

SOUTHERN PATAGONIAN IGUANID LIZARDS OF THE *LIOLAEMUS KINGI* GROUP

J. M. CEI

ABSTRACT: *Liolaemus kingi* (Bell) from the eastern and central lowlands and tablelands of Argentine Patagonia, *L. archeforus archeforus* Donoso-Barros and Cei from the Lake Buenos Aires area, and *L. archeforus sarmientoi* Donoso-Barros from southern Santa Cruz province and neighboring Chilean territories, form a natural group, which is analyzed here. Serological relationships of the complex and the geographical distribution of its members are discussed.

BELL'S (1843) short account of a Patagonian lizard, *Proctotretus kingi*, collected by Charles Darwin near Puerto Deseado, Santa Cruz (66°W, 47°40'S) is the first description of a species of the group. Another closely related species, *Liolaemus archeforus* Donoso-Barros and Cei (1971), was recently discovered from the basaltic Meseta del Lago Buenos Aires (71°20'W, 47°S), an isolated volcanic plateau in Santa Cruz surrounded by glacial moraines, but never covered by ice during glacial expansion. My collections of several samples of *Liolaemus* on the austral Patagonian mainland and the recent description of *Liolaemus sarmientoi* by Donoso-Barros (1973) enable me to consider this latter as a subspecies of *L. archeforus* and to attempt a first taxonomic and phylogenetic arrangement of this group, especially serological relationships, examined by the precipitin tests according to the Libby's photronreflectometric technique proposed by Boyden (1942). *Liolaemus kingi* and its allied *L. archeforus* probably contact on the borders of the isolated basaltic plateau near to Lake Buenos Aires. The purpose of the present paper is to support with other kind of physiological evidence the true specific status of *L. archeforus* assumed in our previous work (Donoso Barros and Cei, 1971). The subspecies *L. archeforus sarmientoi* is based upon southern populations, being separated from the nominate subspecies by a noticeable distance covering harsh and poorly known territories. The cautious appraisal of its proposed taxonomic position shall be discussed in the conclusion of this paper.

MATERIALS AND METHODS

Specimens that I studied belong to the Collection of the Instituto Biología Animal, Universidad Nacional de Cuyo, Argentina (IBA-UNC). Standard measurements given are according to customary methods, by calipers and stereomicroscope (accuracy to 0.5 mm). Color descriptions were based on a series of Agfacolor® transparencies taken of living animals. Serological tests utilized the photronreflectometric technique. Captured animals were bled by cardiac puncture; after clotting the expressed sera were filtered through Seitz filters, centrifuged and stored at -20° C. Immune sera were prepared in rabbits by reinforced seral antigens (Freud's Adjuvant). Specific cross reactions were analyzed by comparison of the galvanometric measurements (Photronic Units). Homologous reaction was the result of tests of an antiserum with its own antigens. Heterologous reaction indicates the relative percentage of precipitate of the same antiserum with different specific antigens, considering the measure of the homologous reaction (100%).

Localities of the examined specimens and of the samples utilized for serological researches are given under the species headings, and in the report of immunological results.

A comparative redescription of *Liolaemus kingi*, *Liolaemus archeforus archeforus* and *Liolaemus archeforus sarmientoi* is given. The general features of their geographical distribution and habitat are indicated in Fig. 1.

