

# Hylidae in the Adolpho Lutz Collection of the Instituto Oswaldo Cruz

- V. Mode of Locomotion and Structure of Hand and Foot  
V<sup>a</sup> Phyllomedusa (Pithecopus) burmeisteri distincta A. Lutz  
V<sup>b</sup> Aplastodiscus perviridis A. Lutz

by

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In December 1949 and January of this year the writer and Mr. J. VENANCIO had the opportunity to undertake a short collecting trip through certain parts of the most southern states of Brazil, for the Museu Nacional and the Instituto Oswaldo Cruz. The main objectives were the rediscovery of some frogs examined by Professor Lutz, twenty or twenty five years ago, and provided with differential diagnoses, some of them still unpublished; the collecting of series and the ecological observation of the anuran fauna and its distribution by life zones. These aims were as successful as could be expected given the short time available. The material gathered is now being studied and analysed. In the present paper only two forms will be dealt with.

The writer is indebted to so many institutions and persons for kindness and help that it would be impossible to mention every one of them. The generous assistance of the Director General of the National Malaria Service, Dr. MARIO PINOTTI and of the Regional Director, Dr. MARIO FERREIRA, ably seconded by the staff of the Malaria Institute in Brusque, especially Drs. H. VELLOSO and M. ARAGÃO, and all the field workers, was one of the most important factors of success. The Board of the Biological Society of Rio Grande do Sul, its President, Professor P. RIET CORRÊA, the State Secretary for Agriculture and Professor GLIESCH made it possible for us to visit many interesting localities for our purpose in the northern section of the state. The zoologists of the Museu Paranaense gave us willing help during our short stay in Curitiba. Thanks must also be extended to the Mayor of Serra Alta, or São Bento do Sul, for practical advice and transportation and to the Reverend PRAESES SCHLUENZEN and his family for the charming hospitality of their home.

## V. MODE OF LOCOMOTION AND STRUCTURE OF HAND AND FOOT.

Both the forms described in this paper are of interest in regard to the structure of the hand and foot and the correlated mode and tempo of locomotion, as will be shown below.

*Hyla*, the relatively unspecialized type-genus of the true tree frogs, or Hylidae, moves either by leaping or by adhesion and friction. In jumping it is aided by the long legs and in climbing and clinging by the well-developed disks, as well as by the intercalary cartilage between the two last phalanges, which is diagnostic for the family.

Some Hylidae, however, show a trend towards a different mode of locomotion, by grasping supports and drawing themselves up and by walking on the hands and feet. Grasping is associated with curving the hand or foot around the support or placing the inner digits in opposition to the outer ones. This mode of locomotion generally leads to a slowing of the tempo. It is also associated with the following modifications in the structure of the hand and foot: reduction of the disks and webs, narrowing of the digits, allometric growth and consequent alteration of the usual proportions between the digits and finally, a slight torsion which makes it possible to oppose the inner digits to the outer ones.

In the neotropical region this is best seen in the genus *Phyllomedusa*. It is associated with certain other characters, such as the vertical pupil, scansorial mode of life and the habit of spawning outside water.

In the forms most highly specialized in this direction, the first toe is both longer and more robust than the second, the digits are cylindrical, or torose, the webs totally absent and there is a decided torsion which opposes the inner digits to the outer ones. These are precisely the forms which fit Cope's definition of his genus *Pithecopus* (1866), which deserves recognition, either at full generic status or at least as a separate section of *Phyllomedusa* sensu lato. Taken in its widest acceptation, the latter should include all the neotropical Hylidae with vertical pupil, more or less opposable inner digits, permanently visible dorsal surfaces disruptively separated, in colour and texture, from those concealed in repose and the habit of spawning above water instead of in it. They constitute a very natural group. This particular conjunction of characters is not found in other neotropical Hylids. It is present, though in a lesser degree, in *Agalychnis*, which some European authors already include in *Phyllomedusa*.

The following classification is proposed:

TABLE I

<p><i>PHYLLOMEDUSA</i> sensu lato: Pupil vertical. Inner digits opposable. Spawn non-aquatic. Permanently visible, green, dorsalsurfaces disruptively separated from the vivid surfaces concealed in repose. Paratoids present or not. Vomerine teeth in the large forms. Neotropical.</p>	I AGALYCHNIS Cope, 1865	<p>{ Disks more or less large. Webs more or less fully developed. Inner digits slightly <i>opposable</i>. Spawn on open leaves or other supports. 1 toe shorter than 2. Paratoid glands present or not.</p> <p>Species: <i>moreletii</i>, <i>helenae</i>, <i>dacnicolor</i>, <i>callidryas</i>, <i>lemur</i> (fide Cope).</p>
	II PHYLLOMEDUSA Wagler, 1830 (Sensu stricto)	<p>{ Disks large. Webs reduced. Inner digits somewhat opposable. 1 toe shorter than or equal to 2. Paratoids present. Spawn? Species: <i>P. bicolor</i>, <i>loris</i>.</p> <p>Equatorial South America.</p>
	III HYLOMANTIS Peters, 1872	<p>{ Disks large Webs medium to short. Inner digits slightly opposable. 1 toe shorter than 2. Paratoids absent. Vomerine teeth present. (<i>H. aspera</i>). Spawn in folded leaves (<i>H. guttata</i>). Species: <i>H. aspera</i>, <i>H. guttata</i>. Eastern and South-Eastern Brazil.</p>
	IV PITHECOPUS Cope, 1866	<p>{ Disks small. Webs absent. Inner digits opposable. 1 toe longer, more robust than 2. Paratoids present or not. Vomerine teeth idem. Spawn in folded leaves. Kreise: <i>P. burmeisteri</i> <i>P. hypochondrialis</i>. South America.</p>
Species Incertae Sedis..		<p>{ <i>P. fimbriata</i> (<i>P. appendiculata</i>), SE. Brazil. Might be an <i>Agalychnis</i> by morphology and the fact that it was seen spawning on rocks. <i>P. buckleyi</i>? near <i>Centrolenella</i>? Equador; poorly known region. <i>A. calcarifer</i> = <i>Agalychnis</i>? fide Boulenger — Equador.</p>

*Pithecopus* is South-American. It is best divided into two major groups. The first is composed of mostly large forms (70-90 mms), with visible paratoid glands and vomerine teeth. The second group is made up of small forms (30-50 mms), generally devoid of vomerine teeth and paratoids. There is an exception in each group which may serve as a form of transition in regard to either one or the other of these structures.

