

## The calanoid fauna (Crustacea, Copepoda) of the Cordillera Oriental of the Colombian Andes

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### Abstract

Calanoid copepods belonging to four species and one subspecies from lakes and ponds mainly from the Cordillera Oriental (22) and Cordillera Central (1) of the Colombian Andes are recorded. Most of the water bodies studied are located in the 'páramo' region, between 2996 and 4085 m altitude. The family Boeckellidae is recorded for the first time from Colombia. Taxonomic characteristics of *Boeckella occidentalis* Marsh, 1906, *Boeckella gracilis* (Daday, 1902) and the diaptomid *Prionodiptomus colombiensis* (Thiébaud, 1914) are discussed. A new diaptomid genus, *Colombodiptomus*, with one species and one subspecies are established.

### Introduction

The only freshwater calanoid copepod known from Colombia is *Prionodiptomus colombiensis* (Thiébaud, 1914), collected from a mountain lake (2070 m) in the Cordillera Oriental de Los Andes. It was reported again from the lowland waters of the Caribbean plains (Pearse, 1915; Kiefer, 1956).

The South American species of Diaptomidae were listed by Brandorff (1976), the copepods by Löffler (1981) and Dussart (1983, 1984), without adding any other species from Colombia.

Löffler (1963) suggests that boeckellids could also be present in mountain lakes of Colombia. Other species of diaptomids could also occur in the country.

### Material and methods

Table 1 shows the origin of the different samples and the date of their collection. Material collected

by the author from the littoral regions or the outlets of lakes was taken with a hand-net of 40  $\mu\text{m}$  and from the pelagic zone by vertical hauls with a plankton-net of 200  $\mu\text{m}$  mesh-size. The samples were preserved with 5% formalin.

Animals were stained with bengal rose and dissected in polyvinyl lactophenol using sharpened tungsten needles. Illustrations were made with a drawing tube mounted on a Reichert microscope and with a Reichert lanameter.

Dissected and 70% alcohol preserved specimens were stored in the Naturhistorisches Museum Wien, Austria (NHMW) and in the Instituto de Ciencias Naturales, Museo de Historia Natural, Universidad Nacional de Colombia, Bogotá (ICN-MHN). The remaining specimens form part of the author's collection.

### Description of the study area

The names of the localities studied (Loc.) are given in Table 1 together with physical (altitude,

Table 1. Physical and chemical characteristics of 25 waterbodies in Colombia inhabited by calanoid copepods (localities 24 and 25 from the literature)