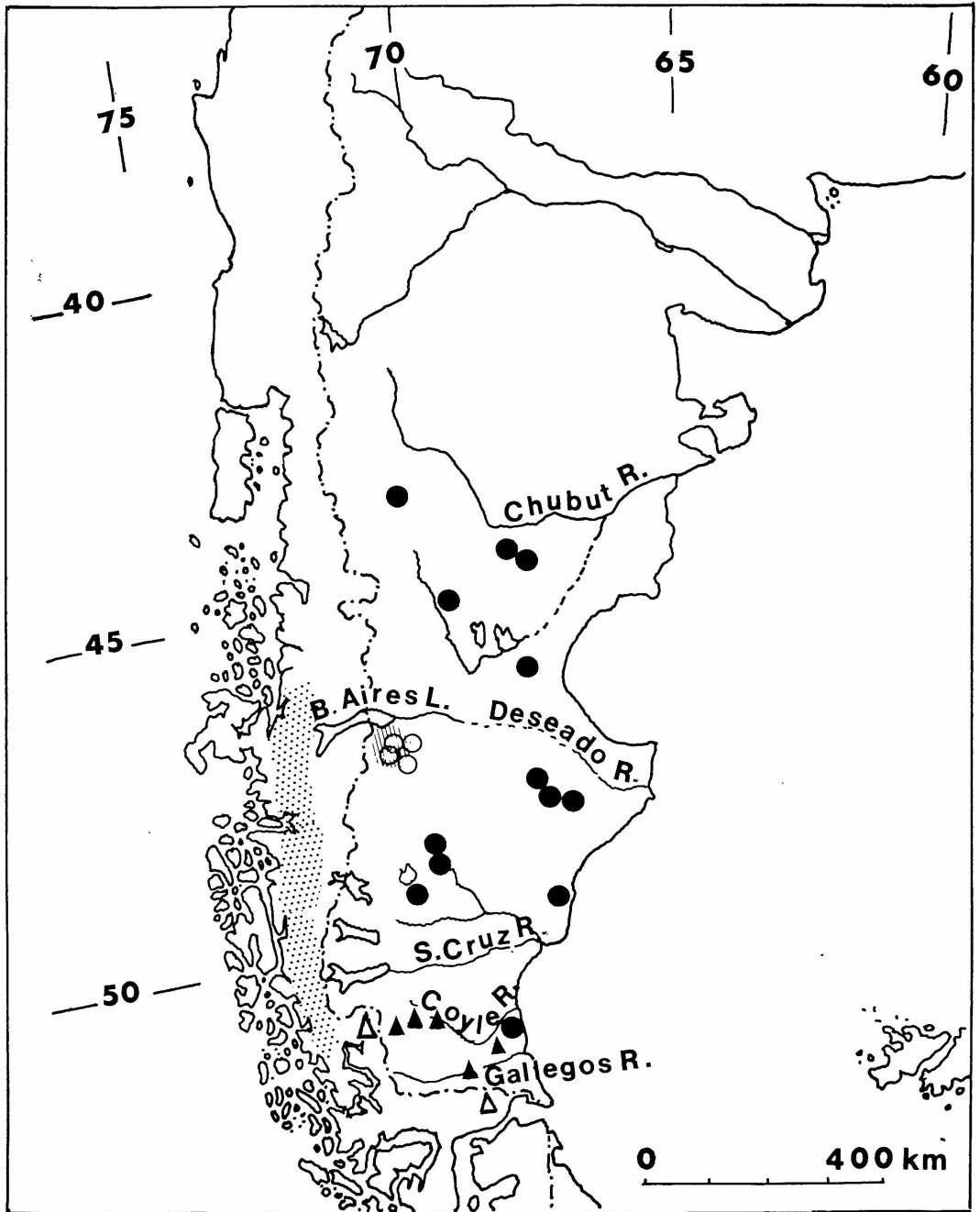


FIG. 1.—Distribution of the cited samples of: *Liolaemus kingi* (closed circles); *L. archeforus archeforus* (open circles); and *L. archeforus sarmientoi* (closed triangles: Argentine samples; open triangles: Chilean localities). Hatched area: Meseta of Lago Buenos Aires; Stippled area: Patagonian continental ice-field.

Liolaemus kingi (Bell)

Material Examined.—IBA-UNC: 864,1-4, 60 km N Gobernador Costa; 794,1-2, Meseta Canquel, Chubut, 1000 m; 700-1, W Meseta Canquel, Chubut, 900 m; 607-1, Tamariscos, Chubut, 800 m; 600-1-5, Pampa Castillo, Chubut; 455,1-2, 90 km W Fitz Roy, Santa Cruz; 875,1-13, Laguna Madre e Hija, Santa Cruz; 521-1, 10 km N Gregores, Santa Cruz, 700 m; 614-1-17, 180 km N San Julian, Santa Cruz; 601-1, 2 km San Julian, Santa Cruz; 523-1, 6 km N Gregores, Santa Cruz, 350 m; 375,1-3, Cardiel Lake, Santa Cruz; 335-1, Cardiel Lake, Santa Cruz; 636,1-2, 15 km NW Rio Callegos, Santa Cruz. 53 specimens (19 ♂♂; 28 ♀♀; 6 juveniles).