The large forms are best grouped around *P. burmeisteri* and the small ones around *P. hypochondrialis*. There are not enough data

available to make it quite sure whether they constitute Artenkreise or Formenkreise. On the basis of existing information, it would seem that there is often not more than one large and one small form per locality. The forms of each group thus seem to be mostly allopatric and vicariant. Within the Kreis to which they belong, the differences from one to another are rather of degree than of quality.

The small forms are mostly so similar to *P. hypochondrialis* as to make it doubtful if they are even subspecifically different, except for *P. rhodei*. *P. perlata*, from N. W. Peru, however, has paratoid glands and dorso-lateral series of pearl-like pustules. As the type is very small (23 mm) it would be interesting to ascertain whether it is adult.

In the *P. burmeisteri* Kreis there is, however, a certain differentiation in accordance with the ecological background. Thus the forms from the equatorial region have longer legs, those from the eastern foot-hills of the Andes a narrower interorbital space and the ones from the Gran Chaco and adjacent regions fuller glands than the diverse forms of *P. burmeisteri* from Eastern Brazil, which are all very similar. The enclosed map shows the regions in which they are found, and Tables II and III indicate a few characters which permit rapid separation of forms and groups.

TABLE II  
PITHECOPUS COPE, 1866

DISTRIBUTION	Forms	Differences
EASTERN BRAZIL.....	<p><i>P. Burmeisteri</i> Boulenger, 1856 (Fig 8-9) Eastern Brazil. Type: male 85 mm.</p> <p>Note: The description includes Argentina, but the Argentinian specimen was later described as <i>P. sawagii</i> by Boulenger.</p>	<p>Disks much smaller than tympanum. Leg short, tibiotarsal to shoulder, tympanum or eye. Paratoid long. Visible surfaces deep green. A purple network of wide meshes enclosing yellow areas on concealed surfaces.</p>
CENTRAL CIS-ANDEAN SOUTH AMERICA	<p><i>P. sawagii</i> Boulenger, 1882 (Fig 7) Oran, Salta, Argentina Type: 75 mm. Also in other parts of Northern Argentina, Southern Bolivia, (L. Muller 1936) and in Mato Grosso, Brazil. (B. Lutz).</p>	<p>Differ from <i>P. burmeisteri</i> by the much more prominent paratoids and the colour. Entirely green except the belly and a median longitudinal strip on the lower aspect of thigh. Glandular ridges, spots at heels and elbows and large white, Y and I shaped spots on gula and chest, all very conspicuous.</p>
Paratoids and glandular ridges more prominent	<p><i>P. rickettsii</i> Guenther, 1896 Santa Fé, Argentina Type: 68 mms.</p>	<p><i>P. rickettsii</i> is covered with warts on the back. <i>P. sawagii</i> is smooth. The warts may be a nuptial character. They may be sub-specific or geographic forms.</p>

TABLE II (conclusion)

DISTRIBUTION	Forms	Differences
HIGHLANDS EAST OF THE ANDES Interorbital space narrower	<i>P. boliviana</i> Boulenger 1902. Bolivia, Chulumani 2000 ms alt. Type: male and female 75 mm.	Fide Boulenger it differs by the interorbital space which is no wider than the upper eyelid. Thighs entirely green above. A broad pinkish white bands, speckled with purple, on the sides of the body, ending before the grom. Yellow spots on the concealed surfaces.
PERU Paratoids absent?	<i>P. colestis</i> Cope, 1874. Peru Moyabamba. Type: 57 mm.	According to Cope: paratoids absent and interorbital space barely wider than the upper eyelid. Sides and concealed surfaces yellow with purple bars.
COLOMBIA Intermediate. Leg long, interorbital space wide	<i>P. nicefori</i> Barbour, 1926 Villavicencio, Colombia Type 80 mms.	Characters unclear. Perhaps intermediate between <i>tarsius</i> and <i>coelestis</i> .
UPPER AMAZONS Leg longer.	<i>P. tarsius</i> Cope, 1868. Type: 95 mm. Nauta. <i>P. tomopternus</i> Cope, 1868. Type 49 mm. Abundant at Nauta.	Disks somewhat larger than tympanum. Leg long, tibiotarsal to the front of the eye. Femur green on dorsal surface. Two isolated spots on breast and on each side of the vent, below. Disks? Tibiotarsal to anterior corner of orbit. Concealed surfaces bright yellow with purple bands. <i>Two appendages on heel.</i>
LOWER AMAZONS Bony incrustations in the back.	<i>P. vaillantii</i> Boulenger, 1882. Santarém, State of Pará, Brazil. V Type: male, 60 mm.	Disks equal to tympanum. Tibiotarsal to posterior corner of eye. Disks light green, minute light spots on the sides. <i>Bony deposits in dorsal skin.</i>
TRINIDAD B.W.I. Disks large. Rudiment of Web. Transition to <i>Phyllomedusa</i> ?	<i>P. trinitatis</i> Mertens 1926. Trinidad, Port of Spain. Type: female 88 mms.	Disks large, 2/3 to 3/4 of tympanum. Leg long, tibiotarsal beyond eye. Disks green, small light spots on concealed surfaces.

