

Rana halecina austriicola COPE, 1886, Proc. Amer. Phil. Soc., XXIII, p. 517.

Rana virescens austriicola WERNER, 1896, Verh. Ges. Wien, XLVI, p. 349. IVES, 1891, Proc. Acad. Nat. Sci. Phila., p. 461.

Rana lecontei MOCQUARD, 1899, Bull. Soc. Philom., (9) I, p. 158.

Rana halecina BOETTGER, 1892, Kat. Senck. Ges. Batr., p. 6. GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 198. WERNER, 1903, Abh. Bayer. Ak., XXII, 2, p. 341. GADOW, 1905, Proc. Zool. Soc. London, part 2, p. 194.

Rana austriicola RUTHVEN, 1912, Zool. Jahrb. (Syst.), XXXII, p. 305.

Fourteen specimens from several widely separated localities, most of them from Tuli Creek, Eden Mine, and Maselina Creek.

These specimens agree very well with a series of *R. austriicola* in the Philadelphia Academy from Hidalgo, Mexico (A. N. S. P., 14615-14616) and another from Mexico City (A. N. S. P., 14605-14614). Several of the Hidalgo specimens are very dark and are similar to two of our specimens from

Greytown on the San Juan River. These two specimens are darker than any of our others and their snouts are less acuminate, but not so blunt as the snout of *R. palmipes*. This bluntness of snout does not seem to be due to any artificial cause. Barbour (1917, Proc. Biol. Soc. Wash., XXX, p. 103) has shown that the snout of *Leptodactylus albilabris* may be more or less depressed. Apparently the snout of *R. austriicola* may be more or less pointed within a certain range. The two specimens in our series with most acuminate snouts are adults of opposite sex. Their gonads are not very large. The two specimens with the bluntest snouts are females with ovaries distended with ova. The difference in head form does not seem to be correlated with sex. It may be dependent upon season or habitat, but without a very large series this would be difficult to determine.

The variation in color is not limited to an intensifying or fading of the tones. There is also a slight variation in pattern. The spots on the back may be more or less confluent. In the smallest and the largest specimens in the collection the spots have been extended to form an unbroken but irregular streak on each side of the back. Each pair of spots may be confluent in a transverse direction, but it is more common for the spots in each longitudinal row to run together. There does not seem to be any progressive development of pattern during the growth of an individual, for specimens of the same size may have very different color patterns.

Two females were taken with their bodies swollen with ova, one on November 18 at Eden Mine and the other on August 17 at Cukra. It is possible that the breeding season of the species extends over several months, but it is more probable that the breeding season varies slightly with each locality. The females are larger than the males. An average pair differ in the proportion of 84:70. Only a few of the stomachs examined contained food. This consisted chiefly of spiders and weevils.

2. *Rana palmipes* Spix

Plate XIV

Rana palmipes SPIX, 1824, Nov. Spec. Test. Ran., p. 29, Pl. v, fig. 1. GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 202. RUTHVEN, 1912, Zool. Jahrb. (Syst.) XXXII, p. 306. GADOW, 1905, Proc. Zool. Soc. London, part 2, p. 194. *Rana chrysoprasina* Deckert, 1915, Zoologica, II, No. 1, p. 20 (*nec* Cope, 1866).

Thirty-five specimens from several localities in the eastern drainage systems: Eden Mine, Cupitna and Pia Creeks, Cooley Plantation on the Rio Grande, and Cukra.

The specimens in this series correspond exactly with those of a series from Guatemala and those of another series from Mexico in the National Museum. The variation in color of our specimens is limited to the fading out of the ground tone and to the developing of spots on the posterior part of the back. In life the color above was grass-green from the tip of the snout to the tympanum and olive from the tympanum to the ends of the appendages. In certain lights a bronze-like shimmer was present on the head. The posterior sides of the legs were mottled with dark brown and white. The lower parts of the legs were less distinctly mottled with brown. The throat was pearly white; the belly and ventral surfaces of the appendages were washed with lemon yellow. The posterior appendages were heavily mottled with brown below.

There is considerable variation in the size of the tympanum in *R. palmipes*. This is apparently not correlated with sex or habitat. Two adult females of identical size, measuring 95 mm. from snout to vent, were captured together in a swamp near Eden Mine. These specimens have the ova equally well developed. The difference in size of the tympanum is very distinct.

	A.	B.
Greatest length	10.0 mm.	8.5 mm.
Greatest width	8.5	7.5

R. palmipes was always found in the vicinity of water, generally in long grass by the edge of some marsh or pond. Five females with ovaries greatly distended with ova were taken near Eden Mine on November 22. Another specimen in the same condition was taken November 23. A young one with the tail not yet absorbed was taken the same day. These data suggest that the breeding period of the species in the vicinity of Eden Mine occurs about the end of November, and that the larva takes about one year to complete its metamorphosis. Females from other localities at an earlier date did not have the ovaries enlarged.

The sexually mature female is much larger than the male. The body length of an average female is 89 mm. from snout to vent, while that of the male is only 72 mm.

R. palmipes apparently takes a variety of food. The stomachs examined contained, for the most part, spiders and insect larvæ. One large specimen of *R. palmipes* had eaten a young one of the same species. A large amount of extraneous wood and grass was contained in the stomach with the young frog. Another specimen which was caught in a swamp near Eden Mine disgorged a small fish when killed with an alcohol injection.

The smallest specimen of *R. palmipes* in the series measures 27 mm. from

snout to vent, and possesses a rudiment of a tail 6.5 mm. in length. It was interesting to find in this specimen that the two halves of the epicoracoid cartilages were firmly attached and did not allow any free movement. The girdle had become firmisternal before the sternum and xiphisternum were distinguishable from the tissue connecting the abdominal muscles and before the omosternum showed evidence of any bony deposit.

3. *Rana cæruleopunctata* Steindachner

- Rana cæruleopunctata* STEINDACHNER, 1864, Verh. Ges. Wien, p. 264, Pl. xv, fig. 1.
 BOULENGER, 1882, Cat. Batr. Sal. Brit. Mus., p. 50. GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 205. FOWLER, 1916, Proc. Acad. Nat. Sci. Phila., p. 396.
Ranula cæruleopunctata COPE, 1866, Proc. Acad. Nat. Sci. Phila., p. 130.
Trytheropsis chrysoprasinus COPE, 1868, Proc. Acad. Nat. Sci. Phila., p. 117; 1876, Journ. Acad. Nat. Sci. Phila., VIII, p. 114, Pl. xxiii, fig. 12.
Rana chrysoprasinus COPE, 1886, Proc. Amer. Phil. Soc., XXIII, p. 276 (*nec* Cope 1866); 1887, Bull. U. S. Nat. Mus., XXXII, p. 19.

Twenty-two specimens from several widely scattered localities along the east and west drainage systems: Eden Mine, Pia, Cupitna, Sixicuas, Maseлина, and Tuli Creeks.

Günther, with little evidence, placed *Rana chrysoprasina* in the synonym of this species. Sufficient evidence is not available to show conclusively that *chrysoprasina* is distinct, but at least it is very probable that *chrysoprasina* does not occur in Nicaragua. I have examined in the National Museum the four young specimens sent from Nicaragua by Dr. Bransford and referred by Cope (1887, p. 19) to *chrysoprasina*. These specimens are in poor condition. They are indistinguishable from *cæruleopunctata*. The specimen which Cope (1876, Pl. xxiii, fig. 12) figured as *chrysoprasina* is also poorly preserved. The large yellow spots on the thighs represent all that is left of the color pattern. The short webbing of the toes and the long snout are typical of *cæruleopunctata*. Another specimen recorded as *chrysoprasina* was sent from San José, Costa Rica, by Van Patten. It is now in the Philadelphia Academy (No. 2153). This specimen is apparently identical with *cæruleopunctata*. The three specimens from Costa Rica recently referred by Deckert (1915, Zoologica, II, No. 1, p. 21) to *chrysoprasina* have been deposited in the American Museum (Nos. 3815-3817). They are identical with our specimen of *R. palmipes* from Nicaragua and should have been referred to that species. In spite of these faulty records, it is still possible that *chrysoprasina* is a valid species.

The type of *chrysoprasina* was sent to the National Museum from Arriba, Costa Rica, by Charles N. Riotte. Cope described the species, but whether

he ever returned the specimen to that museum is not known. At present, the type cannot be found in that institution. Cope actually compared his type with some specimens of *cæruleopunctata*, for he says in the original description (1866, p. 130) of *chrysoprasina*:

This species is allied to the last, but has a relatively shorter muzzle and limbs. Nostril nearer end of muzzle than orbit (equidistant in *cæruleopunctata*), heel to middle of loreal region. Toes fully, not widely palmate, three distal phalanges of fourth free....

Steindachner represents much less palmation than exists in our specimen.

Cope described the color of *chrysoprasina* as "brilliant leek-green, the groin and belly approaching golden." The coloration of *cæruleopunctata* is entirely different. It is possible that Cope had an aberrant specimen of *R. palmipes*. Without further information it is most conservative to allow *chrysoprasina* to stand as valid.

Some of the color in our specimens has apparently faded in alcohol. The color pattern and ground tones are the same as those described for the species. In life, the dark spots on the back were greenish. The concealed portions of the legs, below the spotted pattern, were brilliant red; the ventral surfaces of both anterior and posterior appendages were pinkish. The ends of the toes were red, like the concealed parts of the legs. Most of these reds have changed to white in alcohol.

The ground tones have not changed in alcohol, but these vary somewhat in the different specimens in our series. This variation is confined on most of the body to a general intensifying or fading of color. The yellow spots on the posterior sides of the thighs undergo variation with age. While this variation is not always consistent, it does follow a rather definite plan. In the smallest specimens there are no light spots on the thighs, but the posterior surfaces are pink and are crossed by three dark bars. This blackish pigment gradually encroaches upon the light areas as the individual matures. The pinkish areas change to yellow. Medium-sized specimens have two light spots between the three bars, and a third spot distal to the outer bar. In older specimens the black has increased and has cut the spots in two. The spots seem to divide by fission, like so many amoebæ. Three pairs of spots occur in several of the larger specimens. Sometimes an additional pair of spots is present. The development of color pattern does not progress evenly in all cases. The multiplication of spots may not take place. For example, two adults females in the series are of identical size, measuring 59 mm. from snout to vent. They both have ovaries distended with large ova, and both were taken in the same locality. Yet one specimen has only two yellow spots on one thigh and three on the other, while the other specimen has eight spots on each thigh. There is an apparent sexual difference.