Diagnosis.—A stout short-tailed *Liolaemus*, with short hind limbs not reaching axilla; dorsal scales wider than long, weakly keeled; dorsum reddish brown, crossed by 10-12 white or yellow transverse bars; 75-84 scales around the middle of the body.

Distribution.—From Chubut River to Magellan Channel (42°-52° S).

Description.—The following description is based on adult specimens from Santa Cruz, near the type locality of Puerto Deseado. A large *Liolaemus* with short hind limbs; general form stout; adpressed hind limb not reaching axilla in males, reaching middle of body in ♀♀; tail short; tail/head + body: 0.95-1.28, (\bar{x} = 1.09, N = 8 ♂♂), 0.88-1.20, (\bar{x} = 1.03, N = 8 ♀♀); head longer than wide, length contained in 18-20 dorsal scales; dorsal head scales rather large; rostral enlarged, two and half times wider than long, with 2 or 3 small adhering scales and 4 or 5 internasals; nasals irregular, opening backward; 1-3 frontals irregular; 2-3 small postfrontals; interparietal subpentagonal, smaller than parietals; 6-7 supraoculars; subocular expanded, a single series of scales between labials and subocular; 8-9 supralabials and 5-6 infralabials; temporal scales smooth; ear opening large, oval, with 2 or 3 prominent scales on its anterior border; side of the neck granular, plicate, with a longitudinal fold and a short antehumeral fold; mental trapezoidal, wider than long; 2 divergent rows of 4-5 postmentals. Dorsal scales imbricate, wider than long, weakly

keeled, not mucronate (Fig. 2A), smaller than ventrals and caudals; lateral scales smooth, triangular; ventrals scales imbricate, rounded and smooth; caudal scales keeled, triangular at the base of the tail, squarish and more conspicuously carinate on the remainder of the tail; limb scales smooth, slightly keeled on the tibia, granular on the thigh. 75-84 scales around the middle of the body; 20-25 lamellae under the 4th toe; head + body length 77-100 mm (14 ♂♂) and 72-90 mm (14 ♀♀); 7-10 preanal pores.

Color.—Dorsum pale yellowish or reddish brown, with 10-12 transverse bars; bars broken, white or yellow, black bordered, many with conspicuous central spot; head darker brown. Dorsal bars generally separate, not crossing back; irregular dots or bars on flanks and limbs; tail irregularly banded; belly whitish or yellow, mottled with black in some. No remarkable sexual differences in dorsal and ventral pattern. Juveniles and newborn specimens always show more conspicuous transverse white bars. (Fig. 3A, B).

Variation.—In some northern populations (Chubut: Gobernador Costa) the conspicuous dorsal bars are brilliant white and yellow in ♀♀, or a blackish ground color in ♂♂. In population from Meseta de Canquel (Chubut) the transverse white bars and spots are also evident, but largely separated on the dorsum. Individual variation is great in Santa Cruz populations, with specimens with broken dorsal bars crossing the back from each flank, and ventral surface grayish, or the belly black.