The subspecies described in this paper, *P. b. distincta*, is a new member of the *burmeisteri* Kreis. It comes from the northern part of Santa Catarina, a part of Eastern Brazil not yet included in the territory of *P. burmeisteri*, and intermediate between the ranges of *P. burmeisteri* and *P. b. iheringii*. It is one of the smallest, if not the smallest form of the group. The vivid concealed surfaces of the thighs are immaculate instead of showing the network-pattern usually found in the others. Moreover, the vomerine teeth are variable. The females, which are large, have well developed teeth. In the males, which are much smaller, they may be present and similar, more feeble, a very common occurrence, or altogether absent. In the latter case there may be a slight asperity in the palate in their usual place, perceptible by an exploratory needle.

TABLE III

PITHECOPUS BURMEISTERI (BOULENGER, 1856)

SUBSPECIES	Differences	Remarks
<i>P. burmeisteri burmeisteri</i> (Fig. 8-9) Federal District, states of Rio de Janeiro, Espírito Santo and south-eastern Minas Gerais. 55-80 mms.	Characters of the original description. <i>Disks white, concealed surfaces yellow with purple network.</i>	All the forms except <i>P. b. distincta</i> were originally described as full species.
<i>P. burmeisteri bahiana</i> (Lutz) 1925 (Fig. 10) Salvador, Capital of the State of Bahia. Type: 75. Also Ilheos, Bahia.	<i>Leg short, tibiotarsal barely to axila.</i> Dorsal surface entirely dark green, glandular ridges citron. Disks and distal parts of inner digits yellowish citron above.	The specimens from the coastal lowlands between Rio and Bahia show intermediate melanistic trends. Those from Belo Horizonte, at the edge of semi-arid country, have short legs and few spots.
<i>P. burmeisteri distincta</i> A Lutz, 1950. (Figs. 1-6) Northern part of eastern Santa Catarina. Types: female 70 mm. Males 50-57 mms.	Differs by smaller size; absence of pattern on limbs, vivid red colour of concealed surfaces, variable condition of vomerine teeth.	
<i>P. burmeisteri iheringii</i> Boulenger, 1885. (Fig. 11). Southern Rio Grande do Sul. Many cotypes, 67mms. Sex?	Differs by narrower head and green disks. Concealed surfaces orange with loose purple network of vertical stripes.	The figure of this form given by Werner (1912) is very like <i>P. b. burmeisteri</i> . The writer has not seen <i>iheringii</i> .

A relatively small specimen of the Amazonian *P. vaillantii*, in the collection of the National Museum in Rio also has feeble teeth. While describing *P. palliata*, which he separated from *P. hypochondrialis* after considering them identical, Peters (1872) mentions slightly raised but toothless ridges between the choanae. KELLOGG (1932) also states that one of his specimens of *Agalychnis moreletii* is devoid of vomerine teeth. These examples indicate that the character is variable in diverse forms of *Phyllomedusa* sensu lato. The conditions just described and the habitual absence of vomerine teeth in the lesser forms suggest that there may be a certain threshold of size for their phenotypic appearance and constancy. If so, the threshold in *Phyllomedusa* is much higher than in *Hyla*; In the latter I know of only one instance, of variability that of *Hyla decipiens*. A. LUTZ. All the specimens collected at the type locality, the vicinity of the Instituto Oswaldo Cruz in Rio, are very small (16-19 mms) and devoid of vomerine teeth. Those from other colonies, some of them only a few miles away, are larger (22-23 mms) and have the teeth present. This species also deviates from the norm by possessing nuptial pads and spawning outside water.

The other form described below poses a problem in Hylid relationships. It has the general characters of *Hyla* but shows a trend away from that genus in the structure of the hand and foot.

At first sight it has a certain resemblance to other montane, medium-sized, green tree-frogs from south-eastern Brazil, namely *Hyla albofrenata*, *Hyla musica* and *Hyla albosignata* (Lutz 1949). Some specimens of these forms hold the first finger at a slight angle to the second, half covering it and as if mildly opposable to it. This is more common in *Hyla albofrenata*. Otherwise, their hands and feet conform to the usual shape. They have normal webs and very large disks.

In the new form, the webs are very much reduced. They are absent between the two inner fingers, limited to an oblique strip between the two inner toes and short on the lateral digits. The first finger is very thick at the base, and the opposition between it and the second is more marked and more constant. The two first toes are very short and diverge slightly inwards and upwards, from the outer ones. The fourth toe is disproportionately elongate. Moreover, there is an aberrant feature present: the disks are quite thin and narrow, somewhat nail-like and no wider than the digits. These are also unusually slender and weak, more rounded than usual in *Hyla* and rather similar to those of *Phyllomedusa*. They are frail and incline to fold into the palm or sole after death.

In the northern part of its range the new form overlaps with the southern part of the range of *Hyla albosignata*, which is nearest to it also in voice and in build. Ecologically they remain quite distinct. *Hyla albosignata* and the other montane species mentioned above are sylvan and arboreal. The new form is a marsh-dweller and not a good climber, as already noticed by A. LUTZ. It lives in high, more or less open, wet or flooded country, with hygrophilous vegetation and

a few shrubs. It has been collected on the ground, sitting just above water on swamp-plants and on bushes reachable by hand. Mr. J. VENANCIO points out that it, also remains in the lower parts of vivaria, which is very unlike *Hyla*.

This is evidently correlated with the structure of the hand and foot, especially that of the digits and disks. NOBLE and JAECKLE (1928) point out that tree-frogs are not good climbers unless the disks attain a certain size in relation to the weight of the body. Opposable inner digits, aided by well-developed pads on the palm, sole and inner surface of the digits, such as are seen in *Phyllomedusa*, may serve as a substitute. Locomotion by grasping is, however, much slower than locomotion by adhesion and friction. The new form has not yet attained the *Phyllomedusa* mode. The opposition between the inner and the outer digits is incipient and more or less reduced to the hand; additional pads are generally present.

