

Florida. However, *T. c. carolina* (or *bauri*) type turtles seem to be represented in the Blancan deposit of Haile XV A. A single peripheral in the University of Florida collections from the Hemphillian McGehee site, Alachua County, Florida (Webb, 1964) may belong to the genus *Terrapene*. It is quite large, and its shape is highly suggestive of one of the posterior peripherals of *T. c. putnami*. A number of factors concerning this site and its contained fauna suggest that the deposit was formed in or near a stream very close to the sea. Milstead (pers. comm.) has long felt that the undoubted Pliocene deposits of Florida contain a box turtle similar or identical to *T. c. putnami*. If so, then contemporaneous inland deposits will probably be found to possess *T. c. carolina*.

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A New Tree-Frog (Centrolenidae) From Costa Rica

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Centrolenella ilex, a large new form from the humid tropical forests of Costa Rica, belongs to a Middle American species group characterized by having vomerine teeth, green bones, white parietal peritoneum, colorless hepatic peritoneum and a lavender ground color in preservative. Included species are *albomaculata*, *granulosa*, *ilex*, *prosoblepon*, and *spinosa*. South American allies are *antioquiensis* (lacks vomerine teeth), *anthisthensi*, *buchleyi* (lacks vomerine teeth), *cochranae* (vomerine teeth present or absent), *ocellata*, *ocellifer*, and *parabambae*. The type-species of the nominal genera *Centrolenella*, *Cochranella*, and *Teratohyla* all belong to this group. *C. ilex* appears to be related to *C. albomaculata* and *C. spinosa* of Costa Rica.

AMONG the most beautiful denizens of the tropical and subtropical zones in lower Central America are the delicate little frogs of the family Centrolenidae. Members of this group have a green dorsal ground color, large forward-directed eyes, and a venter so transparent that some of the internal organs are clearly visible through the

skin. Centrolenids are invariably found in vegetation, from low shrubs to tall trees (15 m) along the banks of fast moving streams. The eggs of this family are deposited in gelatinous circular masses on leaves above the stream (Starrett, 1960) and undergo development out of the water. After some time, advanced larvae fall or are washed out

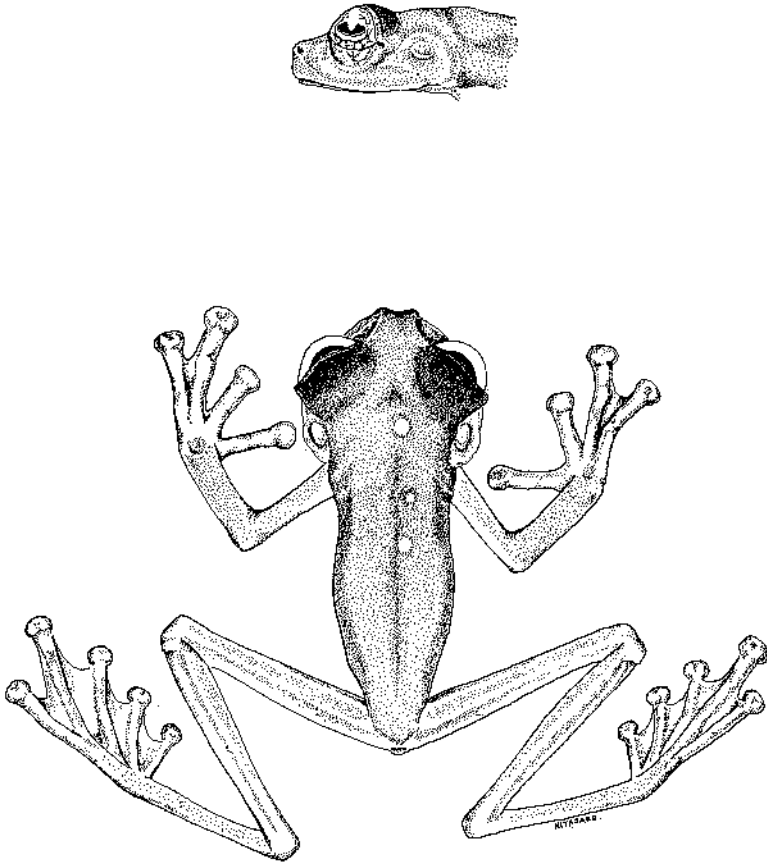


Fig. 1. *Centrolenella ilex*, paratype. Above, lateral view of head. Below, dorsal view entire frog; line = 10 mm.

of the masses by heavy rains into the stream below.

