

A Reconsideration of Two Montane Species of *Eleutherodactylus* in Hispaniola (Anura: Leptodactylidae)

S. BLAIR HEDGES

Department of Biology, 208 Mueller Laboratory,
Pennsylvania State University, University Park, Pennsylvania 16802

ABSTRACT.—Newly collected material of a poorly known montane species of Hispaniolan frog, *Eleutherodactylus darlingtoni*, requires a reassessment of that species and its close relative, *E. leoncei*. Although previously believed to be sympatric, these two species are redefined, and shown to have allopatric distributions in the Massif de La Selle and Sierra de Baoruco.

RESUMEN.—La colecta de nuevos **especímenes** de una especie de rana poco conocida de la zona montanosa de La **Española**, *Eleutherodactylus darlingtoni*, hace necesaria una re-evaluación de dicha especie y su pariente cercano, *E. leoncei*. Aunque anteriormente se consideraban **simpátridas**, ambas especies se redefinen y se demuestra la distribución **alopátrida** de ambas en el Massif de La Selle y la Sierra de Baoruco.

The island of Hispaniola is inhabited by over 50 species of *Eleutherodactylus*, all of them endemic (Schwartz and Henderson, 1988; Hedges and Thomas, 1989). Most of these species occur on the biogeographic "South Island," the area south of the Cul de Sac and Vane de Neiba. Among these South Island species are two relatively large frogs found in the highest elevations of the Massif de la Selle (Haiti) and the adjoining Sierra de Baoruco (Dominican Republic). *Eleutherodactylus darlingtoni* Cochran is known from only the type series and associated specimens collected in the region of Morne La Visite in the Massif de La Selle, and one specimen from an imprecise locality, "La Selle ridge on Sal Trou Road" (Cochran, 1935; Shreve and Williams, 1963; Schwartz, 1982). *Eleutherodactylus leoncei* Shreve and Williams, however, is known from more specimens and localities, ranging from Morne La Visite in the west (Massif de La Selle) to 24 km SW Barahona in the east (Sierra de Baoruco). Therefore, as presently understood, the restricted range of *E. darlingtoni* is contained entirely within the more widely distributed *E. leoncei*. Recent collections of *Eleutherodactylus* from the Massif de La Selle have turned up new material of *E. darlingtoni* that enhances our knowledge of this poorly known species, and necessitates a

reevaluation of both *E. darlingtoni* and its close relative, *E. leoncei*.

The type series of *E. darlingtoni* is comprised of very dark frogs, dorsally and ventrally. This uniform dark coloration was one of the few diagnostic traits used by Shreve and Williams (1963) to distinguish *E. darlingtoni* from *E. leoncei*. In the latest key to Hispaniolan *Eleutherodactylus* (Henderson and Schwartz, 1984), coloration is used as the primary means of separating these two species. However, newly collected material indicates that *E. darlingtoni* is considerably more variable in pattern and coloration, with some specimens closely resembling the lighter and typically mottled appearance of *E. leoncei*. Although Henderson and Schwartz (1984) attribute pale scapular blotches only to *E. leoncei*, this unusual dorsal pattern feature, resembling a pair of quotation marks, is present in all specimens of *E. darlingtoni* and *E. leoncei* that have been examined. In fact, it is this distinct pattern feature, along with their similar size, that suggests a close relationship.

Because of the failure of coloration differences in diagnosing these two species, I investigated the possibility that *E. leoncei* is a synonym of *E. darlingtoni*. It is now clear that *E. leoncei* is a valid species based on other differences, and this new informa-

tion requires a reevaluation of both species.

Eleutherodactylus darlingtoni Cochran
(Fig. 1A)

Eleutherodactylus darlingtoni Cochran, 1935: 368. Type-locality: "near La Visite, La Selle Range, Haiti" [Department du Sud'Est]. Holotype: MCZ 19847, adult male collected 16-23 September 1934 at "5000 to 7000 feet" [1515-2120 m] by P. J. Darlington.

Eleutherodactylus leoncei Shreve and Williams, 1963:335 (part, specimen from "near La Visite" [MCZ 21592]).