This frog was first seen twenty nine years ago on the Serra da Bocaina, which is part of the Maritime Range situated on the border of the state of São Paulo with that of Rio de Janeiro. A single specimen was caught, after listening for several nights to its musical call. The voice, the totally green colour and the habitus suggested a Hylid, but although the pupil was horizontal and there were maxillary and vomerine teeth present, it seemed rather aberrant from *Hyla*. Dissection was refrained from as the specimen was unique and seemed to belong to a rare species. A short description was drawn up and Professor LUTZ also suggested the name *Aplastodicus*, if further specimens should prove it to be generically distinct. As it was entirely green, the specific name chosen was *perviridis*. In the course of the next years, the voice was heard, once or twice, in the same place, by A. LUTZ and J. VENANCIO, but no further specimens were obtained, nor was it ever found in the mountains near Rio or to the north of the capital.

During our recent excursion the new form was found to be more abundant further south. It was heard every night in the mountains of northern Rio Grande and southern Santa Catarina (Serra Geral) and in the ones on the northern border of the latter state (Serra do Mar). Fifteen specimens were collected. They confirmed the diagnostic characters of the first one and again impressed the finders by the structure of the extremities.

A skeleton was prepared. It showed no structural differences from *Hyla*, except for the poor ossification of the phalanges and their relative length, especially disproportionate in the 4<sup>th</sup> toe. The terminal phalange is claw-shaped, as in most Hylids, but not very swollen at the base; the intercalary cartilage is like that shown by Noble (1932, p. 508) in his figure of *Pseudacris* or *Hyla ocularis*. The disks contain much less fibrous tissue than usual in the type-genus.

Other tree-frogs with the structural characters of *Hyla*, except for the extremities, have been described before, from other parts of the extremely wide range of that genus. They have been separated off as genera by outstanding herpetologists and returned, in part, or



entirely, to the type genus, by others equally competent. Narrow disks and digits, plus other correlated morphological and physiological differences, have occurred three times at least, once in the Australian, once in the Nearctic and now in the Neotropical region. The Australian forms were put to the genus *Litoria* created by Tschudi in 1838, which was accepted by DUMÉRIL and BIBRON (1841) and added to by GUENTHER (1858), but synonymized with *Hyla* by Boulenger. (1882). The North American forms are included in *Pseudacris* FITZINGER 1843, also named *Chorophilus* by BAIRD (1854). This genus was maintained by COPE (1866, 1877 etc.) and rejected by NOBLE (1923), mostly on the basis of *P. ocularis*, which, according to HARPER (1939), is not a member of the genus.

The Australian, North American and South American narrow-disked tree-frogs differ from each other in a number of points. The most extreme forms of *Litoria*, such as are shown by BOULENGER (1882) in Plate XXVI of his Catalogue, under the names of *H. affinis*, *H. nigrofrenata* and *H. latopalmata*, are very ravid in appearance, a fact already remarked on in regard to the type species, *L. freycinetii*, (Figs. 13, 13a), by DUMÉRIL and BIBRON. They are slender in build and have well-webbed feet. The hand, especially in of the first three, is similar to that of the *Pithecopus* section of *Phyllomedusa*, with the first finger larger than the second and evidently opposable to it. This character is considered diagnostic for the genus by GUENTHER (1858). *Pseudacris*, so far as the writer can judge from the literature, is not only slender but also small. Some figures like that of NOBLE (1932, p. 511) convey the impression of the slight twist in the position of the inner finger, which is generally present when there is an incipient degree of opposition between it and the second. The fingers and the inner toes are entirely free. The third finger and the fourth toe are disproportionate in length.

The Brazilian form, for which LUTZ proposed the name *Aplastodiscus*, is very different from either in build. It is large and heavy, the legs are short and the eyes very oblique. The hand is quite different from that of the other two. The first finger is very swollen at the base, but shorter and less opposable than that of *Litoria*. The third one is not elongate as in *Pseudacris* (figs. 14, 14a). The outer alike, especially in regard to the very long fourth toe, which is extensively free and may be useful in climbing. *Aplastodiscus* is more webbed than the nearctic form. It seems likely that *Pseudacris* (*Chorophilus*) *cuzcanus* Cope (1877), which, though very small, is also robust, olive-coloured and montane, comes nearer to our form than to the northern genus.

Besides the narrow disks and digits the three forms have of course in common the trend away from the mode of climbing of *Hyla*. Two of them, at least, exhibit a slight transition towards the grasping hand, although it is rudimentary in *Aplastodiscus* and in apparent conflict with the webbed foot of *Litoria*. The writer knows nothing

about the ecology of the Australian form. *Pseudacris* is referred to as the swamp tree-frog. *Aplastodiscus*, though montane, is also a marsh-dweller. Perhaps all three, but at any rate *Aplastodiscus*, have arrived at a stage of differentiation which signifies rather the loss of scansorial capacity than the opening out of new biologic opportunity.

These forms have evidently arisen independently of each other, in different regions, by more or less parallel evolution. They may thus be regarded as polyphyletic, though one might reasonably postulate a common ancestor as wide-spread and unspecialized as *Hyla*. They seem too different to be lumped together, nor does it seem logical to accept three different sub-generic categories of *Hyla* with narrow disks.

Were it not for the rules of nomenclature and the geographic element involved, it might be better to regard them as three separate sections of a new genus with a name such as *Lepthyla*, which DUMÉRILL and BIBRON (1841) would have proposed for *Litoria* had Tschudi's name not been published earlier. Barring this possibility it seems simpler to let the other forms remain in their present position and to create a new genus, *Aplastodiscus*, for the south-american form.

PHYLLOMEDUSA (PITHECOPUS) BURMEISTERI DISTINCTA  
LUTZ NOV. SUBSP.

(Figs. 1-6)

DIAGNOSIS. A *Phyllomedusa* with the *Pithecopus* foot, belonging to the Formenkreis of *P. burmeisteri*, to judge by the general morphology and the colour of the iris.