The males, which are much smaller than the females, have the smaller number of spots.

Rana cæruleopunctata was very rare along the low flat coastal regions such as those through which Maselina Creek flows; but it was often seen in the mountainous regions of northern Nicaragua and in the hilly country near Tuli Creek. *R. cæruleopunctata* is a frog of the dense jungle. It was found chiefly on the ground among dead leaves in damp, shady places. One pair was taken November 23 while in embrace. Other specimens, taken between this date and December 1, had the ovaries greatly distended with ova. The breeding season of the species in the vicinity of Tuli Creek must therefore be about the end of November. There is a decided difference in size between the sexes. The female of the pair taken in embrace measures 58 mm. from snout to vent, while the male measures only 40 mm.

4. *Dendrobates tinctorius* (Schneider)

Calamita tinctorius SCHNEIDER, 1801, Hist. Amphib., p. 175.

Dendrobates tinctorius BOULENGER, 1882, Cat. Batr. Sal. Brit. Mus., p. 142. COPE, 1887, Bull. U. S. Nat. Mus., XXXII, p. 19. PERACCA, 1896, Bol. Mus. Torino, XI, No. 253, p. 11. DECKERT, 1915, Zoologica, II, No. 1, p. 22. FOWLER, 1916, Proc. Acad. Nat. Sci. Phila., p. 396.

Dendrobates tinctorius auratus COPE, 1893, Proc. Amer. Phil. Soc., XXXI, p. 340.

Hylaplesia tinctoria GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 207.

Dendrobates amœnus WERNER, 1901, Verh. Ges. Wien, LI, p. 627.

Two adult specimens from Tuli Creek.

Werner (1901, p. 631) has recently revised the Dendrobatidæ, and has described a new species of *Dendrobates* from Costa Rica. In his key he distinguishes this species, *amœnus*, from *tinctorius* by a difference in leg length, the tarso-metatarsal articulation in the former species reaching beyond the end of the snout. The legs of our specimens are proportionately as long as those of *amœnus*, but it does not seem to me that leg length in this case is a specific character. Werner, in his description of *amœnus*, says: (translation) "the tarso-metatarsal articulation reaches the nostril, the end of the snout, or beyond." This would cover the range of variation exhibited in other specimens of *tinctorius* in this museum. Three of these specimens are from British Guiana, one from Colombia, and one from Costa Rica. Our two Nicaraguan specimens have the tarso-metatarsal articulation reaching only slightly beyond the snout. I have examined two specimens of *tinctorius* from Taboga Island. These were collected by James Zetek and are now in the National Museum (Nos. 51955-51956). They are indistinguishable from our two Nicaraguan specimens. The Taboga

Island specimens are topotypes of *D. auratus*. If the Central American race is distinct from the South American, it will have to receive a new name, for Boulenger (1913, Proc. Zool. Soc. London, p. 1026) has shown that the type probably came from Guiana. The first available name for the Central American form would be *auratus*, but we have not enough evidence to separate the Central American form. Our Costa Rican specimen is identical with the Nicaraguan specimens and Werner's description of *amaenus* agrees well with either these specimens or our Guianan specimens. The color varies somewhat in all of the specimens, but very little is known about color variation in the green and black variety of *tinctorius*.

Boulenger, in discussing the color varieties of *tinctorius*, has said (1913, *op. cit.*, p. 1028):

The numerous varieties of *Dendrobates tinctorius* are much in want of revision. Among those already described there is one which is unquestionably entitled to specific rank, and for which I wish to propose the name *D. paraensis*. Disks of fingers and toes much larger than in *D. tinctorius*; a small but very distinct tubercle on the inner side of the tarsus, nearer the metatarsal tubercles than the tibio-tarsal articulation.

One specimen of *tinctorius* in the American Museum (No. 3139) from Jimenez, Colombia, was purchased from Rosenberg. Since it was identified by Boulenger as *tinctorius*, it probably represents what he considers the typical form. Moreover, its digital expansions agree very well with Boulenger's (1913, *op. cit.*, text fig. 178) figure of those of *tinctorius*. The three specimens in the American Museum from Guiana were collected near Georgetown by Rodway. The digital expansions of these specimens are much larger than those of *D. paraensis* as figured by Boulenger (1913, *op. cit.*, text fig. 178). The digits of both Guianan and Colombian specimens differ from the Central American specimens in having the dorsal surface covered by two distinct disks. In the Nicaraguan specimens there is some evidence of disks, but their posterior edges are fused with the rest of the integument. There is considerable difference in the exact form of these digital disks. In the Guianan and Nicaraguan specimens they are elongate, while in the Colombian specimen they are round, as figured by Boulenger. With the small series of specimens of *tinctorius* available for study, it is impossible to determine the systematic status of the species in Central America. Further work may show that the form of the digits represents a good character by which to distinguish the Central American race.

The arrangement of the black spots varies greatly in the Central American specimens. These spots are arranged in life upon an iridescent blue-green ground color. Both of the Nicaraguan specimens were captured during a shower and both about ten o'clock in the morning. They were found among

the leaves on the floor of the forest which surrounds Tuli Creek. One specimen was taken November 7, and the other November 21.

The stomachs of these two specimens contained mostly ants, although a few beetles and other insects were present. There were about fifty ants in each stomach. Dr. Wheeler has identified most of these as *Wasmannia auropunctata* Rog. Seven other genera were represented, but each by only a few workers: *Strumigenys*, 2 sps.; *Rhopalothrix*, n. sp.; *Leptogenys* (*Lobopelta*), sp.; *Trachymyrmex*, sp.; *Ponera*, sp.; *Pheidole*, 2 sps.; and *Solenopsis*, sp.

5. *Dendrobates typographus* Keferstein

Dendrobates typographus KEFERSTEIN, 1867, Gött. Nachr., p. 360. DECKERT, 1915, Zoologica, II, No. 1, p. 22. WERNER, 1901, Verh. Ges. Wien, LI, p. 630. *Hylaplesia typographa* GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 207.

Taken only in the southeastern part of Nicaragua and the northeastern part of Costa Rica: thirty-two specimens from the region about Cukra, two from La Hunter, and three from Colorado Bar.

Werner (1901, p. 630), in his revision of the Dendrobatidæ, describes the tympanum of this species as (translation) "very small, much smaller than the disks of the fingers." In our series, the tympanum is always larger than the disks of the fingers, but sometimes the dorsal half of the tympanum may be undifferentiated from the temporal region, making the tympanum appear like a small crescent.

In alcohol, the color of all but two or three of our specimens is a metallic blue. The dorsal and lateral surfaces of the specimens are washed with a pearly gray and spotted with dark blue. In a few of the specimens the pearly gray is replaced by a pink. The color, in all but these pink specimens, has been greatly modified in alcohol.

In life, the color of the head and body was a brilliant carmine. A few dark blue spots were generally present on the back. In practically all of the specimens from Cukra and Colorado Bar the appendages were a brilliant blue. The two specimens from La Hunter had only the lower half of the appendages, from the humerus and femur down, washed with blue. A blue patch was generally present on the sacral region. The two specimens from La Hunter had the entire dorsal surface excepting the appendages tinged with brilliant carmine, but the dark blue spots appeared soon after the specimens had been killed in formalin. The ventral surface of the specimens was variable, blue, carmine, or a pearly gray predominating in different individuals. Four young specimens from Cukra, averaging 12.5 mm. from snout to vent, were very different in coloration from the adults,

which were 22 mm. long. The dorsal surface was very dark red, clouded with dark brown. The ventral surface was a dark blue. Dark blue spots appeared on the dorsal surface after death.

All of the specimens were caught in damp, shady situations near the water. They were found under leaves and pieces of decaying wood which were strewn about on the ground. Only a few stomachs were examined. They contained mostly small red ants. One pill bug and a spider were found with the ants.

6. *Leptodactylus pentadactylus* (Laurenti)

Plate XV, Fig. 2

Rana pentadactyla LAURENTI, 1768, Syn. Rept., p. 32.

Leptodactylus pentadactylus GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 212.

Four specimens, varying in size from 34 to 134 mm. from snout to vent, all taken in the eastern side of the Republic: Eden Mine, Sioux Plantation, and Maselina Creek.

The smallest specimen is from Eden Mine, the most northerly point on the mainland from which the species has been recorded. It has been known from the island of Dominica, B. W. I., for a long time, but never so far north on the mainland. The largest specimen taken at Maselina Creek shows the transverse cross-bars on the back. These are absent in the two medium-sized specimens. In the smallest specimen the interorbital bar and a supratympanic spot are present as well as the labial bars. All of the specimens but the largest one have the ventral surface dark brown spotted with white — the characteristic coloration of the immature. In all of the specimens there was, in life, a considerable amount of red on the thighs. In most alcoholic specimens of *L. pentadactylus* which I have examined the red has faded out, but this bright tone is evidently very striking in life.

Two of the specimens were caught in the morning. One was taken in a hut at Maselina Creek, and the other was found under a pile of boards near the edge of a house at Sioux Plantation. It is evident that *L. pentadactylus* is accustoming itself to human habitations. The stomach of the largest specimen contained several cockroach wings; fragments of the legs, wings, and heads of grasshoppers; one spider; and a large amount of vegetable material.

7. *Leptodactylus albilabris* (Günther)

Cystignathus albilabris GÜNTHER, 1859, Ann. Mag. Nat. Hist., (3) 4, p. 217.

Leptodactylus labialis IVES, 1891, Proc. Acad. Nat. Sci. Phila., XLIII, p. 461.

Leptodactylus albilabris GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 213. STEJNEGER, 1904, Rept. U. S. Nat. Mus., 1902, p. 561, figs. 6-10. GADOW, 1905, Proc. Zool. Soc. London, part 2, p. 194. RUTHVEN, 1912, Zool. Jahrb. (Syst.), XXXII, p. 307. BARBOUR, 1914, Mem. Mus. Comp. Zool., XLIV, No. 2, p. 255; 1915, Proc. Biol. Soc. Wash., XXVIII, p. 72; 1917, Proc. Biol. Soc. Wash., XXX, p. 103.

Several hundred specimens from many localities in the east and the west; most of the specimens from the headwaters of Tuli Creek.

Besides this huge series, I have examined a number of specimens collected in Mexico by Dr. A. G. Ruthven and have compared these mainland specimens with the large series of specimens in the National Museum from Porto Rico and the neighboring islands. With these large collections it has been possible to determine something of the range of variation in mainland and island specimens, but it has not been possible to shed much light upon the original home and subsequent migration of the species.