Diagnosis. —A member of the subgenus *Euhyas*, characterized by a liver with long and pointed left lobe, smooth venter, relatively long vomerine odontophores, conspicuous inguinal glandular areas, no vocal slits or vocal sac in males, and terrestrial habits (Hedges, 1989b). It is a relatively large species (SVL 20.8 -25.3 mm in males, 32.8 -39.6 mm in females) with supraxillary and postfemoral glandular areas, expanded digital tips, and a variable color pattern with one constant feature: a pair of light scapular marks resembling apostrophes ("). It can be distinguished from *E. leoncei*, with which it shares all of these features, by its larger digital tips (Fig. 2), shorter vomerine odontophores (usually extending to inner margin of choanae), slightly longer hindlimbs, and a shorter and more rounded snout (viewed from above). Also, the light scapular marks of *E. darlingtoni* are narrower than those of *E. leoncei* and are surrounded by a narrower black border. It is important to note that the difference in vomerine odontophore length has some degree of overlap, and that the difference in fingertip width is very slight in smaller individuals (e.g., males). Although Shreve and Williams (1963) noted the differences in vomerine odontophores and fingertip width, their two other differentiating characters (coloration and body size) do not distinguish *E. darlingtoni* from *E. leoncei*. Both species are variable, overlap considerably in coloration, and there does not appear to be a significant difference in body size.

Variation. —There is considerable variation in dorsal skin texture and coloration in this species. In general, the smaller individuals (mostly males) are more tuberculate than the large (female) specimens. Coloration ranges from a light brown mottled dorsum (UF 53859), or white venter with scattered brown flecks (UF 59216), to a uniform dark brown dorsum and venter (UF 59241). Female specimens tend to be darker, but there is overlapping variation in both sexes. The light scapular marks are present but faint even in the darkest specimens. The undersides of the hindlimbs and feet are usually dark except for the enlarged tubercles, which are distinctly pale (yellow or orange in life).

Measurements (in mm).—For all adult specimens (5 males, 12 females, respectively), measurements are (range, mean): snout-vent length (SVL) 20.8 -25.3 (23.6), 32.8-39.6 (36.3); head length (HL) 7.97 -10.5 (9.26), 12.1 -14.7 (13.5); head width (HW) 7.85 -10.3 (9.22), 11.9 -15.6 (14.0); tympanum (TYM) 1.98-2.35 (2.09), 1.98-2.60 (2.31); eye length (EL) 3.25-3.98 (3.53), 4.05-5.02 (4.57); eye-naris (EN) 2.02-2.73 (2.46), 3.27-3.96 (3.59); thigh length (THL) 9.95-12.6 (11.5), 14.9 -19.8 (15.6); shank length (SHL) 11.3 -13.8 (12.4), 16.8 -20.8 (19.2); fingertip (III) width (FTW) 0.92-1.26 (1.12), 1.57-2.33 (1.94).

Natural History. —Most specimens were collected under rocks and logs in pine forest (*Pinus occidentals*) during the day, although several were collected in and around limestone sinkholes (UF 59241-244, 60518-519). Associated species were *E. audanti*, *E. furcyensis*, and *E. jugans*. The call of *E. darlingtoni* has not been described. Although males lack vocal slits and a vocal sac, this does not mean that the species is unable to call. Many vocal species of frogs, especially *Eleutherodactylus*, have a laryngeal apparatus but lack a vocal sac (Hedges, 1989a, b).

Distribution. —Known only from a relatively small area in the central Massif de La Selle, in the general vicinity of Morne La Visite and the nearby Parc National La Visite (Fig. 3). Altitudinal distribution from 1720 m to 2200 m.