Distinguished by the absence of any pattern on the concealed aspects of the limbs, the relatively small size, and the range.

DESCRIPTION OF HOLOTYPE: *Female*, adult. Build robust, size rather small for the *burmeisteri* group. Head fairly massive, body tapering slightly from the shoulder to the groin; leg short, tibiotarsal articulation to the tympanum, heels barely meeting. Snout oval, truncate between the nostrils, flaring slightly downwards in front; loreal region somewhat vertical, hollowed out between the eye and the nostril; canthus rostralis short, angular. Tongue pearshaped, long; narrow in front, wide, hardly emarginate and extensively free behind. Vomerine teeth in two perfectly distinct, slightly separate, somewhat oblique patches between the choanae. Interorbital space wider than the upper eyelid. Eye slightly longer than the distance from its anterior corner to the nostril. Tympanum distinct, slightly more than half the longest diameter of the eye. Paratoids narrow, long, not very distinct, but the porous tissue reaching to the level of the adpressed elbow. Disks very small, especially those of the inner finger and 2 and 3 toes. Digits free; first finger shorter than the second, fourth almost as long as the third; first toe much larger

then the second, which is very feeble; subarticular, palmar and plantar tubercles rounded, the inner metatarsal not standing out from them. Skin of dorsal surface shagreened but not rough, of gula and chest minutely, of abdomen and mid-ventral aspect of thigh more coarsely aureolate.

*Male Paratypes.* Build more slender, size much smaller, head slightly more vertical. In nuptial specimens the forearm very stout and a dark pad on the outside of the first finger, which is wide at the base. Vocal sac not evident. Vomerine teeth present or not. Paratoids narrow, but perfectly distinct, well defined from the upper eyelid to the tympanum or the axilla, continued as porous glandular tissue to the elbow or beyond. No other distinguishing characters.

MEASUREMENTS (in millims). Type *Female*: Snout-vent 70, head length 20, width 21, eye 7, eye-nostril 6, tympanum 4, interorbital space 7, upper eyelid 5; femur 26, tibia 28, tarsus 17, foot 25. *Males*: 50-57, average 53-55, head length 15 to 17, av. 15, width 14 to 17, av. 16, eye 5, tympanum 3 to 4, av. 3, interorbital space 6, upper eyelid 4; femur 17 to 22, tibia 19 to 23, tarsus 15 to 17, foot 15 to 20.

VARIATION. The most striking individual variation consists in the unequal development of the vomerine teeth. Three males have them as well developed as the females; in three they are absent, though in two, especially one, there is a slight asperity on the vomer. In the other nine the teeth are present but the patches are weak, short and widely separated. In one of the specimens from Corupá this is especially so on the right side. The shape of the tongue is not quite so variable; nevertheless, one specimen has an asymmetric tongue and in two others it is uniformly wide and short. The other characters are not more variable than usual and some slight differences may be due to shrinking. In our males the most constant proportion seems to be that of 1.5:1, between the interorbital space and the upper eyelid. There are slight variations as to the length of the leg and the proportions of its different segments. When the tibia is more than two millimeters longer than the femur the heels overlap slightly instead of barely touching. In the male caught in Jan. 1949 the adpressed tibiotarsal articulation reaches the posterior corner of the eye instead of the tympanum.

The variability of the vomerine teeth has not been used as a diagnostic character because it seems to occur in other species of *Phyllomedusa* and in one *Agalychnis* at least (KELLOGG 1932). Their constant presence is probably dependent on a threshold of size.

COLORATION. Dorsal, permanently visible, surfaces, clearly delimited from those concealed in repose; the separation disruptive, cutting, longitudinally, across the back of the hand and foot, dividing the two inner from the outer digits, sometimes bisecting the fourth toe. Dorsal colour extensive to the sides on the head and the upper part of the body, covering most of the tibia, and the outside of the tarsus,

hand, foot and outer digits; on the arm limited to a wide oblique strip, and on the thigh to a rather narrow, median longitudinal band. A few prolongations, or wide open, meshes, the colour of the dorsum, on the sides; in some specimens one or two short, interrupted, vertical lines on the upper arm, besides the more common blotches along the femoral band, which look as if paint had been daubed on carelessly.

In life these surfaces are a deep saturated green. Shortly after death they may seem a dark blue-green, later they become deep blue. Old specimens may be partly purple or entirely isabella gray. Colour of the concealed surfaces vivid red on the immaculate thighs and inside of the forearm and tarsus, paler on the hand and foot, very pallid on the inner digits, which are sometimes blotched with dark. Sides of the body going over into buff or orange-yellow, anteriorly. White or faintly purplish, glandular lines, underscored in dark, on the edges of the forearm and tarsus, from the elbow about to the base of the outermost digit; a similar line on the edge of the lower jaw, prolonged well onto the shoulder behind and matched in front by a similar one; a short narrow supranal ridge. A white spot on the posterior corner of the eye, sometimes another on the anterior one. Iris gray, tympanum green. Disks of 1 and 2 finger and 3 and toes white. In some of the nuptial males the ridges are more marked.

Pre-and sub-anal region, midventral aspect of the thigh and lower surface of forearm and tarsus dark brown, with a violaceous tinge, passing into testaceous, vinaceous and pinkish tones of buff on the ventral surface of the body. (Females and two males). Throat gray, overlaid with cream. A few cream spots on it and orange ones on the midventral aspect of the thigh. Pigmentation of the perianal region, midthigh and lower surface of limbs lighter and much reduced in the other males, fenestrated on the thighs in some, and with scalloped inner rim on the distal segments, in most of them; ventral aspect of the body, palms and soles light. Stippled lines and arabesques of very minute dark brown chromatophores may be scattered on the light lower surfaces, but they are generally too reduced to form a pattern; at best they achieve a quite shadowy replica of the network on the gula and chest of *P. b. burmeisteri*. In one specimen only are these lines marked enough to form an ornamental design on the lower aspect together with the dark pigment of the thighs and scalloped inner borders of the limbs. (fig. 2). Tubercles gray.