No.	Locality	Collector	Date	Elevation (m)	Surface area (ha)	Mean depth (m)	Surface temperature (°C)	Conductivity ( $\mu\text{S cm}^{-1}$ , 20 °C)	pH	Alkalinity (meq)	Total hardness (meq)
<i>Cordillera Oriental</i>											
1	Laguna Corazón Partido, Páramo Sumapaz	Cleef	18.01.73	4085	-	-	-	-	-	-	-
2	Laguna La Guitarra, P. Sumapaz	Cleef	10.01.73	3375	58.00	-	-	-	7.40	-	-
3	Laguna El Sorbedero, P. Sumapaz	Cleef	13.01.73	3460	18.70	-	-	-	-	-	-
4	Laguna El Nevado, P. Sumapaz	Cleef	12.01.73	3485	65.60	-	-	-	-	-	-
5	Laguna La Primavera, P. Sumapaz	Cleef	09.01.73	3535	15.60	-	-	-	-	-	-
6	Laguna Los Tunjos III, Páramo Chisacá	Gaviria	23.06.82	3680	0.55	5.0	16.0	20.0	8.60	1.24	0.388
7	Pond, Páramo Curubital	Gaviria	27.06.84	3650	0.02	0.8	9.0	-	-	0.06	0.062
8	Laguna Bocagrande, P. Curubital	Gaviria	27.06.84	3660	1.80	10.0	6.0	-	-	0.03	0.068
9	Laguna El Rincón, P. Curubital	Gaviria	27.06.84	3730	1.70	12.5	9.0	-	-	0.02	0.020
10	Pond near barrack ruin, P. Chisacá	Gaviria	13.11.83	3500	0.01	0.8	-	16.0	-	0.06	0.140
11	Laguna de Ubaque	Rodriguez	25.04.84	2070	9.60	-	-	87.0	8.10	1.18	1.508
12	Laguna de Chingaza	Gaviria	20.04.83	3250	88.00	17.0	14.8	36.0	7.05	0.40	0.544
13	Pond near Laguna Verde, Páramo de Chuza-Chingaza	Gaviria	20.04.83 25.09.83	3540	0.01	0.8	-	-	-	-	-
14	Chuza Reservoir, P. de Chuza-Chingaza	Gaviria	28.09.83	2996	537.00	90.0	13.5	21.7	7.70	0.26	0.314
15	Laguna de Buitrago, Páramo de Palacio	Cleef	27.04.73	3560	0.81	-	-	-	-	-	-
16	Lake Pozo Azul, P. de Chuza-Chingaza	Gaviria	13.12.83	3380	2.20	5.0	15.8	3.2	6.65	0.06	0.020
17	Pond near Laguna Siecha, Páramo Guasca	Gaviria	29.01.83	3540	0.40	0.4	18.0	3.5	5.70	0.04	0.056
18	Laguna Verde, near Neusa Reservoir	Cleef	19.08.72	3625	12.50	-	-	-	6.10	-	-
19	Lake Tota	Gaviria Arango	09.01.84 08.08.83	3020	5619.00	34.0	15.0	-	-	-	-
20	Laguna Negra Superior, Páramo de la Rusia	Cleef	19.12.72	3775	-	-	-	-	-	-	-
21	Laguna Colorada, Páramo Pisba	Cleef	22.05.73	3420	-	-	-	-	6.10	-	-
22	Laguna Alto de Las Cruces, Páramo Guántiva	Cleef	03.05.73	3725	2.00	-	-	-	6.00	-	-
<i>Cordillera Central</i>											
23	Laguna del Otún	Rodriguez	25.04.83	4050	-	-	-	-	-	-	-
<i>Caribbean Plains</i>											
24	Pool at Fundación	Pearse	15.08.13	200	-	-	-	-	-	-	-
25	Swamp near Barranquilla	Gessner (Kiefer)	14.12.52	200	-	-	-	-	-	-	-