Remarks. —The sympatry of *E. darlingtoni*

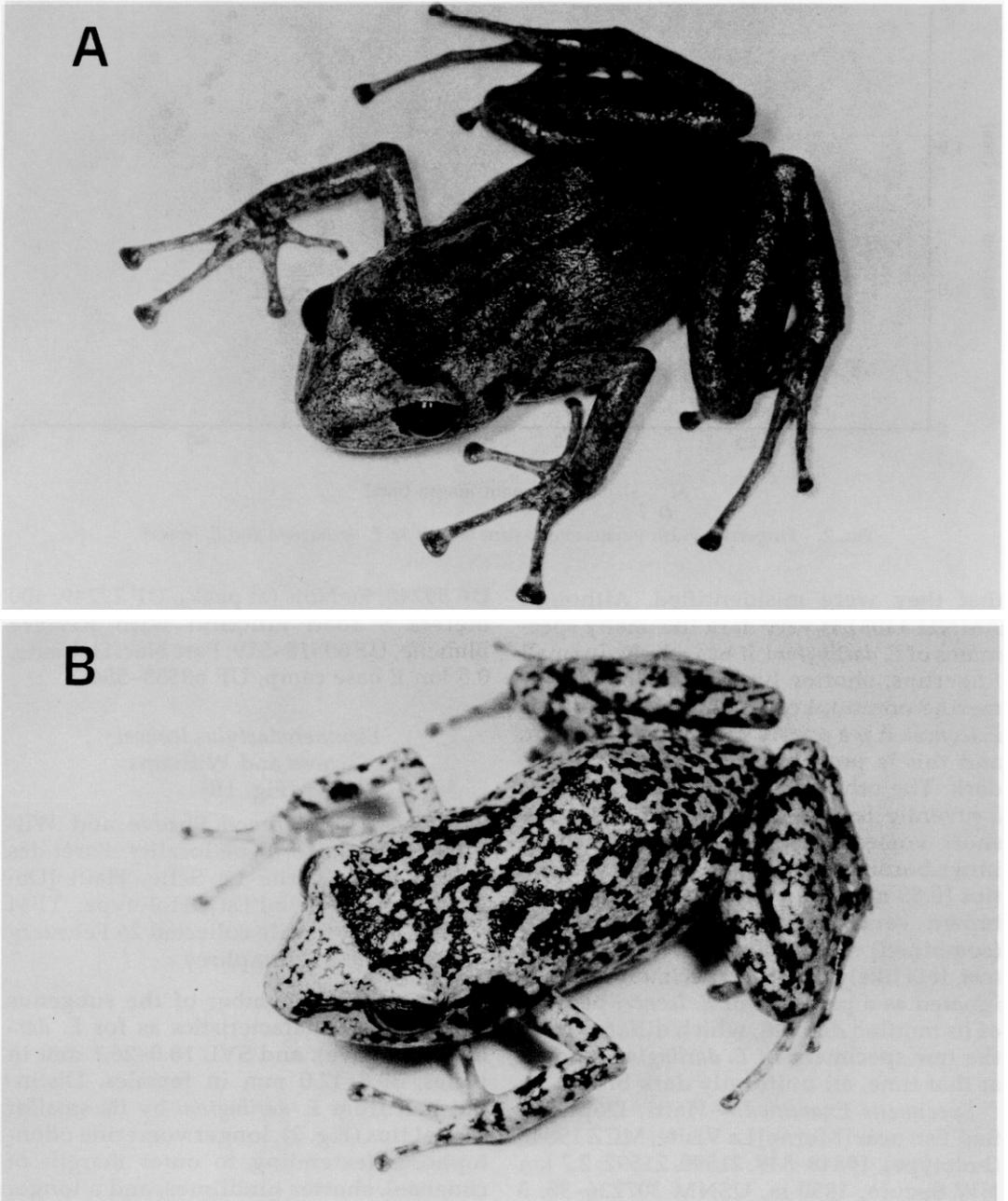


FIG. 1. (A) *Eleutherodactylus darlingtoni* (USNM 307237), from 2.7 km NW Seguin (Haiti). (B) *E. leoncei* (USNM 307243), from 10.3 km S El Aguacate (Dominican Republic).

and *E. leoncei* was based on two specimens identified by Shreve and Williams (1963). One, from near Morne La Visite (MCZ 21592), was considered to be *E. leoncei*,

whereas AMNH 44031, from "La Selle ridge on Sal Trou road" (=region of **Forêt** des Pins), was identified as *E. darlingtoni*. A re-examination of both specimens indicates