*Colour Notes:* RIDGWAY (1912): Dorsum forest, bice or light bice green; shortly after death bottle-green or terre verte, later indigo, tyrian or slate blues. Concealed surfaces: Brazil red, scarlet to peach on limbs, strawberry to coral on hand and foot, pinkish, vinaceous or cinnamon tints of buff on digits. Iris grape green, or olive and pale olive gray. Testaceous, vinaceous and buff tints on the ventral aspect of the darker specimens. WILSON (1938): Spinach or Scheele green on the back; from Saturn red through the indian oranges to the light egyptian buffs on concealed limb-surfaces and digits. Iris paler and more gray than his pod-greens. SÉGUY: dorsal colour: 351, 406, 366-7,

or 360-366. Concealed surfaces, where vivid 188, digits 200-199. Iris: 207.

VOICE. According to Mr. J. VENANCIO the call is similar to the croack, "cwaak, cwaak" of *P. burmeisteri burmeisteri*, though slightly weaker and not unlike the rasp produced by a noisy clearing of the throat.

BEHAVIOUR. Apparently similar to that of the other members of the group. The specimens caught on Jan. 8, 1950, by Mr. J. VENANCIO, were sitting on ferns and other plants growing along an artificial ditch of water, formerly connected with the reservoir at Rio Vermelho, in a horizontal clearing on wooded slopes.

ECOLOGY. Like some other forms of *Phyllomedusa (Pithecopus)*, *P. b. distincta* seems to have a certain tolerance for differences of a few hundred meters of altitude. This is probably dependent on the presence of appropriate sites for the larvae. Rio Vermelho lies some 800 to 900 meters above the sea and the Saraiva road, which is immediately below it, must be some 600-750 ms. high. Corupá is almost at the foot of the range, but a local collector informs that in the breeding season the species is often seen at 200-300 ms. of altitude.

RANGE. Apparently intermediate between that of *P. b. burmeisteri* and *P. b. iheringii*. The former which is much larger, occupies a extensive territory north of Santa Catarina and has yellow areas enclosed in a purple-brown network on the sides of the body and concealed surfaces of the limbs. The latter, which the writer has not seen, was described by Boulenger from southern Rio Grande do Sul. He states that he saw numerous specimens, that the disks were green and that there were conspicuous purple lines, forming vertical bars, or a wide-meshed network on the bright orange concealed surfaces of body and limbs.

TERRA TYPICA. Eastern section of northern Santa Catarina at Rio Vermelho and Saraiva road in the county of Serra Alta, also called São Bento do Sul, and at Corupá (ex Hansa).

TYPES. Holotype a female, paratypes fifteen males and one more female. Five, including the holotype collected January 8, 1950 at Rio Vermelho by J. VENANCIO; six males gathered, one at a time, in March 1924, September 1947 and January 1949 and three more, found together, in December of the same year by K. Nahderer, on the Saraiva road; one male from Corupá (ex Hansa) leg. Ehrhardt 12 Dec. 1928; the other female (67 mms) and four males sent from the same place, in April 1950, by Braunsburger. The new series belong to the Museu Nacional; the specimens collected before 1941 are in the Adolpho Lutz Collection of the Instituto Oswaldo Cruz.

REMARKS. This form was first seen by Professor LUTZ in 1924 and 1928. He made a note of the diagnostic characters, labelled the specimens "*distincta*" and had a water-colour made of the second which

had died shortly before arrival, but awaited further specimens so as to describe them. The form should thus be credited to him. The present writer must, however accept responsibility for not according *distincta* more than sub-specific rank.

#### APLASTODISCUS A. LUTZ, NOV. GEN.

GENOTYPE: *Aplastodiscus perviridis* A. Lutz.

DIAGNOSIS. Structural characters of *Hyla* except for the disks and digits. Disks laminae-like, thin, narrow, generally no wider than the digits. These also narrow, rounded and frail, with poorly-ossified phalanges. Hand short, foot long. First finger inserted at an angle, as if slightly opposable. Fourth toe disproportionately long and extensively free. Webs very reduced. Build heavy. Eye oblique.

#### APLASTODISCUS PERVIRIDIS A. Lutz, nov. sp.

(Figs. 12, 12a, b, c, d)

DIAGNOSIS. Characters of the genus. Entirely green, the dorsal surface heavily overlaid with dark chromatophores. Iris dark brass with metallic glint and a light median arc in the upper part.

From the coastal mountains of southern Brazil.

TYPE 42 mms. others: 38-47 mms.

Marsh-dweller, poor climber. Montane.

TYPE: Male from the Serra da Bocaina on the border between the states of São Paulo and of Rio de Janeiro. Collected January 15, 1931, by JOAQUIM VENANCIO and BERTHA LUTZ, at 1 100 ms. of altitude, in the ADOLPHO LUTZ Collection at the Instituto Oswaldo Cruz. Sixteen additional specimens from Santa Catarina and Rio Grande do Sul: Two from Bôca da Serra near São Francisco de Paula, one collected by Professor R. GLIESCH and one by BERTHA LUTZ and J. VENANCIO; eight from Caracol, slightly further inland, both places in northern Rio Grande do Sul at 22°32'S 44°35'W Gr. and at 800-900 ms. of altitude on the Serra Geral. One from São Joaquim, southern Santa Catarina, at 1400 ms. of altitude in the same Serra Geral. Five from northern Santa Catarina, Serra do Mar, at 800-900 ms of altitude, two at Serra Alta (S. Bento do Sul) and three on its outskirts, at Oxford, all collected by BERTHA LUTZ and VENANCIO.