There are many differences between the mainland and island specimens. In a series of a hundred specimens from both regions, there are many individuals which are very unlike but others which are so similar that no one distinguishing character can be given. Three characters may be used to distinguish the average mainland specimen from the average island specimen. The dorsal surface of the legs distal to the femora is covered, in the island specimens, with numerous sharp-pointed rugosities, while in the mainland specimens these tubercles are less numerous and blunt — in some cases they may be absent. The brown spots which form the dorsal color pattern in the mainland specimens are rarely or never outlined with white, while in island specimens white is often present and sometimes very distinct. The throat of the mainland specimens is either white or is stippled around the edges with dark brown. In the island specimens the throat may be entirely washed with brown. These differences are not constant; they probably represent nothing but local variations. The Nicaraguan specimens generally have the ventral surface of the thighs slightly spotted, while the Mexican specimens generally lack the spots. Island specimens probably differ from the mainland specimens because of a difference in environment rather than because of ancient isolation.

It is indeed strange that, in spite of all the collecting which has been done in Central America, *L. albilabris* has never before been taken south of Mexico. Bransford, McNeil, Stimpson, and others collected in Nicaragua; and yet they never took this species. It does not seem probable that the species could have been overlooked, for Stejneger (*op. cit.*, p. 562) had said "it is one of the commonest, most obtrusive, and most easily caught batrachians wherever it occurs." Is it possible that the species has been confused

with *L. melanonotus* and *L. caliginosus*? No evidence is available to show that this is the case. We must, then, assume that *albilabris* in recent years has been rapidly extending its range southward. It is probable that *L. pentadactylus* has recently extended its range northward. Both species may have been introduced by man, but here again we can only conjecture. If it is proved that they have been introduced by man, the argument (see Barbour, 1914) in favor of the introduction of *L. albilabris* into Porto Rico by human agency is greatly strengthened. In both Porto Rico and Nicaragua the foreigner has adapted itself entirely to the new country, reminding us in this respect of our own English sparrow.

8. *Leptodactylus melanonotus* (Hallowell)

Cystignathus melanonotus HALLOWELL, 1860, Proc. Acad. Nat. Sci. Phila., p. 480.
Leptodactylus melanonotus BROCCHI, 1882, Miss. Sci. Mex., Batr., p. 20. BARBOUR, 1914, Mem. Mus. Comp. Zool., XLIV, No. 2, p. 254.
Leptodactylus caliginosus MOCQUARD, 1899, Bull. Soc. Philom., (9) I, p. 163. GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 214. GADOW, 1905, Proc. Zool. Soc. London, part 2, p. 194. ATKINSON, 1907, Ohio Naturalist, VII, p. 151. RUTHVEN, 1912, Zool. Jahrb. (Syst.), XXXII, p. 306.

More than a hundred specimens from many localities on both the east and the west sides of the Republic; most from the vicinity of Tuli Creek.

I have compared this large series with a specimen of *L. caliginosus* in the American Museum from Merida, Venezuela, and heartily agree with Barbour (*loc. cit.*) that *L. melanonotus* is perfectly distinct from that species. Little has been said of the variation in *L. melanonotus*, for most authors have considered the Central American species synonymous with the wide-ranging *L. caliginosus*. Most of our specimens were taken in swamp-lands. The color pattern is obscured by the very dark ground tones. In several specimens from Eden Mine the ground color has faded to a gray brown and a color pattern has appeared, consisting of a dark interorbital bar edged anteriorly with light gray and a number of dark spots on the back and lips. A few dark spots on the legs tend to form transverse bars. Even in the lightest specimens this color pattern is indistinct. The throat and edges of the belly are reticulated with dark brown in all specimens. This ventral coloration serves as an excellent field mark for distinguishing *L. melanonotus* from *L. albilabris*. In most adult specimens the white interstices of the dark reticulations on the posterior surfaces of the thighs change to an orange, simulating the coloration in *L. pentadactylus*, but in many adult specimens the orange is wanting. This condition is apparently not correlated with sex.

The most striking external character of *L. melanonotus* is the longitudinal rows of warts which sometimes appear in adult specimens. These are of most common occurrence in very large females but females of equal size and having ova equally developed may or may not have warts. Males and females may have exactly the same degree of wartiness, or they may entirely lack the tubercles. Wartiness is not correlated with sex in this species. Two very large females from the same general locality, with ova well developed, are strikingly different, one having eighteen rows of warts and the other none. The wartiness of *L. melanonotus* is probably due to some stimulus in the environment.

9. *Syrrhophus ridens* (Cope)

Phyllobates ridens COPE, 1866, Proc. Acad. Nat. Sci. Phila., XVIII, p. 131.

Syrrhaphus ridens GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 216.

Three adult specimens from the vicinity of Tuli Creek and one from Cupitna Camp.

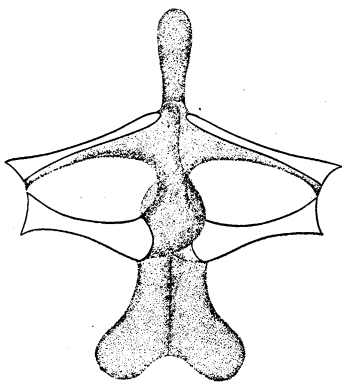


Fig. 1.

Fig. 1. Pectoral girdle of *Syrrhophus ridens* (Cope).

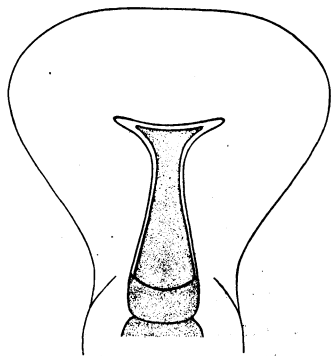


Fig. 2.

Fig. 2. Terminal phalanx of *Syrrhophus ridens* (Cope).

Cope, at the beginning of the original description of the species, says:

The close areolation of the abdomen, throat, and lower face of the femora, the recurved angle of the mouth, the minute ($\frac{1}{4}$ orbit) tympanum, above the ordinary position, the truncate tongue are marked features in this species.

In the two largest specimens before me the ventral surface is entirely smooth; in the smallest it is slightly granular. The tympanum of three of the specimens is about one-fourth the diameter of the eye; the tympanum

of the smallest specimen is about one-sixth. The specimens agree fairly well with the original description in all other particulars. The color pattern is subject to some variation, but in two of the specimens it is nearly the same as that described for the types. In one of these specimens there are only two, not three, dark bars across the femora. Cope does not mention the color of the posterior faces of the thighs. This is dark brown in all of the specimens. The smallest specimen differs from the others in having a white vertebral stripe.

The type locality of *S. ridens* is the San Juan River, Nicaragua. Our specimens are practically topotypes, for Tuli Creek flows into Lake Nicaragua near the San Juan. The type specimens are apparently lost. They were supposed to have been sent to the National Museum, but there is no record of their having been received by that institution. It has been pointed out that our specimens differ from the types, but the areolation of the ventral surface may not be a constant feature. *Eleutherodactylus diastema* has been considered by Cope to be closely related to *S. ridens*. I have examined the two types of the former species in the National Museum. The ventral surface of one (U. S. N. M., 25170) is smooth, while that of the other (U. S. N. M., 25171) is slightly areolate.

If *S. ridens* is not closely related to *E. diastema*, it is, at least, very closely allied to the genus *Eleutherodactylus*. If it possessed vomerine teeth, it would be referable to that genus. The digital expansions, although large, are subtriangular in shape and have T-shaped terminal phalanges, as shown in figure 2. The sacral diapophyses are slightly dilated, as in several species of *Eleutherodactylus*. The pectoral girdle is typical of the genus *Eleutherodactylus* (Fig. 1).

10. *Eleutherodactylus ranoides* (Cope)

Lithodytes ranoides COPE, 1886, Proc. Amer. Phil. Soc., XXIII, p. 275.

Liophyla ranoides COPE, 1893, Proc. Amer. Phil. Soc., XXXI, p. 335. GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 225.

Five specimens from the vicinity of Tuli Creek and one from Cukra.

The types of this species (U. S. N. M., 14179) are nearly identical with those (U. S. N. M., 29771-2) of *E. rugulosa* (Cope). The color has faded considerably in these specimens, the gray changing to brown; but *E. rugulosa* may be distinguished from *E. ranoides* by its vomerine teeth, which are in two round fascicles almost touching one another. In the latter species the vomerine teeth are in two transverse fascicles distinctly, although not widely, separated from one another. The former species has the dorsal

surface slightly more tubercular than the latter. In general proportions and in color pattern, the species are very similar. The types of *E. rugulosa* were collected in Tehuantepec, the types of *E. ranoides* in Nicaragua. The former species is not represented in our Nicaraguan collections. It is possible that the two species have been confused in the past and that *E. rugulosa* does not occur in Nicaragua.

The earlier name, *Eleutherodactylus*, is here employed for *Hylodes*. Günther uses the generic name *Liohyla*, but he admits (1900, p. 220) that he retains the name "only because it is convenient to lessen the great number of species described as *Hylodes*."

Two of the specimens of *E. ranoides* from Tuli Creek have a narrow vertebral line of white. All of the specimens have a very fine, longitudinal, white line across the mottled throat region. One very young individual, measuring only 16 mm. from snout to vent, as compared with 43 mm. of the adult, is much browner than the others. In spite of its small size, it has the characteristic mottled throat-patch divided by a white line.

One specimen, an adult male caught November 25 near the edge of Tuli Creek, contained in its stomach a large grasshopper. Fragments of a grasshopper's wing were found in the stomach of another specimen.

11. *Eleutherodactylus polyptychus* (Cope)

Hylodes polyptychus COPE, 1886, Proc. Amer. Phil. Soc., XXIII, p. 276. GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 228, Pl. LXVI, fig. C. DECKERT, 1915, Zoologica, II, No. 1, p. 15.

Twenty specimens, all from eastern Nicaragua and northeastern Costa Rica: Eden Mine, Pia Creek, La Hunter, and Colorado Bar.

In spite of the intensive collecting done in the region of Tuli Creek and the Chontales Mountains, this species was not taken in western Nicaragua. Although apparently limited in range, it displayed considerable diversity in color. The ground tone (in alcohol) is a light tan, but the back is heavily washed with brown. In some of the specimens the dorsal coloration is a uniform brown, but in most of the specimens some of the yellow appears to form indistinct patterns. Two patterns are repeated on several specimens. In one, the yellow appears as two longitudinal stripes, one on each side of the back. In the other, a Δ -shaped yellow mark appears on the pectoral region and a shade of the same on the sacral region.