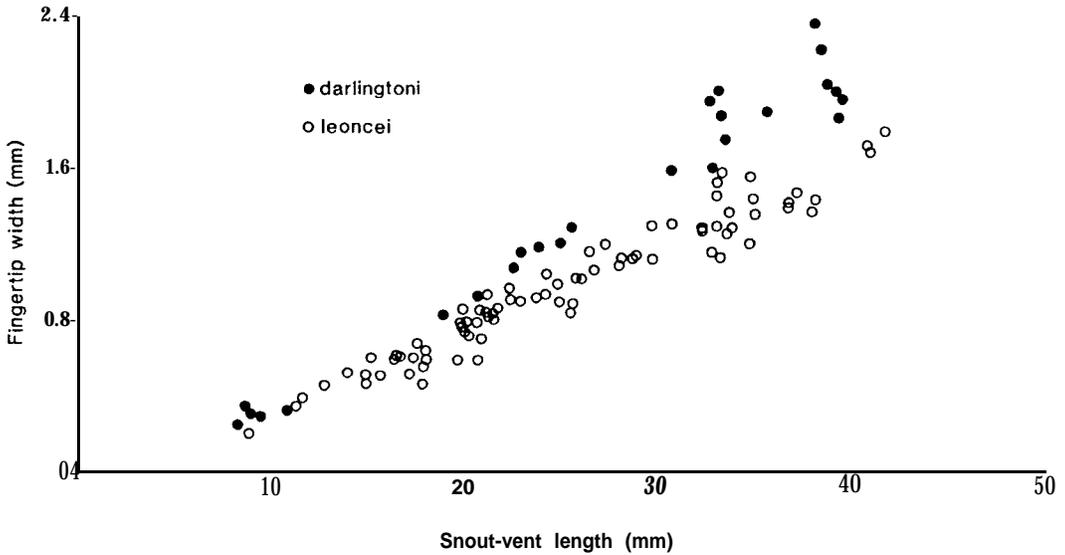


FIG. 2. Fingertip width versus snout-vent length in *E. darlingtoni* and *E. leoncei*.

that they were misidentified. Although AMNH 44031 is very dark like many specimens of *E. darlingtoni*, it has relatively small fingertips, shorter limbs, and longer vomerine odontophores indicating that it is *E. leoncei*. It is a poorly preserved specimen, and this is probably the reason that it is dark. The other specimen, MCZ 21592, is a juvenile female (SVL= 18.9 mm). It has short vomerine odontophores (reaching inner border of choanae), enlarged finger tips (0.83 mm), and a nearly uniform dark brown venter, three characteristics that (combined) clearly place it with *E. darlingtoni*. It is likely that this specimen was designated as a paratype of *E. leoncei* because of its mottled dorsum, which differed from the few specimens of *E. darlingtoni* known at that time, all uniformly dark brown.

Specimens Examined. —Haiti: Dept. du Sud'Est; near [Morne] La Visite, MCZ 19847 (holotype), 19848-849, 21590, 21592; 2.7 km NW Sequin, 1850 m, USNM 307236-38; 3 km WSW Morne Cabaio, UF 53859; "small creek E Riviere Blandre", UF 59215-217; "sinkhole W of La Visite base camp", UF 59241-244; "limestone outcrop (Saddle Peak) E of La Visite," UF 59245; Galette Seche, UF 59246; "ridge between Roche Cabritte and 'Peak 2242 m'," UF 59247; "sinkhole on S slope of Morne Cabaio",

UF 59248; Fe Nois (at peak), UF 29249; 400 meters S road junction with Riviere Blanche, UF 60518-519; Pare Nat. La Visite, 0.5 km E base camp, UF 60553-554.

Eleutherodactylus leoncei
Shreve and Williams
(Fig. 1B)

Eleutherodactylus leoncei Shreve and Williams, 1963:335. Type-locality: Forêt des Pins near Morne La Selle, Haiti [Department du Sud'Est]. Holotype: YPM 1167, adult female collected 26 February 1959 by P. S. Humphrey.

Diagnosis. —A member of the subgenus *Euhyas*, with characteristics as for *E. darlingtoni* (above), and SVL 18.0–26.1 mm in males, 30.8–42.0 mm in females. Distinguished from *E. darlingtoni* by its smaller digital tips (Fig. 2), longer vomerine odontophores (extending to outer margin of choanae), shorter hindlimbs, and a longer and more acuminate snout (viewed from above). The dorsum of *E. leoncei* is less tuberculate than in *E. darlingtoni*, especially when males are compared. Coloration in *E. leoncei* is less variable than in *E. darlingtoni* and no specimens are uniformly dark brown above and below as occurs in some *E. darlingtoni*.