In the most recent review Taylor (1958) recognized 14 nominal species in Costa Rica and four of these have been reported from Panamá. Although unpublished studies indicate that several names have been proposed for single forms in the region, at least 10 distinct species occur in Costa Rica, eight of which constitute the known centrolenid fauna of Panamá. It was therefore somewhat surprising to discover a rather large and conspicuous unnamed species from the Atlantic slope of Costa Rica. With allusion to Mrs. Priscilla Hollister "Holly" Starrett, who is engaged in a systematic revision of the family, the species is called

Centrolenella ilex, n. sp.

(Figs. 1, 2)

Holotype.—LACM 25205, an adult female, collected by Jay M. Savage and Norman J. Scott, Jr., 21 March 1964.

Type Locality.—COSTA RICA: Provincia de Limón: Canton de Limón: Alta Talamanca: 16 km SW Amubri, on Río Lari, 300 m.

Paratypes.—COSTA RICA: Provincia de Alajuela: 8 km N Ciudad Quesada, 250 m (1); 9.1 km E San Mateo, 547 m (1); Provincia de Limón: Río Chitaría and Turrialba-Peralta road, 775 m (2).

Definition.—The largest Middle American species in the family (females to 32 mm in standard length) characterized as follows: 1) vomerine teeth; 2) green bones; 3) pa-

rietal peritoneum white; 4) hepatic peritoneum without pigment; 5) dorsal color green in life, uniform lavender in preservative or with a few light markings, never any dark markings; 6) finger webbing formula I 3-3 II $1\frac{3}{4}$ -3 III 2- $1\frac{1}{4}$ IV (following system described by Savage and Heyer, 1967); 7) toe webbing formula I 0- $1\frac{1}{2}$ II 0- $1\frac{3}{4}$ III 1-2 IV $1\frac{1}{2}$ -0 V; 8) head viewed from above semicircular in outline, nostrils protuberant and raised above lip line to form a truncate nasal area; 9) upper surfaces smooth; 10) no free, fleshy fringe on posterior margin of lower arm; and 11) no free prepollex or humeral hooks or spines.

General Characteristics.—A large centrolenid with smooth upper surfaces. Head viewed from above, semicircular in outline, slightly broader than long. Nostrils protuberant and raised above lip line to form a truncate snout tip. Nostrils directed laterally. Eyes large, directed forward, completely visible in frontal view. Interorbital width slightly less than orbital diameter. Snout, from side, vertical. Distance from eye to tip of snout greater than orbital diameter. Canthus rostralis obtuse, loreal region weakly concave. Eye membranes opaque. Orbit round, pupil of eye horizontally elliptical. Tympanum round, directed obliquely upward; diameter 10 times in head width.

Anterior limbs moderate. Undersides of palm and fingers covered by low smooth tubercles; fingers with lateral fleshy margins. Disks truncate, not much wider than fingers. Thenar tubercle obscure, narrow and elongate; palmar tubercle broader than thenar but elongate, smooth. Subarticular tubercles small, smooth, usually double on fingers 1 and 4. Modal finger webbing formula I 3-3 II $1\frac{3}{4}$ -3 III 2- $1\frac{1}{4}$ IV. Hindlimbs long. Underside of foot weakly granular. Disks small, rounded. An elongate inner, but no outer metatarsal tubercle. Subarticular tubercles moderate, single. Modal toe webbing formula I 0- $1\frac{1}{2}$ II 0- $1\frac{3}{4}$ III 1-2 IV $1\frac{1}{2}$ -0 V.