There is apparently a definite relationship between the size of a specimen and its rugosity. One adult female, measuring 25 mm. from snout to vent, is nearly identical with the types (U. S. N. M., 14180). This specimen

is more rugose than any of the other specimens. Another female of the same size with equally well developed ova is not so rugose as the former, but it is more rugose than the majority of smaller specimens. There is probably some other factor besides maturity influencing the rugosity of this species.

Only a few stomachs were examined. They contained only insects, and mostly large ants. Two adult females were taken with ovaries greatly distended with ova. One was captured October 1 on Colorado Bar and the other October 22 at La Hunter. This would indicate that the breeding season of the species in eastern Nicaragua extends throughout most of October. Specimens were taken in a variety of habitats, but mostly in the dark jungle where undergrowth was thin, due to the absence of sunlight.

12. *Eleutherodactylus rhodopis* (Cope)

Plate XVI, Fig. 1

Lithodytes rhodopis COPE, 1866, Proc. Acad. Nat. Sci. Phila., p. 323.

Hylodes rhodopis GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 232, Pl. LXVII, figs. c and c'. GADOW, 1905, Proc. Zool. Soc. London, part 2, p. 194. DECKERT, 1915, Zoologica, II, No. 1, p. 15.

One specimen from Kanawa and another from Eden Mine.

E. rhodopis is apparently as variable as other Central American species of *Eleutherodactylus*. But it varies not only in color; there is considerable discrepancy in the leg lengths of the two specimens before me. I have compared these specimens with others from Mexico and Guatemala in the National Museum. The tibio-tarsal articulation in most specimens extends beyond the end of the snout. In one of our specimens it just reaches that point. This specimen is a male with small gonads. The ground color of this specimen was light orange in life, of the other dark brown. The color pattern was nearly the same in both and similar to that described for the species. Both specimens were taken in the dark forest, among the dead, wet leaves on the ground.

13. *Eleutherodactylus rugosus* (Peters)

Hylodes rugosus PETERS, 1873, Monber. Ak. Wiss. Berlin, p. 610. GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 233.

Lithodytes megacephalus COPE, 1875, Journ. Acad. Nat. Sci. Phila., VIII, p. 110, Pl. XXIII, fig. 11.

Lithodytes pelvicolus COPE, 1877, Proc. Amer. Phil. Soc., XVII, p. 89.

Hylodes megacephalus GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 239.

Thirty-one specimens from several scattered localities: Eden Mine, Backas Creek, Cupitna Camp, Kanawa, Cukra, and Tuli.

This large series of specimens shows conclusively that *E. megacephalus* is but the adult of *E. rugosus*. The specimens range from 8 mm. in length (snout to vent) to 41 mm. The largest specimen is a male; an old female would probably be larger. All of the intermediate steps between the different modes of coloration given for the types of *E. megacephalus* and *E. gulosus* are represented in the series. The incipient stages in the formation of the supraciliary crests characteristic of *E. megacephalus* are found in medium-sized individuals. No specimens from Chiriqui, the type locality of *E. rugosus*, have been available for study, but in the National Museum two specimens (Nos. 29894-29896), probably collected in Costa Rica, and three others (Nos. 29963-29964), from San Carlos, Costa Rica, are identical with young specimens in our series.

Günther was correct in referring *Lithodytes pelvicolus* Cope to *E. megacephalus*. The type (U. S. N. M., 3236) falls well within the range of variation exhibited by young specimens in our series. The tympanum of the type specimen is nearly as large as the eye, but, since the tympanum varies greatly in our series, its size cannot be a diagnostic character.

There is very little external difference between the type of *E. gulosus* Cope (U. S. N. M., 32590) and the type of *E. megacephalus* (U. S. N. M., 32579). Both specimens are females with well developed ova. It is strange that *E. gulosus* is so much larger than *E. megacephalus*. Without other specimens than the type, it is probably best to allow *E. gulosus* to stand as a valid species.

The most striking change in the coloration of *E. rugosus* is the transformation of the dark, purple-brown ground color into a light tan. This change does not take place in adults only. There are many small specimens in the collection which have the coloration described as characteristic of *E. megacephalus*. But the majority of our specimens have the purplish ash coloration characteristic of *E. rugosus*. The most constant features in the coloration of the species are the dark reticulations of the ventral surface, the light interorbital bar, and the dark supratympanic stripe. The dark spots on the back, lips, and legs are generally present, but in very dark individuals most of the color pattern is obscured. In life, the palms and soles of the appendages of the dark individuals are a light tan. This color is retained on the palms in the light variety, but it is generally replaced on the soles by a black.

The majority of specimens were caught in clearings among dead leaves on the ground. These situations were sometimes shady and moist, but never swampy. Only a few stomachs were examined. These contained

14. **Eleutherodactylus bransfordii** (Cope)

Lithodytes bransfordii COPE, 1886, Proc. Amer. Phil. Soc., XXIII, p. 274.

Hylodes bransfordii GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 238.

Over a hundred specimens from most of the localities visited in both the east and the west.

E. bransfordii and *E. polyptychus* occur together in the same region. The adults of both species have a number of longitudinal rows of tubercles on the back, and they are very similar in general proportions; but the former species may readily be distinguished from the latter by its narrow snout and different ventral coloration.

Our series of *E. bransfordii* shows a remarkable range of color variation. The ground color is generally some tone of gray or pinkish gray. Numerous darker blotches may appear on the dorsal surface. Of these the most constant are the interorbital band, a Δ -shaped mark on the pectoral region, and a number of cross-bands on the legs. A black spot on the tympanum and another under the eye are almost always present. In the smaller specimens the skin is smooth and the color pattern is not distinct, but a white vertebral stripe is often present.

The digital expansions of *E. bransfordii* are very small and somewhat diamond-shaped. It is generally assumed that the form of the digital expansions and the shape of the terminal phalanges are correlated. We would expect simple phalanges in slightly dilated disks. The terminal phalanges of *E. bransfordii* are T-shaped, but, more strangely still, the phalanges do not extend very far into the small disks. The greater part of the disks are unsupported by bone. If the shape of the terminal phalanges and the form of the digital expansions are correlated, the factor of size must play a considerable rôle.

15. **Bufo hæmatiticus** Cope

Bufo hæmatiticus COPE, 1862, Proc. Acad. Nat. Sci. Phila., p. 157. GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 243.

One specimen from Eden Mine.

I have compared this specimen with the type of the species in the National Museum (No. 4344). The type specimen came from Truando, Colombia. In spite of the distance which separates the localities where these two specimens were collected, they are, nevertheless, nearly identical in color as well as in relative proportions.

Our specimen of *Bufo hæmatiticus* was caught among the leaves on the

mostly beetles. One medium-sized individual contained in its stomach two beetles and a large ant (*Neoponera obscuricornis* Emery). The walls of the stomach of *E. rugosus* are thicker and more muscular than those of any other species of Nicaraguan *Eleutherodactylus* which I have examined.

13. *Eleutherodactylus nubilus* (Günther)

Hylodes nubilus GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 237, Pl. LXIX, fig. a.

Fifty-five specimens from many localities in the east and west; most of the specimens from the vicinity of Tuli and Pia Creeks and from Eden Mine.

Although this species, like *Leptodactylus albilabris*, is common throughout Nicaragua, it has never been taken from that Republic before this time. The species was described only recently from Costa Rica. It is surprising that none of the early collectors found it in Nicaragua.

The species shows such an extraordinary range of color variation that it is easier to point out the few constant characters rather than to try to describe the total range. The gray throat-patch divided by a broad white band, the dark reticulations on the posterior surfaces of the thighs, and the dark interorbital band are more or less distinct in all of the specimens; but in some of the specimens with a broad vertebral line the interorbital bar is indicated only by two spots. The average ground color is not dark purplish, as described for the type, but it is some value of brown. Dark bars on the lips and appendages are often present, although sometimes indicated by only a slight shading. An extensive dorsal color pattern is present in only a few of the smaller specimens. It consists of a dark W-shaped mark on the pectoral region and a dark spot in the middle of the back. A few dark reticulations are sometimes present on the dorsal surface of the snout. Three black spots are occasionally present on each side of the body, one above the tympanum and the other two posterior to it and nearer to the axis of the body. The three dark spots are arranged in an oblique line directed toward the axis. The yellowish vertebral line is present in less than half of the specimens.

Two of the specimens from Maselina Creek have the bodies greatly distended with large ova. One of these specimens was taken September 4, and the other September 13. It seems probable that the species breeds in eastern Nicaragua during the end of September. The species was found in many different habitats, but always in the vicinity of water.

ground in a dense, but not swampy, jungle. It had been feasting on ants. Its stomach contained a great many large red and black ones. The following species were represented in the contents of this single stomach: *Pachycondyla harpax* F. (4), *Ectatomma ruidum* Rog. (1), *Eciton hamatum* F. (3), *Atta cephalotes* (4), *Apterostigma* sp. (1).

16. *Bufo marinus* (Linné)

Rana marinus LINNÉ, 1758, Syst. Nat., I, p. 356.

Bufo marinus IVES, 1891, Proc. Acad. Nat. Sci. Phila., p. 461. COPE, 1893, Proc. Amer. Phil. Soc., XXXI, p. 335. MOCQUARD, 1899, Bull. Soc. Philom., (9), I, p. 166. GADOW, 1905, Proc. Zool. Soc. London, part 2, p. 194. ATKINSON, 1907, Ohio Naturalist, VII, p. 151. RUTHVEN, 1912, Zool. Jahrb. (Syst.), XXXII, p. 309.

Over a hundred specimens from several localities in the east and the west; most specimens from the town of Rio Grande.

The range of variation in this large series is very small, and nothing more than has already been described by several authors, most recently by Ruthven (1912, p. 309). The sexually mature males are readily distinguishable from the females by the numerous, low, spiny tubercles on the back. This rugosity is correlated only with sex. It is not to be confused with the rugosity caused by external factors. Such rugosity occurs in several species of *Eleutherodactylus* and *Leptodactylus*; and, as we have shown above, is probably due to the influence of the environment.

A rather varied diet was found in the few stomachs examined. This consisted chiefly of large cockroaches. Such insects were to be expected, since the majority of these giant toads were taken around street lamps in the town of Rio Grande.

17. *Bufo coniferus* Cope

Bufo coniferus COPE, 1862, Proc. Acad. Nat. Sci. Phila., p. 158. GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 251, Pl. LXIX, fig. B.