Geographical and Ecological Remarks.—*Liolaemus kingi* has an extensive range in the Patagonian provinces, from Northern Chubut to the Magellan Channel (Fig. 1). Its habitat is characterized by rocky, dry environments such as the basaltic ravines or sandy and stony shores. Like most Patagonian reptiles, it is viviparous: neonates are 72-74 mm long. Several other species coexist with *L. kingi*: *L. boulengeri*, *L. bibroni*, *L. fitzingeri*, *Diplolaemus bibroni*, *D. darwini* and *Homonota darwini*

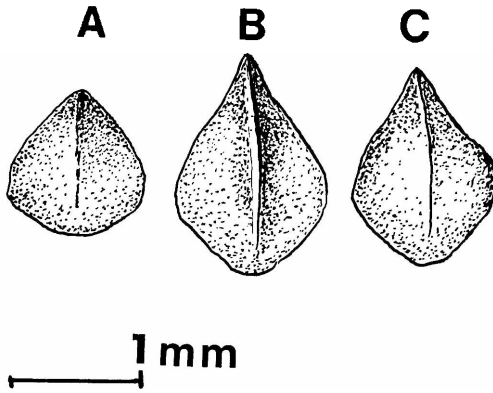


FIG. 2.—Dorsal scales: A—*Liolaemus kingi*; B—*Liolaemus archeforus sarmientoi*; C—*Liolaemus archeforus archeforus*. (dorsal scale of *L. dorbignyi* is $2 \times$ dorsal scale A; the shape is the same, wider than long; unkeeled.)

occur throughout its range. *Liolaemus archeforus sarmientoi*, *L. magellanicus* and *L. lineomaculatus* are also relatively abundant in the area of the Chalia River, Southern Santa Cruz Province.

Liolaemus archeforus archeforus

Donoso-Barros and Cei

Material Examined.—IBA-UNC: 516, 1–2 (Holotype), Meseta Lago Buenos Aires, Black Swan Lagoon, Santa Cruz, 1,500 m; 517, 1–6, Meseta Lago Buenos Aires, Puesto Lebrun, Santa Cruz, 1,500 m; 518-1, Meseta Lago Buenos Aires, Santa Cruz, 1,600 m; 848, 1–13, Meseta Lago Buenos Aires, Puesto Lebrun, Santa Cruz, 1,400 m; 857, 1–6, Moraines facing Meseta Lago Buenos Aires, Casa de Piedra Hill, Santa Cruz, 800–1,000 m; 870-1, 3 km N Río Pinturas, near Meseta Lago Buenos Aires, Santa Cruz, 800–900 m. 29 specimens (11 ♂♂, 12 ♀♀, 6 juveniles).

Diagnosis.—A large slender *Liolaemus*, with moderate hind limbs, reaching axilla in the ♂♂; dorsal scales longer than wide, keeled, sharply pointed; dorsum dark brown or black, crossed by broken white or bluish transverse bars; 68–75 scales around the middle of the body.

Distribution.—Plateau and basaltic borders of the Meseta del Lago Buenos Aires, Santa Cruz, between 1,500 m and 800 m.

Description.—A large *Liolaemus*, elongate, with moderately short hind limbs;

adpressed hind limb reaching or nearly reaching axilla in ♂♂, not reaching axilla in ♀♀; tail one and a quarter times or more as long as head + body; tail/head + body 1.33–1.34 in ♂♂, 1.08–1.23 in ♀♀; head moderate, longer than wide, contained in 15–19 dorsal scales; dorsal head scales smooth, convex, moderate in size; rostral twice as long as wide with 2 small adhering scales and 4 internasals; nasals irregular, opening backward; 3–4 frontals; 2–3 small postfrontals; interparietal smaller than parietals; 4–5 supraoculars on each side; subocular expanded, a single series of scales between labials and subocular; 5–7 supralabials and 5–7 infralabials; temporal scales smooth; ear opening large, oval, with 2–3 prominent scales on its anterior border; sides of the neck granular, with a longitudinal fold open in V behind ear; a short antihumeral fold; mental scale enlarged, one and a quarter times as wide as long; 2 divergent rows of 4 postmentals. Dorsal scales imbricate, longer than wide, triangular, keeled, pointed, not mucronate; keels forming longitudinal lines; dorsal scales slightly smaller than ventrals and caudals; flank scales smooth, triangular; ventral scales imbricate, smooth, rounded; caudal scales triangular at base of tail, elsewhere squarish, diagonally keeled above, smooth on the half of the lower surface of tail, slightly carinate on the terminal portion; limb scales triangular and smooth, on tibia softly carinate; thigh granular. 68–75 scales around the middle of the body: 20–24 lamellae under the 4th toe; 6–8 preanal pores; head + body length 69–87 mm, mean 74.4 (10 ♂♂) and 76–92 mm, mean 82.1 (10 ♀♀). Contrary to *L. kingi*, ♀♀ of *archeforus* are longer than ♂♂.