Throat smooth, wrinkled laterally in male where vocal sac expands. Venter and postero-ventral area of thighs strongly granular, elsewhere underside smooth.

Choanae ovoid, large, separated by distance slightly greater than distance between nostrils. Vomerine teeth in transverse series between choanae, separated at midline. Ostia pharyngea small. Tongue small. Paired vocal

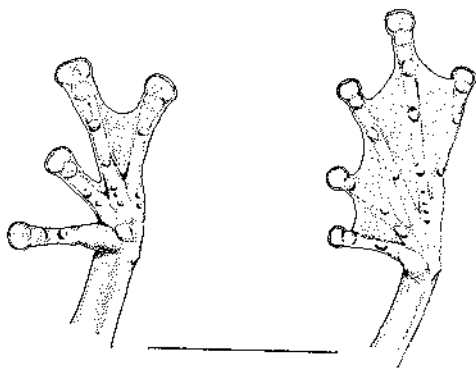


Fig. 2. *Centrolenella ilex*, paratype. Left, underside of hand. Right, underside of foot; line = 10 mm.

slits in males located posterior and lateral to tongue.

Coloration.—In life, uniform deep green above; below, white throat and venter, dull yellow hands and feet. Iris a reticulum of ivory and black. Bones green. Viscera partially hidden by a white parietal peritoneal sheath, no white pigment in visceral peritoneum. In preservation green pigment has turned to lavender and yellow reticulum. Undersides dull white. In one paratype three dorsal areas that resemble light spots are present. The areas of reduced pigmentation were not apparent in life or shortly after preservation. In the specimen from near San Mateo several light spots were present in life.

Measurements.—Standard length is in millimeters, all others are given as percentages of standard length. In the style of notation used here the first figure is the minimum, the second the mean, and the third the maximum. Data are based on four adults, one male 27 in standard length and three females 28.5-30.0-32. No sexual dimorphism in proportions was found. Head length, 33-34.0-39; head width, 33-34.7-36; vertical tympanum, 3.5-4.2-5.1; orbit, 12-12.8-14; eye to tip of snout, 12-13.2-14; interorbital, 10-11.1-12.5; hindlimbs (anus to tip of fourth toe), 175-180.5-191; tibia, 59-61.5-65; foot (including tarsus), 73-76.7-81.

Distribution.—All localities from which *C. ilex* is known are in tropical moist or wet forest areas (Holdridge, 1964) in the Atlantic foothills of the Cordilleras Central and Talamanca and on the Pacific versant in the gorge of the Río Grande de Tárcoles (Fig. 4).

Comparisons and Relationships.—The Middle American forms of Centrolenidae appear to belong to three species groups. One of these, characterized by lacking vomerine teeth, having white bones, a colorless parietal peritoneum, white visceral peritoneum, and being white to yellow in preservative includes: *chirripoi*, *chrysops*, *colymbiphyl- lum*, *decorata*, *fleischmanni*, *millepunctata*, *reticulata*, *talamancae*, *valerioi*, and *viridissima*. The second group has vomerine teeth, green bones, white parietal peritoneum, colorless hepatic peritoneum, and lavender color in preservative. Included species are: *albomaculata*, *granulosa*, *ilex*, *prosoblepon*, and *spinosa*. *C. prosoblepon* differs from the other forms in this group in that most males and some females have a prominent bony hook on the humerus that forms an obvious external projection. *C. spinosa* is distinctive within the family in having a sharp prepollex spine in males and the prepollex free in both sexes. The species *pulverata* is intermediate between the two groups in having vomerine teeth, pale green bones, colorless parietal peritoneum, white visceral peritoneum and is whitish in preservative.