Three specimens from eastern Nicaragua, one from each of the following localities: Cupitna Camp, Kanawa, and Maselina Creek.

The type specimen (U. S. N. M., 4335) of this species was collected in Turbo, Colombia. It is larger than any of our specimens and differs in having more tubercles on the back. These tubercles are less pointed than in our specimens. There is apparently no other difference between our specimens and the type. Our largest specimen measures only 49 mm. from snout to vent. None of the specimens are sexually mature.

In alcohol, these three toads appear nearly uniform gray with a slight indication of a darker pattern; in life, they were very different. The dorsal ground tone was bright leaf-green with velvety dark gray, almost black, markings, tending to form a Δ -shaped mark on the pectoral region and a pair of ocelli on the sacrum. These dark markings were replaced by light gray blotches in one specimen. On the edges of some of the gray blotches there appeared a few large cream-colored spots. In another specimen the hands, feet, upper arms, and anterior part of the femoral regions were all tan-colored. Laterally there was a row of tubercles washed with tan, but the tubercles on the back were the same as the ground tones of the regions in which they were situated. The sides of the head were tan, but appeared metallic green in reflected light. The ventral surface was green, mottled with gray. The pupil of the eye was horizontally elliptical. The iris was golden with a greenish tint and it was reticulated by a few black veins.

The specimens were caught in three different but related habitats:

- 1.) Soft mud on the edge of the rain forest.
- 2.) Moist leaves covering the floor of the forest.
- 3.) Moss-covered vine about five feet from the surface of the water in a forest swamp.

Most of the stomach contents consisted of beetles, but a few ants were present. Several large weevils, a large histerid, and a few ants were contained in one stomach. The ants in this stomach were *Paraponera clanata* F., *Neoponera obscuricornis* Em., *Apterostigma* sp., and *Hylomyrma* sp.

18. *Bufo valliceps* Wiegmann

Bufo valliceps WIEGMANN, 1833, Isis, p. 657. IVES, 1891, Proc. Acad. Nat. Sci. Phila., p. 461. GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 252. GADOW, 1905, Proc. Zool. Soc. London, part 2, p. 194. ATKINSON, 1907, Ohio Naturalist, VII, p. 151. RUTHVEN, 1912, Zool. Jahrb. (Syst.), XXXIII, p. 309.

Nearly a hundred specimens; two from Tuli Creek, all of the rest from the east, where they were taken in nearly every locality visited.

Specimens of this species in the National Museum from Guatemala and Costa Rica agree perfectly with our series; but the average condition of the large series of *B. valliceps* in the American Museum from Texas is much more rugose above. The warts are more numerous and flatter in the Texan specimens than in the Nicaraguan specimens. Günther (1900, p. 252) has noted this discrepancy in the northern and southern specimens, and has pointed out that there is a constant difference in color. It is probable that there are

two races of *B. valliceps* in Central America. No specimens from Honduras and Mexico are available for study and it is impossible to determine the ranges of these forms. It is possible, however, that the northern form is but a local variation. There are not sufficient data upon which to base a subspecies.

The color of *B. valliceps* is variable, but, as in many other species of *Bufo*, it follows a definite sequence in its development. In the young, a pattern is present, consisting of three or four black spots on the back, a black interorbital bar, and dark cross-bars on the legs. A light vertebral stripe is nearly always present. As the individual matures, the ground tone becomes much darker and the color pattern gradually disappears. This change in coloration apparently does not always progress evenly. Many of the smaller specimens in the collection do not have the black spotting. In very small specimens the black spots are not present.

B. valliceps was taken in a great variety of habitats. It was often associated in the woods with *B. marinus*, but that species outnumbered it five to one. It was rarely seen about human habitations, but was noted in almost every other place, from the sea beaches to the highest mountains visited.

19. *Hyla chica*, new species

Plate XVIII

Diagnostic characters.—Very small. Vomerine teeth, if present, in two small, widely separated, oblique groups between the choanæ and behind the level of their posterior margins. Fingers free; toes barely webbed, the web very fleshy and hardly distinguishable from the metatarsal region. The following phalanges of the toes free: first (inner) toe, two; second toe, two; third toe, two and two-thirds; fourth toe, three and three-fourths; fifth toe, two and one-third. Tympanum one-third the diameter of the eye. Tibio-tarsal articulation reaching the eye or slightly beyond.

Description of Type (Sexually mature male).—Extremely small; tongue longer than broad, unemarginate behind; vomerine teeth absent; head slightly longer than broad; snout slightly longer than diameter of the eye, sharply pointed, slightly projecting; canthus rostralis distinct; loreal region scarcely concave; interorbital space broader than upper eyelid; tympanum pigmented and not very distinct, about one-third the diameter of the eye. Fingers free; toes slightly webbed, the web very fleshy and hardly distinguishable from the metatarsal region; first (inner toe) with two phalanges free, second toe with two, third toe with two and two-thirds, fourth toe with three and three-fourths, fifth toe with two and one-third; disks of the digits sub-diamond-shaped, smaller than tympanum; subarticular tubercles distinct; one metatarsal tubercle; no tarsal fold; tibio-tarsal articulation extended forward reaches the middle of the eye. Entire upper surface smooth; belly and lower part of throat slightly granular; no folds on dorsal surface; a distinct fold across the chest.

Ground color, in alcohol, light yellow, both dorsal and ventral surfaces tinged with brown, which appears under the lens as a number of widely separated melanophores; a dark brown stripe on each side of the head from the tip of the snout along the canthus rostralis, through the edge of the upper eyelid and fading out upon the tympanum; a broad interorbital bar fading out gradually on its posterior margin; a spot in front of the interorbital bar of the same color; a number of dark mottlings in the middle of the back extending from the pectoral to the sacral regions; posterior surface of thighs, dorsal surface of tibio-fibulas, and forearms tinged with dark brown; two pale stripes across each of the two last-mentioned surfaces; entire ventral surface uniformly stippled with brown.

Color in life nearly the same; the cross-bars on legs and arms yellow; ventral surface slaty yellow; "color of internal organs plainly seen through the delicate skin."

Dimensions.

Tip of snout to vent.....	16.0 mm.
Width of head.....	6.5
Length of fore limb from axilla.....	9.5
Hind limb from vent to tip of longest toe.....	21.5

Type.—A. M. N. H., 8230; near Bluefields, Nicaragua,—Maselina Creek, two miles from mouth; Halter and Mannhardt collectors, June 23, 1916.

There are two other specimens from Maselina Creek in the collection referable to this species. These specimens are not so well preserved as the type. They differ from the latter chiefly in having two groups of vomerine teeth which lie posterior to the choanæ and are obliquely directed backward. The specimens differ somewhat in color from each other. In one, the ventral surface of the legs is dark brown, and the dark head stripe extends slightly posterior to the tympanum. In other ways it is very similar to the type. The other paratype is an adult female. It is much larger than the male, measuring 20 mm. from snout to vent. This specimen is a nearly uniform brown on the back and is lighter below. In life it was different in coloration from the other two specimens. The collectors described it as dark brown above, with a light interorbital bar of grayish brown. The melanophores on the ventral surface were widely separated, giving the throat and belly a stippled appearance. The chest was less spotted than the rest of the ventral surface, and the ground color of that region was bluish white instead of yellowish white. The eyes of all the specimens were very similar. The pupils were black, horizontal, elliptical, but nearly round. The upper half of the iris was a bright tan, the lower half a bronzy brown.

All of the specimens were taken on the swamp-lands bordering the Maselina Creek. The type specimen, to quote directly from the collectors' field notebook, was "caught on the under side of a cocoanut palm leaf after an all-day rain. When approached with a bright acetylene lamp, it did

not become disturbed, but at intervals of eight or nine seconds it would inflate the vocal sack, puff up the body enormously for its size, and then with a snap would 'peep' once. This 'peep' was high-pitched and very loud, like the sudden pulling of a high-strung piano wire."

This male was taken June 23; the adult female was taken September 13. It is very probable that the male was calling for a mate, since its gonads were

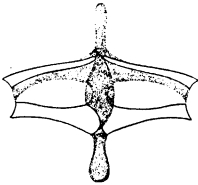


Fig. 3.

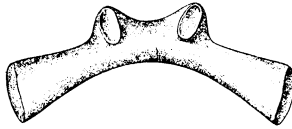


Fig. 4.

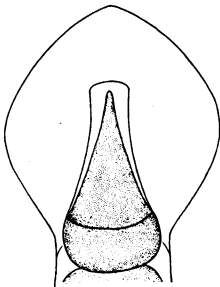


Fig. 5.

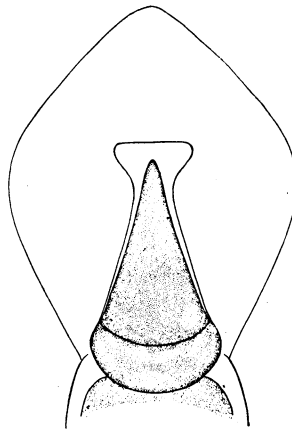


Fig. 6.

- Fig. 3. Pectoral girdle of *Hyla chica*, new species.
 Fig. 4. Sacral diapophyses of *Hyla chica*, new species.
 Fig. 5. Terminal phalanx of finger of *Hyla chica*, new species.
 Fig. 6. Terminal phalanx of toe of *Hyla chica*, new species.

very well developed. The breeding season of the species may be prolonged through several months; but on this point we can only conjecture. The smallest specimen was caught September 13 "on the upper surface of a large leaf in a swamp." It seems probable that the species, at least during the breeding season, is confined to the swamp-lands.

Hyla chica may be readily distinguished from any other *Hyla* by its remarkably short webs and small size. The type specimen, although only

sixteen millimeters in length, possesses well developed gonads. This specimen has a superficial resemblance to an adult *Syrrhophus ridens*, with which it agrees in general form, color, and in the absence of vomerine teeth. But the shape of the digital expansions and the length of the toes at once distinguishes the two species. The close relationship of *Syrrhophus ridens* to *Eleutherodactylus* has been discussed above. The digital expansions are very similar to those of that genus, while in *chica* they are diamond-shaped, as in several other species of *Hyla*.