Color.—Head and dorsum black, mottled with white, yellowish, or bluish scales, arranged in narrow transverse broken bars (12–14) on the back; limbs irregularly streaked with white; tail paler than body, with white-bordered black or brown marks; ventrally white or yellow; belly dusky black; under surface of tail yellow. No remarkable sexual differences in dorsal and

ventral pattern. Juveniles pale gray or yellow with more conspicuous transverse bars than in adults. (Fig. 3C).

Variation.—The dorsal pattern is constant in the entire series. However, the transverse light bars are irregular and quite indistinct in some animals. The ventral color varies with age, being paler in juveniles.

Geographical and Ecological Remarks.—*Liolaemus archeforus archeforus* is known only from the volcanic meseta south of Lake Buenos Aires, Santa Cruz, and the 800–900 m high moraines, surrounding the escarped plateau. Lizards were captured during the summer months under stones or in the crevices of the basaltic rocks, covered by luxurious lichenous vegetation. Air temperature was often 1°C at midday (January 1973) with hailstorms and icy downpours. When temperatures exceeded 5°C lizards commenced moving. Their cyclic activities and feeding seem to be in accordance with the low surface or soil temperatures of the meseta, bordering the continental icefield of Ofqui, in adjacent Chile. Other species of iguanids coexisting with *Liolaemus archeforus archeforus* are *Liolaemus lineomaculatus* and the endemic genus *Vilcunia silvanae* (Donoso-Barros and Cei, 1971).