Four generic names have been proposed for members of the family: *Centrolene* Jiménez de la Espada, 1872 (monotype: *Centrolene gekoideum* Jiménez de la Espada, 1872); *Centrolenella* Noble, 1920 (orthotype: *Centrolenella antioquiensis* Noble, 1920); *Cochranella* Taylor, 1951 (orthotype: *Centrolenella granulosa* Taylor, 1949); and *Teratohyla* Taylor, 1951 (monotype: *Centrolenella spinosa* Taylor, 1949). Goin (1964) has recently stated that only two genera appear to be represented by the 12 species of the family in northern South America. He regarded the gigantic species *gekoideum* (up to 77 mm in standard length) as forming a monotypic genus characterized by large finger disks and a humeral spine in males. The name *Centrolene* must apply to this genus. All other South American species were placed in *Centrolenella* by Goin. On the basis of published data, which usually lack information on bone and peritoneal color, features best observed in living animals, it appears that *griffithsi* and *petersi* (Goin, 1963) of Ecuador belong with the *fleischmanni* group (group I above). *Antioquiensis* Noble, 1920 (which lacks vomerine teeth); *anthisthensi* Goin, 1963; *buckleyi* Boulenger, 1882 (which lacks vomerine teeth); *coch-*

ranae Goin, 1961 (which may or may not have vomerine teeth); *ocellata* Boulenger, 1918; *ocellifera* Boulenger, 1899; and *parabambae* Boulenger, 1898, of north and western South America appear closest to the second group mentioned above, as does *geijskesi* Goin, 1966, from Suriname. Thus the types of *Centrolenella*, *Cochranella*, and *Teratohyla* all are more closely allied to one another than to the *fleischmanni* group or to *Centrolene gekoideum*. Since *pulverata* tends to be intermediate between typical *Centrolenella* and *fleischmanni* and its allies, it seems best to follow provisionally Goin's (1964) arrangement which recognizes only two genera in the family, especially since the relations of the 12 Brazilian species (Taylor and Cochran, 1953) remain obscure. Studies now near completion by Mrs. Starrett clarify the relationships and status of the several species groups in a definitive fashion.

Centrolenella ilex is immediately distinguished from the Middle American frogs allied to *C. fleischmanni* (including the nominal species *chirripoi*, *chrysops*, *colymbiphyl- lum*, *decorata*, *millepunctata*, *reticulata*, *talamancae*, *valerioi*, and *viridissima*; (Taylor 1942, 1958) since these frogs lack vomerine teeth, have white bones, no pigment in parietal peritoneum, hepatic peritoneum white, and fade from pale green in life to yellow or white in preservative.

C. ilex differs from *C. pulverata* (characters for the latter form in parentheses) of Costa Rica and Panamá in the white parietal peritoneum (colorless), unpigmented hepatic peritoneum (white), semicircular head outline (subelliptical to pointed), smooth dorsum (granular), no arm fringe (a fringe present), and lavender dorsal ground color in preservative (yellowish-white).

The new Costa Rican species resembles the following Central American centrolenids in characters 1-4, as given in the definition above, and in the lavender ground color of preserved animals: *albomaculata*, *granulosa*, *prosoblepon*, and *spinosa*. *Ilex* differs from *granulosa* in having a smooth dorsum (granular in *granulosa*), more extensive toe webbing (formula for *granulosa*: I 1½-2½ II 1-2 III 1-2 IV 2-1 V), semicircular snout (subovoid in *granulosa*), and in lacking large dark dorsal spots (usually present in *granulosa*). The new form differs from *prosoblepon* in having more extensive toe webbing (formula for *prosoblepon*: I 1½-2½