The terminal phalanges of *H. chica*, in spite of their small size, are claw-shaped. In the male, the majority of phalanges are typically claw-shaped, but several of the phalanges of the female show a slight dilation. The extreme range of this variation in phalanx form is shown in figures 5 and 6. It is interesting to speculate how these dilations arose. The claw-shaped phalanges of most hylids show little variation. *H. chica* resembles several species of *Eleutherodactylus* in the shortness of its web. That genus is characterized in part by T-shaped terminal phalanges. Does the reduction of the web cause new mechanical strains to be evolved? Are these dilations a response to such strains? Too little is known about the habits of this tiny tree-toad to warrant any conclusion as to the origin of the phalanx dilations.

Other structures than the phalanges are modified in this species. *H. chica* shows many signs of degeneracy, or at least of specialization on a simpler plan than that found in most of the species of *Hyla*. Its pectoral girdle is weak, the sternum being very narrow (Fig. 3). The sacral diapophyses are very slightly dilated, as shown in figure 4. This condition may be due to the small size of the species, for in other hylids of small size, such as *Pseudacris* and *Acris*, the sacral diapophyses are nearly cylindrical. In *Hyla crucifer* the sacral diapophyses are more dilated than in *Hyla chica*, but the former species is much the larger. The modern tendency in the classification of the larger groups is to regard the shape of the sacral diapophyses of great diagnostic importance. *Syrrhophus ridens* has these structures longer and slightly more dilated than *Hyla chica*. Yet we refer the former species to the Leptodactylidæ, and the latter to the Hylidæ. We do this because the sum total of the internal structures of *Syrrhophus ridens* points toward *Eleutherodactylus* as the stock from which that species arose, while the internal structures of *H. chica* are modified, but show distinctly their *Hyla* origin. There is no use of referring *H. chica* to any other genus than *Hyla*. It has been shown by Günther (1900, Biol. Centr.-Amer., Batr., p. 286), Gadow (1901, 'Amphibia and Reptiles,' p. 203) and more recently by von Kampen (1906, 'Resultats de l'Expedition Scientifique Néerlandaise à Nouvelle-Guinée, Amphibia,' p. 174) that the genus *Hylella*

is very artificial. It is probable that *H. chica*, with its small size and weak or absent vomerine teeth, holds the same position in the amphibian fauna of Nicaragua that *Hyla smithii* does in Mexico.

20. *Hyla boulengeri* (Cope)

Plate XVII

Scytopsis boulengeri COPE, 1887, Bull. U. S. Nat. Mus., XXXII, p. 12.

Hyla boulengeri GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 267.

Three specimens, one from each of the following localities: Kanawa, Sioux Plantation on the Rio Grande, and Tuli Creek.

Hyla boulengeri was hitherto known only from the type, which is now in the National Museum (No. 13974). This type specimen is smaller than two of our specimens and larger than the third. It differs considerably from its original description, which reads in part:

Eye prominent, size moderate; its diameter twice that of tympanic membrane, and equal interorbital width, and the length from its anterior border to the nostril. . . . Fingers free, the first opposing the second, which is longer and equal to the fourth (fifth).

The most striking feature of *Hyla boulengeri* is its long, depressed snout. In our specimens the distance from the eye to the nostril averages one and one-third times the greatest diameter of the eye. In the type specimen this distance is one and one-fourth times the greatest diameter of the eye, and not equal to the orbit's diameter, as stated by Cope. Moreover, the tympanum is nearly two-thirds the diameter of the eye in the type specimen. The second finger is distinctly shorter than the fourth in all of the specimens. Cope placed the species in the genus *Scytopsis*, which was characterized by an accumulation of sebaceous glands above the tympanum, but these glands are not prominent in any of the specimens. Only a slight indication of a supratympanic fold is present.

Our specimens in life differed from each other in the intensity of their coloration, but their color pattern was much the same. The lightest colored specimen was an adult female and in life the ground tone above was an ash gray, tinged with yellow. A metallic bronze-like lustre was visible in certain lights. When the leg was contracted into the resting position, the exposed parts were the same color as the back. The concealed parts were dark lemon yellow and were crossed by three black bars which tended to form regular transverse stripes across the legs when they were slightly extended. The sides of the abdomen were yellowish green, spotted with

black. The throat region was mottled with white and brown, the reticulations fading out on the belly. The ventral surface of the legs was yellowish, mottled with gray. The three black bars on the femoral and tibial region were visible from below. When the pupil was contracted, the iris appeared a light bronze and it was divided into quarters by a series of black lines.

The other two specimens of the series were much darker in life than this female, but the metallic lustre was present. In alcohol the yellows have faded and the specimens are tinged with a purple of low intensity.

Two of the specimens were caught in the immediate vicinity of sluggish streams; the third was found among the wet leaves covering the floor of the forest about Kanawa. This specimen was taken August 16. It was a female with ovaries greatly distended with ova. This would indicate that the breeding season of *H. Boulengeri* occurs about the end of August. Food was found in the stomach of one specimen. The remains of three grasshoppers were distinguishable.

22. *Hyla quinquevittata* Cope

Hyla quinquevittata COPE, 1886, Proc. Amer. Phil. Soc., XXIII, p. 273. GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 268. ATKINSON, 1907, Ohio Naturalist, VII, p. 152.

Two half-grown specimens from Tuli Creek and one adult from Cukra.

The type of *Hyla quinquevittata* is now in very poor condition and probably was in little better shape when Cope made his description, for our fresh specimens do not correspond entirely with the original description. The type specimen (U. S. N. M., 14187) was probably placed in too strong alcohol, for it is very badly shrivelled. The fingers appear to have a slight rudiment of a web, but this may be due to shrinkage, for in two of our specimens there is no trace of a web. When the body of the type specimen is straightened out, the tibio-tarsal articulation marks the end of the snout, or at least does not extend beyond that point, as stated by Cope.

There is a great discrepancy in the published description of the closely related *Hyla phaeota*. Günther (1900, p. 269) has remarked upon this point. The type specimen of the species is in the National Museum. The three outer fingers are slightly webbed. The tympanum is three-fourths the size of the eye. Nearly three phalanges of the fourth toe are free, the rest of the toes are webbed to a point half the length of the penultimate phalanges.

Our specimens of *Hyla quinquevittata* range from 16 mm. to 32 mm. in length. In color they differ chiefly from one another in the distinctness of

the dark longitudinal bands. In the two smaller specimens the dark bands are broken up, only one band on each side of the back being sharply defined. In the largest specimen only a few dark reticulations indicate the position of the bands. The characteristic bars on the legs occur in only the smallest specimen, but a few dark blotches are present on the legs of the other specimens.

The habitat of *Hyla quinquervittata* is apparently the dense jungle. Two of the specimens were caught among the leaves on the ground. The third was bought from a native. The largest specimen contained in its stomach over a dozen termites and one ant (*Tetramorium quineense* Fabr.).

23. *Hyla baudinii* Duméril and Bibron

Hyla baudinii DUMÉRIL AND BIBRON, 1841, *Erpét. Gén.*, VIII, p. 564. WERNER, 1896, *Verh. Ges. Wien*, XLVI, p. 350. GÜNTHER, 1900, *Biol. Centr.-Amer.*, *Batr.*, p. 270, Pl. LXXI. GADOW, 1895, *Proc. Zool. Soc. London*, part 2, p. 194. RUTHVEN, 1912, *Zool. Jahrb. (Syst.)*, XXXII, p. 310.
Smilisca baudinii DECKERT, 1915, *Zoologica*, II, No. 1, p. 12.

Fifteen specimens from the Sioux Plantation and twelve from Cooley Plantation, on the Rio Grande; three specimens from Cukra.

Ruthven (1912, p. 310) has recently described the colors of this variable tree-toad in life. The majority of our specimens have the ground color of the back some tone of brown, but other specimens show the complete range of variation discussed by Ruthven. Specimens from Mexico in the National Museum and in this Museum, are in no way different from our Nicaraguan specimens. Three specimens (A. M. N. H., 3984-3986) from Colombia, collected by H. G. F. Spurrell, and presented to the American Museum by the British Museum, do not differ from the Nicaraguan specimens in color, but they may, nevertheless, be a distinct geographic race of *H. baudinii*. The hind legs are longer than in any of our specimens, the fingers and toes are somewhat thicker. The sternum is wider than in any of the five Nicaraguan specimens I have examined. There are other less important differences. No specimens of *H. baudinii* from Costa Rica or Panama are available for study. There may be specimens showing intergrading characters in these regions. Without a larger series of specimens, it does not seem advisable to describe this race.

The males of *H. baudinii* differ from the females in possessing two external vocal pouches, but there are other differences by which the sexes may readily be distinguished. The females are much larger than the males. Their tibio-tarsal articulation extends further forward, and their tympanums are relatively larger.

Five females with the ovaries distended with ova were collected on the Rio Grande between July 15 and July 25. This places the breeding season of *H. baudinii* in the region of the Rio Grande about the end of July. The vast majority of the specimens of *H. baudinii* were taken in the damp roof-thatching of native huts. The collectors made several of these huts their headquarters and sometimes they had only to step out of their door to collect a number of specimens under the eaves. Only a few of the stomachs examined contained food. This consisted entirely of grasshoppers.

24. *Hyla albomarginata* Spix

Hyla albomarginata SPIX, 1824, Nov. Spec. Test. Ran., p. 33, Pl. VIII, fig. 1.
GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 284.

Two specimens from Maselina Creek.

No specimens in the collection have changed so completely in color upon being placed in alcohol as have these two specimens. *H. albomarginata* is usually described as yellowish or pinkish above, uniform or minutely spotted with purple; ventral and lateral surfaces whitish. In alcohol, our specimens agree perfectly with this description; but in life the specimens were differently colored. One specimen, caught near the Maselina Creek on some shrubbery about a foot from the ground, was generally green above. The ground tone was yellowish green between the girdles. This region was minutely spotted with white and brown, which in certain lights appeared very much like frost. The throat region was a light bluish color, the belly a lemon yellow. The appendages were especially brilliant in color. The upper arm was a bluish green, the lower arm a pale green. The hands were lemon yellow. The legs were generally bluish green, but the feet, like the hands, were yellow. The webbing between the toes was bright reddish orange, in strong contrast to the yellow of the toes.

The other specimen was found crouched on a log floating in the Maselina Creek. The log was in the shade of the overhanging limbs of trees. As in the other specimen, the ground tone of the back was green, but along each side of the back there was a stripe of yellowish gray extending from the eye to the groin. The nostril region was tinged with brown, the throat with blue-green. The rest of the ventral surface was uniform yellowish white. After capture, and while still alive, this specimen changed its entire coloration. The ground tone of the back became lemon yellow, with a diffusion of brownish spots between the dorso-lateral stripes. The end of the snout became dark brownish yellow and two or three spots of the same color appeared on the back. The dorso-lateral stripes changed to light yellow

and were edged faintly with orange. A few shades of brownish yellow appeared on the appendages. The webs of the feet remained orange, but the color was of less intensity than before. The ventral surface remained yellowish white, but the blue-green faded from the throat region.