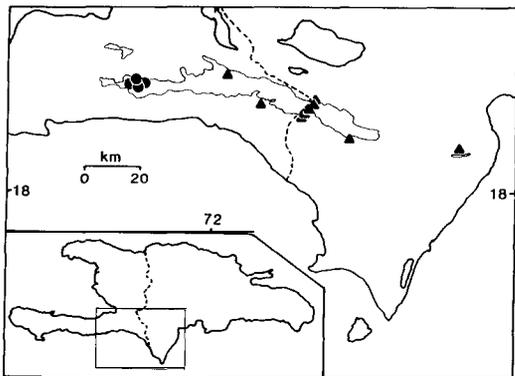


FIG. 3. Distributions of *E. darlingtoni* (circles) and *E. leoncei* (triangles). Narrow line = 1500 m contour; dashed line is border between Haiti and the Dominican Republic.

Variation. —Shreve and Williams (1963) discuss variation in this species and describe coloration in alcohol and in life. Newly collected material of this species agrees with those descriptions.

Measurements (in mm).—For 20 representative adults (10 males and 10 females, respectively), measurements are (range, mean): SVL 19.1–24.3 (21.8), 33.1–36.9 (34.3); HL 7.65–10.3 (8.73), 11.7–13.9 (12.7); HW 7.38–10.4 (8.52), 12.1–14.0 (13.0); TYM 1.79–2.21 (1.95), 2.10–2.43 (2.24); EL 2.58–3.45 (3.08), 3.96–4.44 (4.21); EN 2.34–2.94 (2.54), 3.32–3.87 (3.58); THL 9.06–12.1 (10.4), 12.9–17.2 (15.5); SHL 9.70–12.7 (11.0), 15.7–17.8 (16.9); FTW 0.70–1.04 (0.86), 1.15–1.56 (1.38).

Natural History. —The type series and most subsequent specimens were collected under rocks and logs in pine (*Pinus occidentalis*) and hardwood forests during the day, although one was found crossing a road in pine forest at night. The call of *E. leoncei* has not been described (see comment above for *E. darlingtoni*).

Distribution. —Known from several widely scattered localities in the Sierra de Baoruco and the extreme eastern end of the Massif de la Selle (Fig. 3). It probably occurs throughout the upper elevations of the Sierra de Baoruco. Aitudinal distribution is from 1180 m to 2300 m.

Specimens Examined. —Haiti: Dept. de Sud'Est; Forêt des Pins, Yale Peabody Museum (YPM) 1167 (holotype), 1188–1201,

Albert Schwartz Field Series (ASFS X1914–X1921; 10.6 km SE Forêt Des Pins, ASFS V 44715–736; Oriani, ASFS V 23840–849; “La Selle ridge on road to Saltrou,” AMNH 44031, 44171–176, 44178–186; ca. 15 km W Gros Cheval on logging roads, USNM 307239–41. Dominican Republic: Barahona; 24 km SW Barahona, ASFS V41620; Pedernales; Las Abejas, 11.2 km NW Aceitillar, V29845; 2.4 km N Los Arroyos, V29879; 4.4 km N Los Arroyos, V 29908; 8.3 km N Los Arroyos, V29911–912; 9.6 km N Los Arroyos, V29916–921; 13.4 km N Los Arroyos, V29942–949, 29968; 17.8 km N Los Arroyos, V29953–954; 19 km SW El Aguacate, USNM 307242; 15 km SW El Aguacate, V41314; 12 km SW El Aguacate, V 41332; 11 km SW El Aguacate, V41336; 10.3 km SW El Aguacate, USNM 307243–45.

DISCUSSION

The many similarities between *E. darlingtoni* and *E. leoncei*, especially in details of pattern and coloration, indicate a close relationship. Their allopatric distributions (Fig. 3) suggest that they evolved as vicariants of an ancestral species that was widely distributed along the relatively continuous mountain range comprising the Massif de la Selle and Sierra de Baoruco. There is no substantial physiographic boundary between these two ranges, although the slight depression in the vicinity of Forêt des Pins and the Haitian/Dominican border (to approximately 1600 m) is often considered the boundary. It is unlikely that two names would be applied to this essentially single mountain range if it were located in one country. Geologically, it is treated as a single unit, the “La Selle-Baoruco Block” (Maurrasse et al., 1980), separated from the Massif de La Hotte Block by the Jacmel-Fauche depression (Maurrasse, 1982).