Liolaemus archeforus sarmientoi

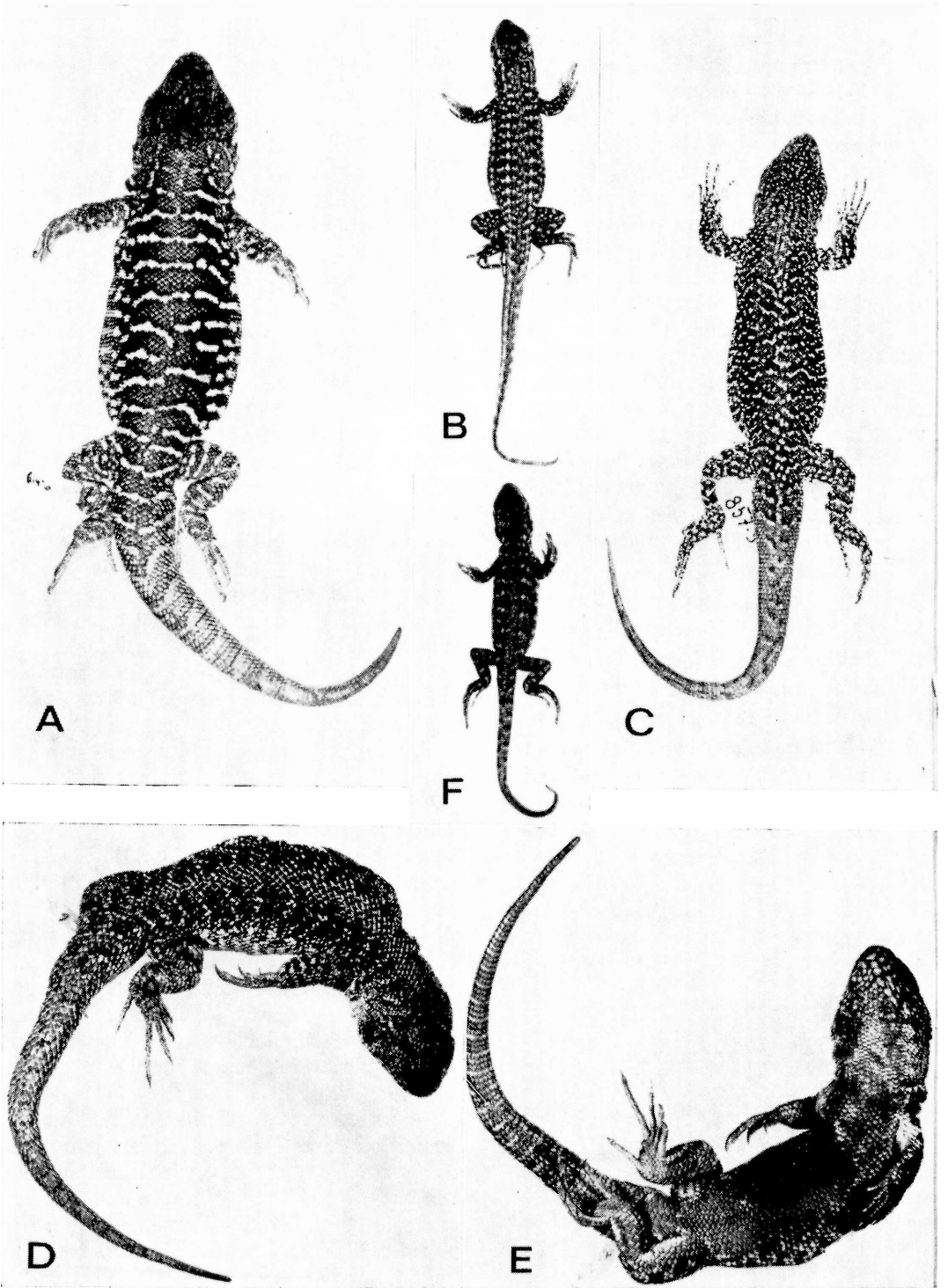
Donoso-Barros

Material Examined.—IBA-UNC: 632-1-2, Estancia Guarumba, 500 m, near Coyle River, Santa Cruz, Argentina; collected by J. M. Cei and L. M. Cei, 6 January 1970; 627, 1-2, Estancia Carlota between Bella Vista and Buitreras, near Gallegos River, Santa Cruz, 20 January 1970, J. M. Cei and L. M. Cei; 629-1, 32 km N Río Gallegos, near Guer Aire, Santa Cruz, 18 January 1970, J. M. Cei and L. M. Cei; 645-1, 10 km N Estancia Guarumba, near Coyle River, Santa Cruz, 16 January 1970, J. M. Cei and L. M. Cei; 643-1, A° Esperanza, Santa Cruz, 14 January 1970, J. M. Cei and L. M. Cei; 617-1, Tapi Aike, Santa Cruz, 15 January 1970, J. M. Cei and L. M. Cei. (1 ♂, 3 ♀♀, 3 juveniles). The specimens described by Donoso-Barros belong to the Museo Zoología Universidad Concepción (Chile): they are MZUC 5626 (Holotype), 5627, 5628 Monte Aymondi, 12-11-62; MZUC 5629, Cerro Guido, 7-1-1955; all collected by T. Cehalovic.

Diagnosis.—A subspecies of *L. archeforus* well differentiated from the nominate species in having a stouter body, shorter hind limbs and tail, lower number of scales around the middle of the body (58–67), fewer lamellae under the 4th toe, more indistinct dorsal pattern with many scattered greenish or bluish scales.

Distribution.—Known from Lago Argentino, Santa Cruz, to Río Gallegos, mainly from the Coyle River Basin. The Chilean localities lie near the Argentine frontier.