DESCRIPTION. Build heavy, body stout, somewhat ovoid, wide from the head to the post-axillary region, narrowing but slightly from the sacrum to the groin. Leg short. Head massive. Snout rounded, with wide, ogival mouth-opening, blunt, somewhat arched, canthus rostralis and almost perpendicular loreal region, slightly hollowed in front and

below the eye. Vomerine teeth in two short, contiguous, heavy patches, forming an arch well behind the choanae, which are rather lateral and small. Tongue wide, obovoid, entire, somewhat free laterally and posteriorly but not on the mid-line. Eye oblique, its longest diameter slightly shorter than the distance from its anterior corner to the tip of the snout. Interorbital space broader than the upper eyelid in the middle, widening greatly posteriorly, because of the oblique position of the eye. Nostrils small, subterminal. In life, tympanum concealed by the skin, more distinct after death. Tibiotarsal articulation to the tympanum, femur and tibia sub-equal, so that the heels meet but do not overlap. Hand short, foot narrow, elongate. Digits rounded, narrow and frail. Disks nail-like, narrow, no wider than the digits. First finger free, very tumified and with a large pad at the base, inserted somewhat obliquely in front of the second, half covering it and held as if opposable to it. Third not unusually elongate. A short web from the distal side of the second to the proximal side of the fourth, reaching the base of the first tubercle on 2 and 3 and that of the second on 4. Two inner toes very short, parallel, diverging slightly inwards and upwards from the outer ones. Third and fifth subequal, fourth disproportionately long and extensively free. An oblique fringe of web between the inner toes, widening slightly between the outer, attaining the base of the second tubercle on 5 but generally not on 3 and 4. Subarticular tubercles poorly developed. A large inner, but no outer metatarsal tubercle. Ski slightly thick especially on the upper eyelids, peri-tympanic region, sides of the body and edges of limbs, but without appendages or glandular ridges outlining the surfaces visible in repose. Minute granulations on the gula and chest, slightly larger on the abdomen. A large median subgular vocal sac.

VARIATION. The type specimen (42 mm.) is now twenty nine years old but the long foot, narrow disks and digits, oblique eyes, short leg and heavy build are very characteristic.

The specimens collected further south, December 1949 and January 1950 were all identified by the colour, iris and voice. They show a certain degree of variability, especially as to the length of the leg.

Ten individuals from the populations of Bôca da Serra and Caracol, northern Rio Grande do Sul, are very robust and, all but one, slightly larger than the type (44-47 mms); most of them are very ovoid in shape. They are very heavily pigmented. Three of them, evidently males at the height of the breeding condition, have hugely distended vocal sacs. The forearms are very thick. The base of the first finger is tumified and in alignment with the edge of the forearm, well in front of the second, covering it, except with the tip, which is narrow and slightly bent. The webs on the outer toes of some of these specimens are very narrow and the webbing altogether much reduced. The chief difference between these southern samples and the type consists in the slightly longer leg, which reaches the posterior corner of the orbit instead of the tympanum, with the tibiotarsal articulation, when adpressed.

The subarticular tubercles are obscured by the presence of intercalated pads, separated by furrows, which continue the larger cushions on the palm and sole. The digits are very similar to those of *Phyllomedusa bicolor*, as figured by Daudin and described by Wagler (1830) as "torose". They incline to fold into the palm and sole after death. This may be due to the poor ossification of the phalanges or to the pull of the pads.

The one individual from southern Santa Catarina comes from a much higher altitude: 1400 ms at. S. Joaquim, on the same serra and near the frontier of Rio Grande do Sul. The digits are even narrower and the disks extremely attenuated. The foot is very long. The first finger occupies the typical position half covering the second. (Fig. 12b). The leg is even a little longer than in those from Rio Grande do Sul. The tibiotarsal articulation reaches mid-orbit when the leg is adpressed. In this particular and in the very slight pigmentation it resembles the specimens from northern Santa Catarina. It is 44 mms. long.

Five individuals from the population of Serra Alta and Oxford, on its outskirts, on the northern border of Santa Catarina and on the Serra do Mar, are slightly less typical. This may be due to the smaller size (38-41 mms). In four of them the leg is relatively long, like in the S. Joaquim specimen and attains mideye. Pigmentation is very slight. The pads on the palms and soles are more circular, those on the digits more attenuated, the fingers flatter and less inclined to double inwards. In one individual the disk on the third finger of the right hand is slightly wider than the digit and the same occurs on the left hand of another specimen.

Individual variations affect the shape of the tongue, which may bear a very shallow emargination, and the teeth, which may be contiguous or slightly separated.

It is interesting that this form, which seems intermediate between other genera, should be rather variable in itself and also that the individuals from the extremes of the range should be larger and more typical, though this may, of course, be due to random collecting.

**MEASUREMENTS:** in millimeters. **TYPE:** Snout-Vent 42, head length 13, width 15, interorbital space 5 (in the middle), upper eyelid 3, eye 5, eye-nostril 4, eye tip of snout 5, tympanum 2, forelimb 26, femur 18, tibia 18, tarsus and foot 29, total 65.

**Skeleton (from Caracol, Rio Grande do Sul):** Snout-Vent 45, head length 13, width 13, interorbital space 4 (bone); upper eyelid, — orbit 6, orbit-nostril 4, orbit-tip of snout 7, tympanum — Femur 20, tibia 19, tarsus 14, foot 18.

**COLORATION.** Entirely green. Dorsal colouring very uniform, in different tones of yellow or olive green, the darker shades more constant. Edges of mouth, gula and chest lighter, more citron, the throat overlaid with yellow; a bluish-white green beneath; articulations blue green. Dorsal surface overlaid with dark chromatophores, diminishing



to the sides and on the limbs and ceasing gradually on the concealed surfaces. Disks a deeper green. Iris very dark brass, with a metallic glint and a very conspicuous light median arc in the upper half; nictitating membrane with a dark border on the free rim; dark chromatophores on the lower lid, like those on the adjacent skin.