These two physiographic provinces located on the Hispaniolan South Island have, for the most part, different *Eleutherodactylus* faunas. The species unique to the La Selle-Baoruco Range are: *alcoae*, *armstrongi*, *darlingtoni*, *fowleri*, *furcyensis*, *glanduliferoides*, *hypostenor*, *jugans*, *leoncei*, *neodreptus*, and *rufifemoralis*. Two species

(*darlingtoni* and *glanduliferoides*) still are known from only a small area in the central region of the Massif de La Selle, and two others (*neodreptus* and *rufifemoralis*) are known from only a small area at the eastern end of the Sierra de Baoruco. Schwartz (1973) treated the region north of Pedernales (Dominican Republic) along the Haitian /Dominican border as part of the Massif de la Selle largely because several Haitian species reach their easternmost limits here. However, the upper elevations of the Sierra de Baoruco between the border road and the region of Polo are very poorly known and may harbor some species now known only from the La Selle range.

Besides *E. darlingtoni* and *E. leonceli*, the only other species that appear to be east/west vicariants in the La Selle-Baoruco range are *E. furcyensis* and *E. rufifemoralis* (Hedges, 1989b). However, their distributions are different: *E. furcyensis* occurs from the north-central Massif de La Selle (Montagne Noir) to the western end of the Sierra de Baoruco (north of Pedernales), whereas *E. rufifemoralis* is known only from the extreme eastern end of the latter range. It is presently unclear what physiographic barriers were responsible for speciation in these two pairs of South Island *Eleutherodactylus* (*darlingtoni/leonceli* and *furcyensis/rufifemoralis*), although judging from their present distributions, it is likely that those barriers were not the same.

Acknowledgments. —I thank Richard Thomas for assistance in the field; David Auth, Ronald Crombie, William Duellman, Charles Myers, José Rosado, Fred Sibley, John Simmons, and George Zug for loan of specimens; Gaston Hermatin, Edmund Magny, Paul Paryski, R. Pierre-Louis, and Florence Sergile for permission to collect and export specimens in Haiti; Sixto In-

cháustegui for permission to collect and export specimens in the Dominican Republic; and Linda R. Maxson for use of facilities. The portion of field work conducted by groups from the Florida State Museum was supported by a USAID / Haiti grant to C. A. Woods (521-0169-C-00-3083). This research was supported by National Science Foundation grants BSR-8307115 (to Richard Highton) and BSR-8906325 (to S.B.H.).

LITERATURE CITED

- Cochran, D. M. 1935. New reptiles and amphibians collected in Haiti by P. J. Darlington. Proc. Boston Soc. Nat. Hist. 40:367-376.
- Hedges, S. B. 1989a. An island radiation: allozyme evolution in Jamaican frogs of the genus *Eleutherodactylus* (Leptodactylidae). Carib. J. Sci. 25:123-147.
- . 1989b. Evolution and biogeography of West Indian frogs of the genus *Eleutherodactylus*: slow-evolving loci and the major groups. In C. Woods (ed.), Biogeography of the West Indies: past, present, and future, pp. 305-370. Sandhill Crane Press, Gainesville, Florida.
- , and R. Thomas. 1989. Supplement to West Indian amphibians and reptiles: a check-list. Milwaukee Publ. Mus. Contr. Biol. Geol. 77:1-11.
- Henderson, R. W., and A. Schwartz. 1984. A guide to the identification of the amphibians and reptiles of Hispaniola. Milwaukee Publ. Mus. Publ. Biol. Geol. 4:1-70.
- Maurrasse, F. J. 1982. Survey of the geology of Haiti. Miami Geol. Soc., Miami. 103 pp.
- , F. Pierre-Louis, and J. G. Rigaud. 1980. Cenozoic facies distribution in the southern peninsula of Haiti and the Barahona peninsula, Dominican Republic. Trans. Ninth Caribbean Geol. Conference 1:161-174.
- Schwartz, A. 1973. Six new species of *Eleutherodactylus* (Anura: Leptodactylidae) from Hispaniola. J. Herpetol. 7:249-273.
- . 1982. *Eleutherodactylus darlingtoni*. Cat. Amer. Amphib. Rept. 284.1.
- , and R. W. Henderson. 1988. West Indian amphibians and reptiles: a check-list. Milwaukee Publ. Mus. Contr. Biol. Geol. 74:1-264.
- Shreve, B., and E. E. Williams. 1963. The herpetology of the Port-au-Prince region and Gonave Island, Haiti. Part II. The frogs. Bull. Mus. Comp. Zool. 129:302-342.