Description.—General form stout, with short hind limbs; adpressed hind limb not reaching axilla; tail slightly longer than head + body (ratio = 1.08); head stout, longer than wide, contained in 14 dorsal scales; dorsal head scales large, somewhat wrinkled; rostral twice as long as wide, with 3 small adhering scales and 5 internasals; nasal as in nominate subspecies; 3 frontals; 2 large postfrontals; interparietal enlarged, slightly smaller than parietals; 6–7 small supraocular, irregular; subocular expanded, a single series of scales between labials and subocular; 7–8 supralabials and 5 infralabials; temporal scales convex, softly carinate; ear opening moderate, oval, with 2–3 prominent scales on its anterior border; sides of the neck granular, with longitudinal and antehumeral folds as in the nominate form; mental enlarged; 2 divergent rows of 3–4 postmentals. Dorsal scales imbricate, somewhat erect, longer than wide, triangular, strongly keeled, pointed, not mucronate; keels forming evident longitudinal lines; dorsal scales nearly equal to ventrals and caudals; flank scales smooth, triangular; ventral scales imbricate, smooth, rounded, triangular on the gular region; caudal scales keeled, triangular, squarish and diagonally keeled on the terminal portion; scales on lower surface of tail keeled; scales on hind limb triangular, conspicuously carinate; scales on forelimb slightly carinate, somewhat erect; 58 scales around the middle of body; 19 lamellae under the 4th toe; 6 preanal pores. Measurements (in millimeters): head length 20; head width 16; head + body 80; tail 87; hind limb 40;



forelimb 25.5 (δ specimen IBA-UNC 632-2).

Color.—Head pale brown; dorsal ground color dark gray or brownish with bluish or greenish scales disposed as transverse, quite indistinct, light spots or bars. Transverse bars (10–11), black bordered, evident in juvenile and newborn specimens. Tail paler than body. Limbs mottled with white; flanks with wide whitish or bluish bars; belly dirty black, yellowish in cloacal region (Fig. 3D, E, F).

Variation.—Females are similar to the δ δ . The number of scales around middle of body varies between 58–67; the number of lamellae under the 4th toe between 19–21. The body length 80–85 mm (δ δ), 75–80 mm (♀ ♀) in the Santa Cruz specimens.

General Remarks.—The subspecies corresponds to specimens reported by Donoso-Barros (1966) as *Liolaemus dorbigny* Koslowsky from Magellanes, Chile, near the Argentine frontier. Careful comparison of our materials with the description of *Liolaemus sarmientoi* by Donoso-Barros enables me to support the identity of the Argentine and Chilean samples of lizards. The evidence of available morphological characters suggests that *sarmientoi* is a southern geographical form of *archeforus*. The geographical ranges of both subspecies do not overlap, but *Liolaemus archeforus sarmientoi* occurs in the open steppe range along the rivers and springs of the Coyle and Gallegos drainage systems. It takes refuge in the more dense grasslands, such as the *Festuca*, *Poa* or *Stipa* meadows, scattered by the spinous “mata negra,” or Patagonian black brush (*Verbena tridens*). These features indicate a more versatile ecology, unlike *L. archeforus archeforus*, usually found in rocky environments. The climate of the Southern Santa Cruz region and Magellanes is moist and cold, in spite

TABLE 1.—Results of cross reactions between immune sera and antigens of *Liolaemus kingi*, *L. archeforus archeforus*, *L. fitzingeri* and *Phymaturus*. Homologous reactions are expressed as 100%. Localities of the samples: 1—Meseta Lago Buenos Aires, Santa Cruz; 2—Casa de Piedra Hill, Santa Cruz; 3—Meseta Canquel, Chubut; 4—Caleta Olivia, Santa Cruz.

Antigens	Anti-sera	
	<i>L. archeforus archeforus</i>	<i>L. kingi</i>
<i>L. archeforus archeforus</i> ¹	100	84
<i>L. archeforus archeforus</i> ²	95	85
<i>L. kingi</i>	85	100
<i>L. fitzingeri</i> ³	61	—
<i>L. fitzingeri</i> ⁴	—	50
<i>Phymaturus palluma</i>	—	46

of a low average of annual rainfall (290 mm). The annual average relative humidity is 72% (Rio Gallegos Station). *Liolaemus archeforus sarmientoi* is viviparous; reproductive females give birth to four young each. At the same collection sites of *L. archeforus sarmientoi*, *Liolaemus magellanicus*, *L. lineomaculatus*, *L. kingi*, *Diplolema darwini* were taken.