II $1\frac{1}{2}$ - $1\frac{1}{4}$ III $1\frac{1}{2}$ - $2\frac{1}{4}$ IV $2\frac{3}{4}$ - $1\frac{1}{2}$ V, semi-circular snout (subovoid in *prosoblepon*), uniform dorsal color with occasional light spots (usually with numerous small dark spots in *prosoblepon*), and in lacking a humeral hook in males (present in all males and some female *prosoblepon*). *C. ilex* approaches *albomaculata* in size and other characteristics but the latter form has slightly less webbing (fingers: I 3-3 II $3-3\frac{1}{2}$ III 2- $1\frac{1}{2}$ IV; toes I 1-2 II 1-2 III $1\frac{1}{2}$ - $2\frac{1}{4}$ IV 2-1 V) than the new species, a fringe on the lower arm (no fringe in *ilex*), and numerous small yellow or whitish spots in dorsal pattern (uniform dorsum or with a few large, light spots in *ilex*). Basically the new species is most similar to *spinosa*, a much smaller form (standard length in males to 20 mm, in females to 23 mm) that has a free prepollex in both sexes and a prepollical spine in males (standard length for male *ilex* 27 mm, females to 32 mm; no free prepollex or spine). Although the two agree in the extent of finger and toe webbing and usually uniform dorsal coloration, *spinosa* has a subovoid snout outline and granular dorsum (semicircular snout outline and smooth dorsum in *ilex*). The differences in head shape among the allies of *ilex* are illustrated (Fig. 3) and may be compared with the new form (Fig. 1).

The new species cannot be confused with any of the members of the *fleischmanni* group in South America as discussed in the preceding paragraphs.

From *anthisthensi*, *antioquiensis*, *cochranae*, *ocellata*, and *ocellifera*, of South America, *C. ilex* differs in usually having a uniform dorsal color without light spots. Light pigmented spots are present in the listed forms and are outlined in deep purple or black in *cochranae*, *ocellata*, and *ocellifera*. *C. anthisthensi* is also smaller (25.6 mm) than the new form, covered with many small light spots and has less finger webbing (I 3-3 II 3-3 III 2-2 IV) than *ilex*. *C. antioquiensis* lacks vomerine teeth, has numerous small light dorsal spots, a moderate sized humeral hook in males, a fringe on the arm, and is much smaller (maximum size 22 mm in standard length) than *ilex* (vomerine teeth present, usually uniform in color or with a few light spots, no humeral hook in males or arm fringe, and maximum size 32 mm).

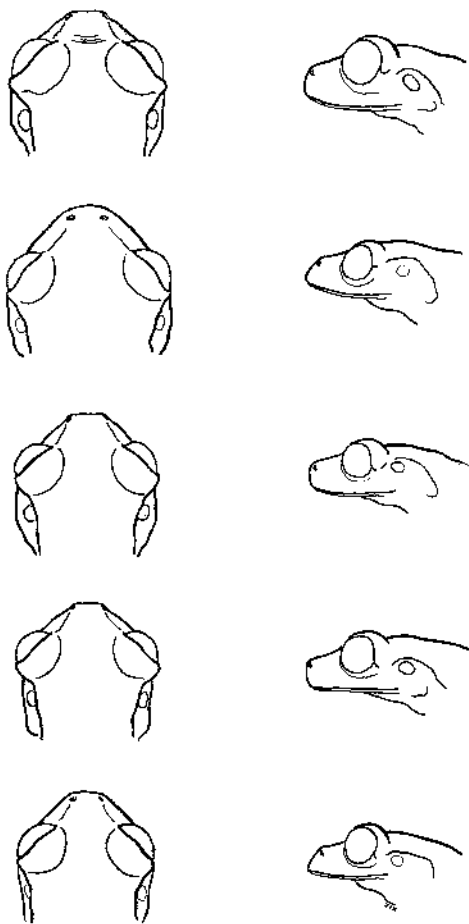


Fig. 3. Diagnostic features of head shape in Central American centrolenids. Dorsal and lateral views, *Centrolenella albomaculata*, *granulosa*, *prosoblepon*, *spinosa*, and *pulverata*. Drawn to various scales.

Of the two northern South American forms with uniform dorsal coloration, the new species differs most obviously from *buckleyi* and resembles *parabambae*. *C. buckleyi* lacks vomerine teeth and has much less finger webbing (I 3-3 II $2\frac{1}{2}$ - $3\frac{1}{2}$ III $3\frac{1}{2}$ - $3\frac{1}{2}$ IV) than *ilex*. *C. ilex* differs from *parabambae* in larger size (27 mm in males, 28.5-32 mm in females versus maximum of 26 mm in *parabambae*), condition of the humerus in males (no bony hook versus a hook present), and coloration (no obvious small dark spots on dorsal surfaces of hindlimbs versus scattered dark spots on thighs and lower leg). *C. parabambae* is currently known from several localities in western Ecuador. At least two other species have been confused with