This specimen, which was caught on a log, had recently eaten one small beetle, one grasshopper, and a very large ichneumon wasp. This wasp had a very long ovipositor. The abdomen of the wasp was removed from the small intestine of the frog, but the end of the ovipositor, still connected with the abdomen, was found in the cesophagus. It does not seem that this frog could have had a very enjoyable meal.

The other specimen of *H. albomarginata* was a female with very large ovaries. This specimen was caught August 16. It is probable that the breeding season of the species in the vicinity of the Maselina Creek occurs about the end of August.

25. *Agalychnis helenæ* Cope

Plate XVI, Fig. 2

Agalychnis helenæ COPE, 1884, Proc. Amer. Phil. Soc., p. 182. GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 290.

One specimen from Cukra region and another from Colorado Bar, Costa Rica.

The latter specimen was kept in an observation cage and studied by Mr. Halter. The following notes are from his field note-book. The specimen was caught at 12 o'clock noon on the upper side of a leaf of a banana tree standing near the edge of the jungle. During captivity, the dorsal coloration was subject to considerable variation. Generally the ground tone was a dark slaty green or a bright leaf-green. A number of pale green spots would often appear. These did not seem to be dependent upon the intensity of the light. They appeared irregularly scattered over the back. Sometimes they would form an H-shaped mark just anterior to the pectoral girdle. The changes in the color of the ground tone did not seem to be correlated with changes in the lighting. The concealed portions of the legs, which appear purplish in alcohol, were a deep blue in life. The feet and hands were brilliant orange. The edge of the upper eyelid was a deep yellow, in striking contrast to the orange-red iris. The ventral surface of the throat and body was yellowish white, of the anterior appendages a slaty color, of the posterior appendages a yellowish white washed entirely, except for a narrow strip, with the deep blue of the concealed portions.

The specimen was rather awkward in its movements. Before jumping,

it would crouch on all fours with appendages at right angles to the axis of the body. It would then laboriously raise the body about an inch from the ground. It would remain in that position for a few seconds, studying the nearby objects, and then would suddenly leap toward one. This specimen could not be induced to feed in captivity. It was tempted with a great variety of food during both the day and evening.

The other specimen was taken at Cukra by a resident sometime during the month of August. It is a female with ovaries distended with ova. This would tend to show that the breeding season of *Agalychnis helenæ* in eastern Nicaragua is about the end of August. Two additional specimens were observed at San Miguel. They were found hiding under the eaves of a native hut. The species is probably wide-spread throughout Nicaragua, for it is known everywhere as "la rana de los platanos."

26. **Ædipus striatulus**, new species

Plate XIX

Diagnostic characters.—Habit similar to *O. variegatus*, but slightly more slender; fingers and toes short, completely enveloped in a web; thirteen costal grooves; distance from snout to vent four times or slightly less the distance to gular fold; parasphenoid teeth distinctly separated from the palatine teeth; ventral surface light yellowish brown, finely streaked with many dark brown lines.

Range.—Nicaragua and Costa Rica.

Type.—Cat. No. 6999, A. M. N. H.; Cukra, Eastern Nicaragua, Halter and Mannhardt collectors; Aug. 2, 1916.

Description of Type.—Palatine teeth in two arched series extending outward beyond the choanæ, and separated from the parasphenoid teeth by a distinct interval; parasphenoid teeth forming a single patch. Head slightly wider than body, truncate; greatest diameter of the eye slightly shorter than distance of anterior corner from the nostril; angle of mouth under posterior edge of the eye; nostril small. Body elongate, not stout; distance of snout from gular fold contained in the distance of gular fold from the anterior edge of vent slightly less than three times; legs short, not meeting on the sides of the body by a distance less than the length of the fore leg. Fingers and toes short, completely enveloped by a web. Tail cylindrical; the distance from the posterior edge of vent to tip of tail equal to distance from the former point to the corner of the mouth; skin smooth; a distinct gular fold; thirteen costal grooves, including the ones in the axilla and groin.

Ground color (in alcohol), both above and below, a pale yellowish tan of low intensity; top of head finely marked with a number of dark brown streaks which radiate from the upper eyelid and assume a longitudinal direction; nuchal region finely streaked with these fine, thread-like lines; on each side of the back a broad streak of dark brown; space between these stripes streaked with fine markings similar to those of the neck region; on the outside of these stripes a number of fine specks of dark brown; sides of the head and body covered above by a stripe of dark

brown and below by a number of fine streaks of the same color; ventral surface streaked by many fine lines of brown; a broad stripe in the mid-line extending from the gular fold to part way the length of the tail; appendages heavily streaked with brown.

Dimensions.

Tip of snout to gular fold.....	11.5 mm.
Tip of snout to vent.....	41.5
Tip of snout to tip of tail.....	85.0
Axilla to groin.....	24.0
Fore leg.....	8.5
Hind leg.....	9.5

Besides the type there have been available for study three other specimens which are referable to this species. One of these was collected in the Chontales Mountains by a native and donated to the collectors. Another was taken on Mt. Mombacho by Mr. W. De W. Miller of the American Museum's ornithological expedition. The third was collected on Mt. Turrialba, Costa Rica, in 1906 by J. F. Tristan and C. F. Underwood. It is now in the National Museum.

The largest specimen of the series was taken in the Chontales Mountains. It agrees with the Costa Rican specimen in having a slightly longer body than the type. In this large specimen the distance from snout to gular fold is contained in the distance from the gular fold to vent exactly three times. The dorsal coloration of this specimen is somewhat different from the type. The fine streaks are mostly replaced by stipple marks, and most of the fine spots between the dorsal and lateral stripes are absent. The ventral streaking of all the specimens, however, is nearly the same and apparently forms a good specific character.

O. striatulus is closely related to *O. variegatus*, but may be distinguished from that species by (1) its shorter body, (2) its very different coloration, especially of the ventral surface, and (3) its slightly different arrangement of teeth. It is also apparently related to *O. dofleini* (Werner), but that species was described as much more robust than *O. variegatus*. Our specimens of *O. striatulus* are decidedly more slender than specimens of *O. variegatus* from Mexico in the Museum of Comparative Zoology, the National Museum, and the Philadelphia Academy of Natural Sciences. Furthermore, our specimens have a very different coloration from that described for *O. dofleini*.

I feel justified in retaining the genus *Ædipus*. In this I have followed the recent work of Fowler and Dunn (1917, Proc. Acad. Nat. Sci., LXIX, p. 21). There is no transitional species between *Ædipus* and *Eurycea*. It seems to me that the several species of *Ædipus* form a natural group.

Although the four specimens of *O. striatulus* were taken in four widely separated localities, situated at different altitudes ranging from sea-level to at least 3500 feet, still these specimens are surprisingly similar and are very different, at least in color, from any previously described Central American salamander. *O. striatulus* is not a local form, but a wide-ranging species. Future work may show that it entirely replaces *O. variegatus* in Nicaragua and Costa Rica. There are one or two records of *O. variegatus* from Costa Rica which I have not been able to confirm, but there is no definite record of *O. variegatus* having been taken in Nicaragua.

The type specimen was found near Cukra under a fallen fence among dead, yellowish leaves which were strewn along a path leading to a deserted plantation. The coloration in life of this specimen was practically the same as that described above for the preserved specimen. The brown and tan color pattern made the salamander very inconspicuous as it wriggled among the leaves. In walking, this specimen raised the body from the ground, the tip of the tail barely touching the surface. When the specimen was put, while alive, in 30% alcohol, it immediately constricted off its tail at a point near the base.

The specimen collected on Mt. Mombacho by Mr. Miller was found on a leaf of a tree about six feet above the ground. It is interesting to find this species having both arboreal and terrestrial habits.

27. *Gymnopsis proxima* (Cope)

Siphonops proximus COPE, 1877, Proc. Amer. Philos. Soc., XVII, p. 90.
Gymnopsis proxima, GÜNTHER, 1900, Biol. Centr.-Amer., Batr., p. 308.

Four specimens, one from each of the following localities: Isle of Boquete on Lake Nicaragua, Hacienda Valencia in the Chontales Mountains, El Bluffs (near Bluefields), and Eden Mine.

The Gymnophiona have recently been revised by Nieden (1913, 'Die Gymnophiona,' Das Tierreich, Berlin). Our specimens agree most closely with *Gymnopsis proxima*, but they do not correspond exactly with Nieden's description of that species. The number of complete annuli varies in the following way: 132 (Bluefields), 135 (Boquete Island), 136 (Chontales Mountains), and 138 (Eden Mine). In all of the specimens the greatest diameter is contained in the body length less than twenty-six times. Two of the specimens are not well preserved and the proportions may be slightly different in life.

Two of the specimens were caught personally by the collectors. One was found at dusk near a very muddy but only temporary swamp. The

color above was very dark gray. The ventral surface at the extreme anterior and posterior ends was the same color, the rest light gray. The other specimen was taken in the afternoon just after a shower. The place where it was found was not at all swampy. This specimen was colored in life like the other one.

EXPLANATION OF PLATES

PLATE XIV

Figure 1. *Rana palmipes* Spix.

Figure 2. Rio Grande, Nicaragua, showing the open river banks where *Rana palmipes* was often found.

PLATE XV

Figure 1. *Rana austriicola* (Cope).

Figure 2. *Leptodactylus pentadactylus* (Laurenti).

PLATE XVI

Figure 1. *Eleutherodactylus rhodopsis* (Cope).

Figure 2. *Agalychnis helenæ* Cope.

PLATE XVII

Figure 1. *Hyla boulengeri* (Cope).

Figure 2. Woods near Cukra showing habitat of *Hyla boulengeri*.

PLATE XVIII

Hyla chica, new species.

PLATE XIX

Ædipus striatulus, new species.