*Colour Notes:* According to Ridgway (1912): Dorsal aspect mignonette green, lighter edges oil yellow. When the chromatophores are wide open, Kroenberg to ivy green on the body, deep olive on the limbs. Sides, gula and ventral surfaces, the different tints of fluorite, olivine, light turtle or light lumière and glaucous greens, on the gula overlaid with yellow but less deep than on the sides; abdomen chalcedony yellow; flanks grape-green; articulations Niagara green or French blue. Iris maroon. According to WILSON'S CHART (1938): Dorsum either fern greens, with the lighter edges citron, or veronese green; or pod-greens and sap-greens in the same combination. Iris ox-blood. Ventral aspect light agathia and nickle greens or medium verdigris.

The dark chromatophores remain visible for a time after death. In the relatively small specimens from Santa Catarina they seem brown, but in the large ones from Rio Grande do Sul they have become a dull bluish to violet gray, more reminiscent of *Centrolenella* than of *Hyla*. The difference in the light arc of the iris is seen to be due to the absence of maroon pigment. Gradually the colour is obliterated leaving a uniformly ivory coloured or isabella gray specimen. The chromatophores are perceptible on slight magnification.

**VOICE.** The call is musical, loud and clear. It is somewhat reminiscent of the single notes of *Hyla albosignata* but has the sound of a whistle rather than of a flute. In the Bocaina range, the type, to which the writer listened for several nights, conveyed the impression of a rhythmic sequence of seven notes, owing to the regular nature of the intervals. In the south the notes were *staccato*, repeated and mostly at the same pitch.

**LIFE HISTORY** unknown.

**BEHAVIOUR.** The specimens caught were either found on the ground (type, under a shrub of *Cestrum corymbosum* about 2 ms high), just above water on low hygrophillous vegetation, or slightly higher on shrubs reachable by hand. This preference is probably correlated with the size of the disks, and the shape of the digits and extremities. As already observed by A. Lutz, *Aplastodiscus perviridis* does not climb well like *Hyla*; nor does it seem to have attained the slower method of locomotion by grasping of *Phyllomedusa*. In vivaria it also prefers to remain below.

**ECOLOGY.** *Aplastodiscus perviridis* is montane but not a rain-forest form, which again must be correlated with the structure of the extremities. It lives in more or less open marsh and has also been found in disclimax formation, somewhat overgrown with tall hollow reeds, or shrubs, such as permanently wet or flooded commons and forsaken gardens.

**KNOWN RANGE.** The first specimen was collected on the Serra da Bocaina, where it is evidently rare. This may well be near the northern limit of its range since it has never been found in the northern part of the state of Rio or the mountains beyond the capital. It becomes more abundant further south. A few individuals were heard calling every night spent in the coastal serras of Rio Grande do Sul and of Santa Catarina. Those in the southern part of the latter state belong to the same orographic system as the mountains of northern Rio Grande do Sul, which are practically at the southern end of the mountainous area of Brazil. Northern Santa Catarina and the Serra da Bocaina belong to the Maritime Range, which is not continuous. The ground intermediate between our collecting stations is partly lowland and most of the mountains in between have not been covered by herpetologists. The relatively high latitudes at which *Aplastodiscus perviridis* has been found correspond climatically to somewhat higher altitudes further north. Physiologically they may indicate adaptation, or tolerance, for somewhat lower temperatures.

**RELATIONSHIPS.** The relationships of *Aplastodiscus perviridis* have been discussed at greater length in the introduction. As pointed out, it gives the impression of being related to the medium-sized green *Hyla* from the same coastal sierras. In the northern part of its range it overlaps with what is probably the southern part of the range of *Hyla albosignata*, which is nearest to it in habitus and voice. *Aplastodiscus* has, however, evolved in a different direction as regards locomotion and has become separated from *Hyla* by the structure of the disks, digits, hands and feet. Ecologically it is equally distinct. The *Hyla albosignata* group is sylvan and arboreal. Their disks, digits, hands and feet have the normal structure of the type genus, though some specimens, especially of *H. albofrenata*, show a slight degree of opposition between the 1 and the other fingers. *Aplastodiscus* must have evolved independently of the narrowfingered Hylids with horizontal pupils, from other regions, though on more or less parallel lines. It differs from the slender Australian *Litoria* and the Nearctic *Pseudacris* (Figs. 14, 14a) not only by the geographical distribution but also by the robust habitus. From *Litoria* (Figs. 13, 13a) it is also separated by the shorter and less opposable inner finger and much less webbed feet. It resembles *Pseudacris* in the disproportionately elongate fourth toe, which may be useful for grasping. It differs however, altogether, by the size, and, in degree, by the presence of short webs on the hands and inner toes. *P. (Chorophilus) cuzcanus* COPE, (1877), which is neotropical, montane, olive-coloured and robust, though the type specimen is very minute, may be more closely related to *Aplastodiscus* than to *Pseudacris*, to which it was joined.

*Aplastodiscus* would seem to be intermediate between *Hyla* and *Phyllomedusa*, though nearer to the first. It is more specialized than *Hyla* but has retained the horizontal pupil. Though less evolved as to locomotion and correlated structure of the extremities than *Phyllomedusa*, *Aplastodiscus* approaches it, somewhat, in the totally green

colour, slightly thickened skin, shape of the paws, reduced webs, narrow disks and digits, nature of the callosities on palm, sole and digits, and especially because of the incipient opposability in the hand. Like the Mexican and Central-American *Agalychnis*, which is also intermediate between *Hyla* and *Phyllomedusa*, it is heavy in build. *Agalychnis* is, however, nearer to *Phyllomedusa* than to *Hyla* and has traveled a different road. The pupil is vertical but it has retained more or less full webs and large disks. It was precisely the poor structure of the latter which led A. Lutz to propose the name *Aplastodiscus* for the South-American form.

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