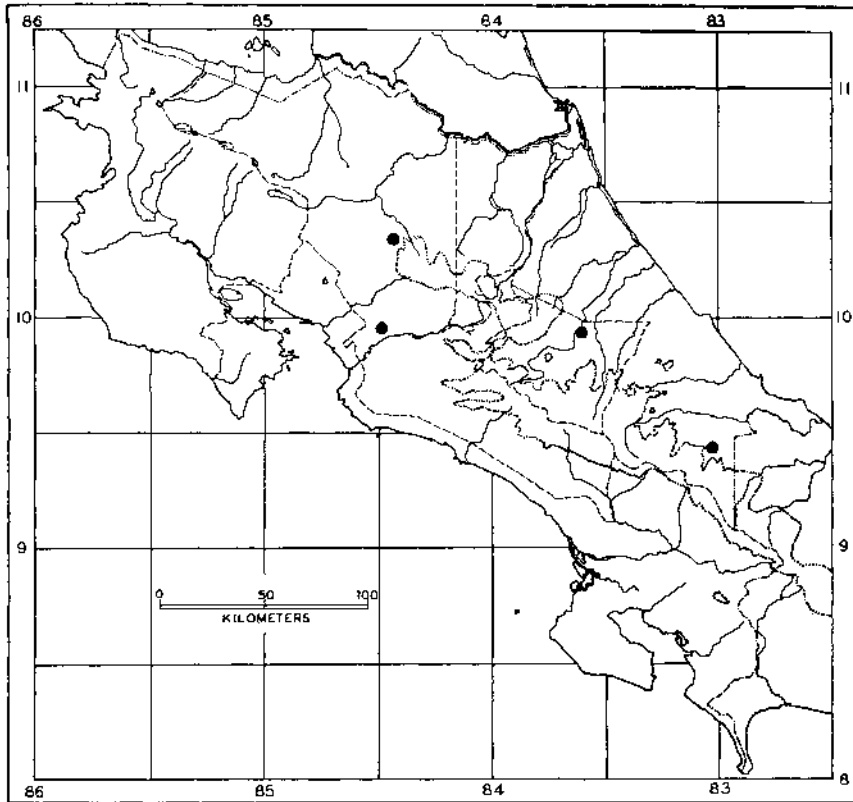


Fig. 4. Distribution of *Centrolenella ilex*; dotted line indicates 1500 m contour.

this form in United States collections. Apparently the name has been applied to any population of small uniformly lavender (in preservative) centrolenids with vomerine teeth from Panamá, Colombia, and Ecuador. All of the frogs from Panamá called by this name, following Dunn (1933), are examples of *C. spinosa*, with the characteristic free prepollex. A second form, seemingly undescribed, lacks the humeral hook in males and the dark hindlimbs spots of *parabambae* and occurs in western Colombia and Ecuador.

C. ilex is readily distinguished from the recently described *C. geijskesi* of Suriname which has a series of small white spots on the arms and legs (absent in *ilex*), a rounded snout outline that tapers to a point and the nostrils not protuberant (snout semi-circular and nostrils protuberant in the Costa Rican form), and more extensive finger webbing (I 3-3 II 2-3 III 0-0 IV) than in *ilex*.

Centrolenella ilex is trenchantly different

from all other members of the family but shows greatest resemblance to *C. albomaculata* and to *C. spinosa*. The coloration and presence of the fringe on the arm in the former and the free prepollex of the latter make a close relationship to *ilex* for either form unlikely.

Remarks.—All examples of the new species were collected from low vegetation along fast moving streams at night. The call of this form was not identified in the field.

The name is from the Latin *ilex*, the generic name for the holly.

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species was collected during my tenure as a John Simon Guggenheim Memorial Fellow, 1963-1964. The holotype is deposited in the collections of the Los Angeles County Museum of Natural History (LACM).

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