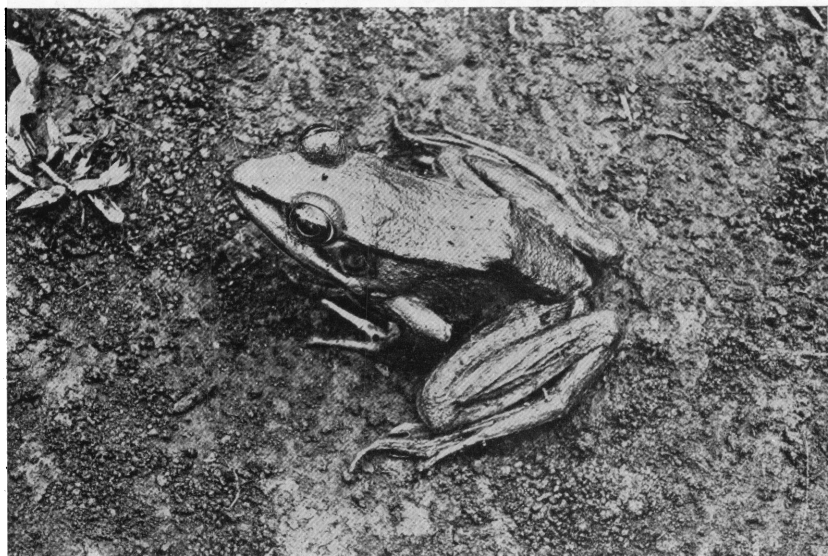


Fig. 1. *Rana palmipes* Spix

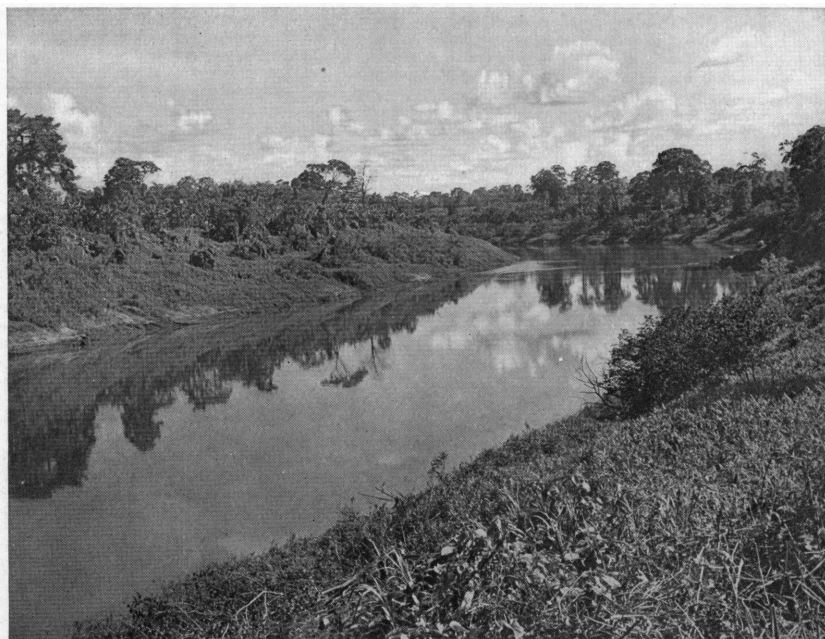


Fig. 2. Rio Grande, Nicaragua, showing the open river banks where *Rana palmipes* was often found



Fig. 1. *Rana austriicola* (Cope)



Fig. 2. *Leptodactylus pentadactylus* (Laurenti)

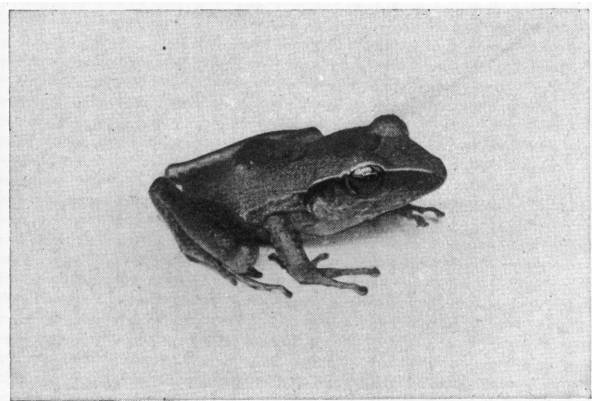


Fig. 1. *Eleutherodactylus rhodopsis* (Cope)

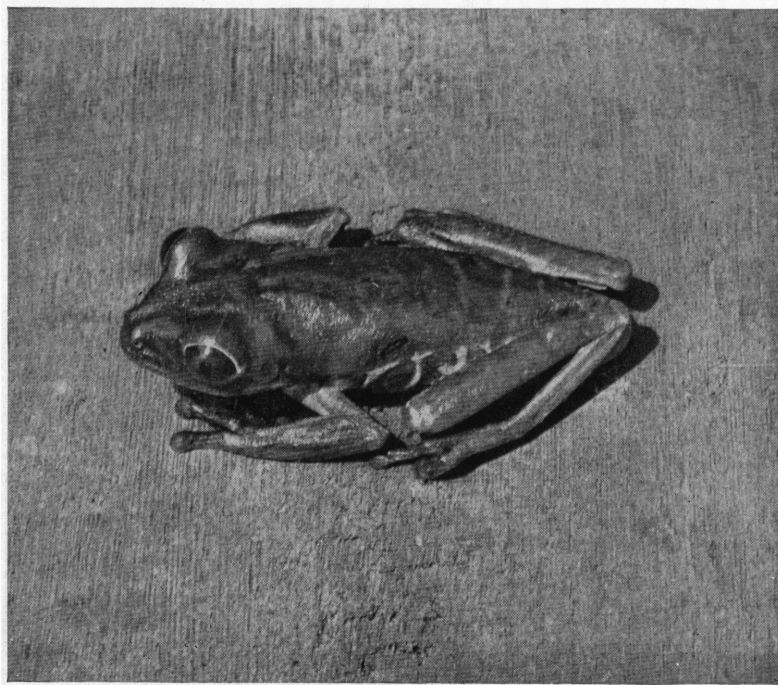


Fig. 2. *Agalychnis helenæ* Cope

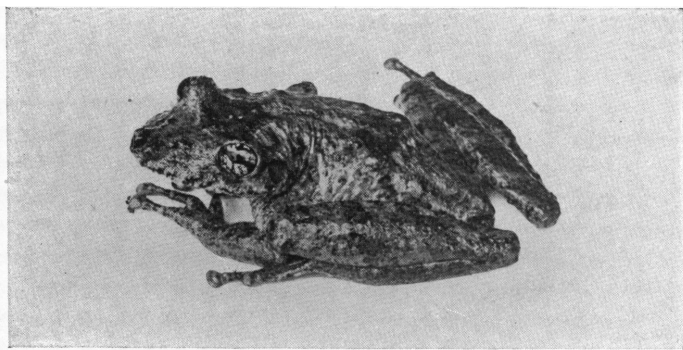


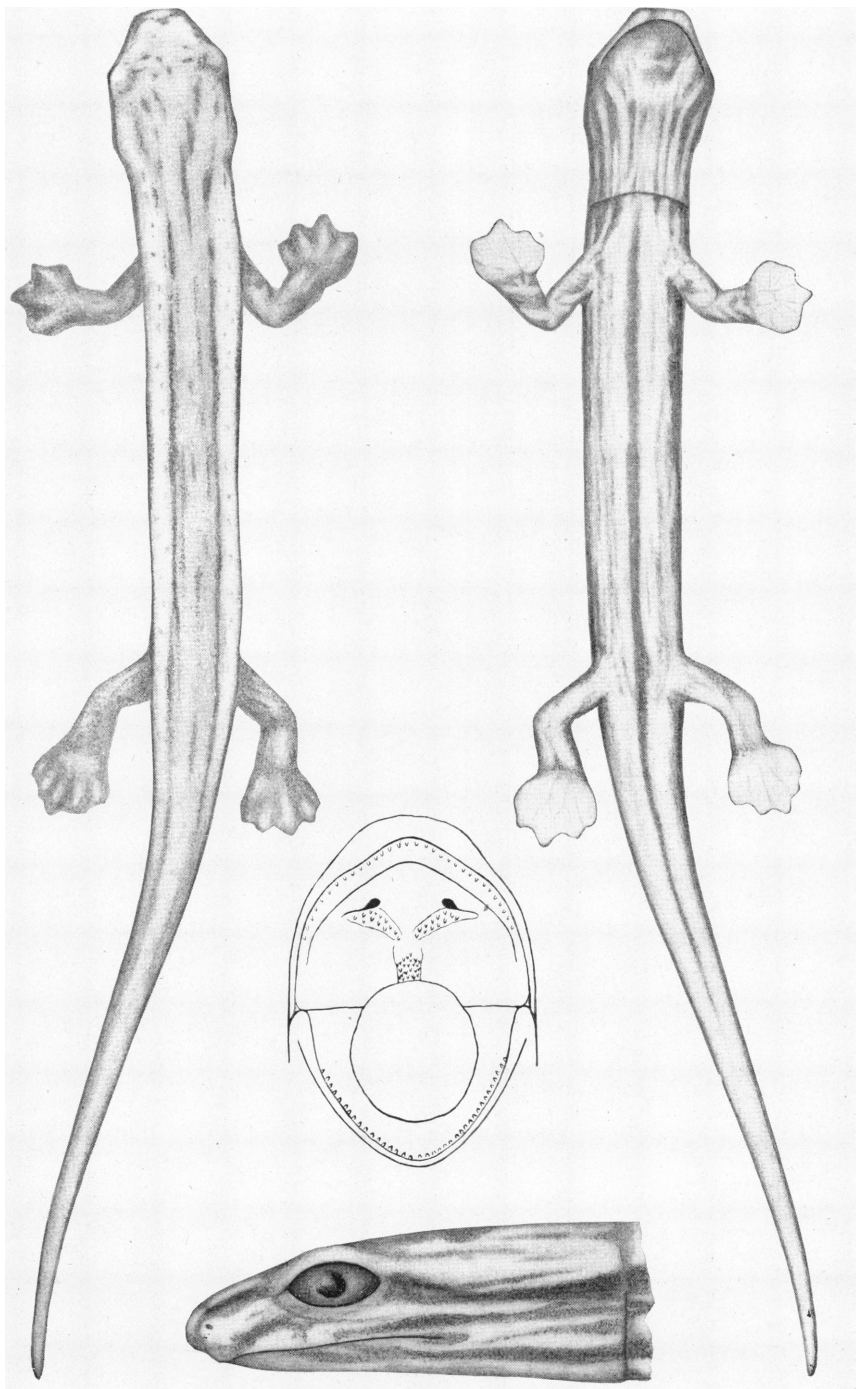
Fig. 1. *Hyla boulengeri* (Cope)



Fig. 2. Woods near Cukra showing habitat of *Hyla boulengeri*



Hyla chica, new species



Edipus striatulus, new species