SEROLOGICAL DATA

Serological comparison was an aid to investigate specific relationships between *Liolaemus kingi* and *L. archeforus*. Immunological results are given in Table 1. Besides their cross reactions, antigens of *Liolaemus kingi* and *L. archeforus archeforus* have been compared with antigens of the Patagonian *L. fitzingeri* and with an allopatric iguanid, *Phymaturus palluma* from Payún (Mendoza, Argentina). The sample of *L. kingi* was taken in Laguna Madre e Hija, Santa Cruz; localities for *L. archeforus* and *L. fitzingeri* are given in Table 1. The data indicate a close relationship between the populations of *L. archeforus* from the meseta (1,500 m) and the

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FIG. 3.—A—*Liolaemus kingi*, δ ; B—neonatal *Liolaemus kingi*; C—*Liolaemus archeforus archeforus*, δ ; D—E—*Liolaemus archeforus sarmientoi*; F—neonatal *Liolaemus archeforus sarmientoi*. (A, C, D, E natural size; B slightly enlarged; F 2 \times .)

populations from the neighboring moraines (800–900 m). On the other hand serological reactions between *L. archeforus* and *L. kingi* are 84–85%, and clearly distinguish both forms at a relatively close but specific level. Serological relationships are weaker between *L. kingi*, or *L. archeforus*, and *L. fitzingeri* or the divergent *Phymaturus paluma*.

DISCUSSION

The Patagonian *Liolaemus kingi* complex contains a number of widespread and adaptive populations between 42° and 53° south latitude. *Liolaemus kingi* is geographically variable, but subspecies cannot be distinguished. The serological evidence and a careful morphological comparison of *L. kingi* and *L. archeforus archeforus* point out the specific status of the isolated form from the meseta of Lago Buenos Aires, as suggested by Donoso-Barros and Cei (1971). *Liolaemus archeforus archeforus* may represent a probable ancient stock of a primitive *L. kingi*-line, which evolved its present characteristics during geographical isolation at the time of the greatest glacial expansion in the Pleistocene. No evidence of glaciation is found for all the upper surface of the basaltic meseta, now inhabited in the same niches by *L. archeforus*, and the curious *Vilcunia silvanae*, an iguanid intermediate between *Proctotretus* and *Liolaemus*, perhaps a relic. In addition to such a specialized herpetofauna, endemism is high for several other groups of animals (Cei, unpublished data). The extended subcordilleran region south of the Meseta del Lago Buenos Aires to the great Viedma and Argentino glacial lakes (50° S) is poorly explored. It is a system of harsh, broken volcanic tablelands, very cold in the dry winter months and snow covered as well during many summer days. *Liolaemus archeforus sarmientoi* occurs southward from Lago Argentino to the Magellan Channel but the northernmost extension of its range is still unknown. The above mentioned morphological differences with the

allopatric *L. archeforus archeforus*, such as body shape, pholidosis and color pattern, clearly justify the proposed subspecific status of *L. archeforus sarmientoi*, which is sympatric with *L. kingi* in southeastern Santa Cruz. However, as recognized by Donoso-Barros (1973), *L. archeforus sarmientoi* differs sharply from the otherwise rather similar *Liolaemus dorbignyi* Koslowsky from Catamarca, Argentina (separated by 2,200 km), in dorsal pattern, in several important differences in the shape and size of dorsal and ventral scales (Fig. 2A, B, C), and in a number of body measurements. The lack of serological evidence and our present poor knowledge of the definite distribution and ecology of both *Liolaemus archeforus* and *L. archeforus sarmientoi* demands a cautious taxonomic appraisal and an equally cautious discussion of their eventual specific or conspecific status. It is not possible to analyze on morphological grounds which of the two forms is the most primitive, but the prolonged geographical and paleoclimatic segregation of *L. archeforus archeforus* (similar to *L. kingi* in several characters) perhaps argues for it being the oldest.

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Instituto Biología Animal, Universidad Nacional de Cuyo, Mendoza, Argentina