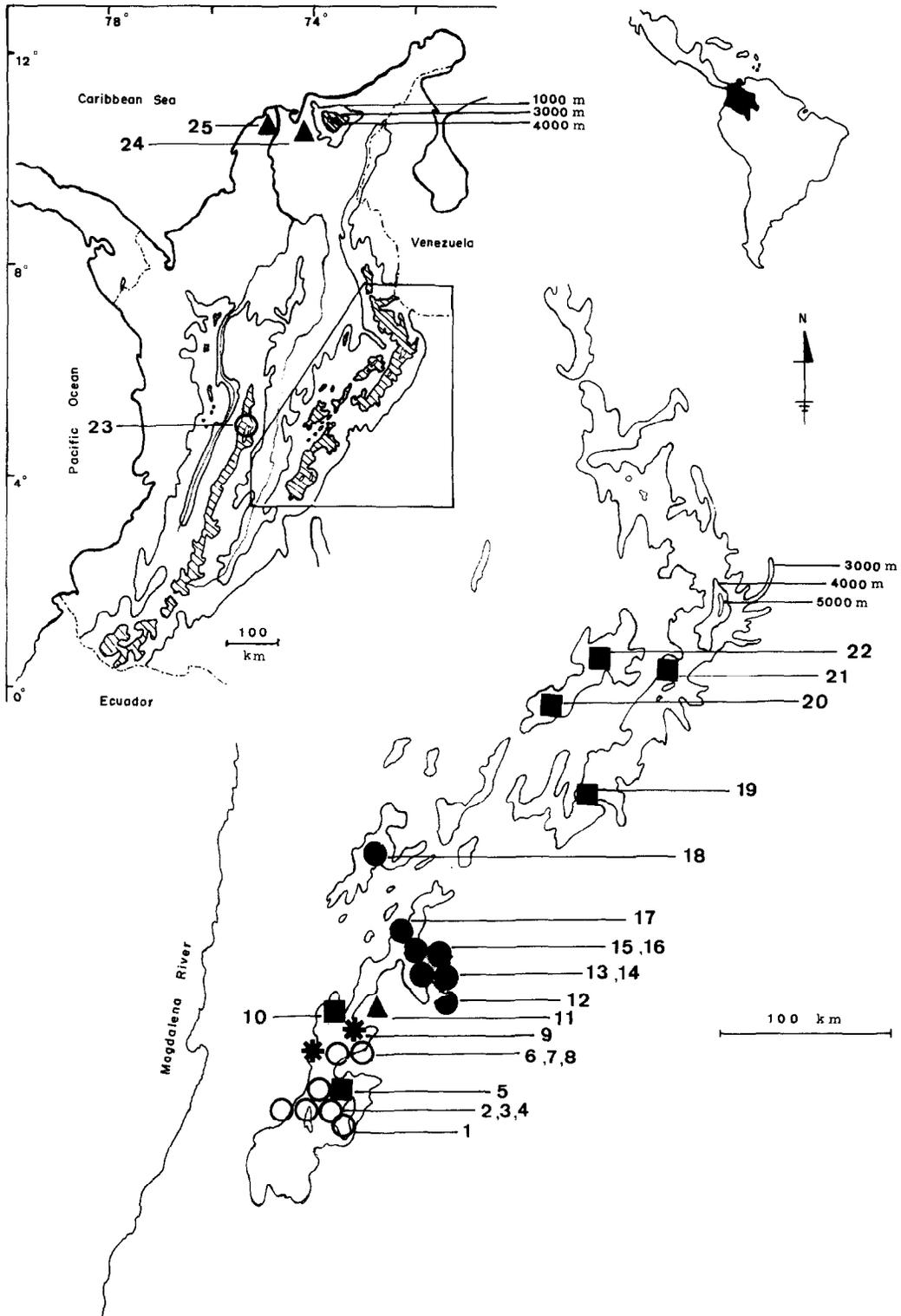


Fig. 1. Location of the sampling sites (names on table 1) and distribution of calanoid species in Colombia ○ *Boeckella occidentalis* ■ *B. gracilis* ▲ *Prionodiaptomus colombiensis* ● *Colombodiaptomus brandorffi* \* *C. brandorffi pilosus*

surface area, mean depth, temperature) and chemical (conductivity, pH, alkalinity, total hardness) characteristics. Fig. 1 shows the location of the water bodies studied and the sampling sites reported in the literature. Samples of some lakes (Lagunas Glaciar 1 and 2 near the Pan de Azucar Peak, L. Cuadrada and L. Pintada in the Valle de Lagunillas, L. Glaciar and L. Grande de La Sierra in the Páramo Cóncavo) of the Sierra Nevada del Cocuy located in the NE of the Cordillera Oriental, collected by Cleef were also examined, but did not contain calanoid copepods.

Except for Laguna de Ubaque and the ponds located in the Caribbean plains, all the sampling sites are situated in the 'páramo' region, a typical high mountain zone of the tropics. In contrast to the climate in the southern 'puna', the 'páramo' climate is humid. Annual precipitation rates vary between 700 and 3000 mm, mean annual temperatures in the 'páramo' belt vary between 13–14 °C and 0 °C (Cleef, 1981).

## Results

### List of species found

#### Family Diaptomidae

*Colombodiaptomus brandorffi* n.g., n.sp.

*C. brandorffi pilosa* n.ssp.

*Prionodiaptomus colombiensis* (Thiébaud, 1914)

#### Family Boeckellidae

*Boeckella occidentalis* Marsh, 1906

*B. gracilis* (Daday, 1902)

## Taxonomy

### *Colombodiaptomus* n.g.

The differences from the other genera of american diaptomids and from the species of 'Diaptomus' which are not placed in any genus are the following:

*Male*: right 1st antenna with spines on segments 8, 10, 11, 12 and 13. Presence of a spine on

segment 12 and the reduced size of that on segment 8 differentiates the new genus from *Leptodiaptomus* (Light, 1938), lack of spines on segments 15 and 16 and presence of one on segment 12, from *Notodiaptomus* (Kiefer, 1936). Antepenultimate segment without hyaline lamella and without process, either one or the other structure present on *Leptodiaptomus*, the latter in contrast to *Dactyloidiaptomus* (Wright, 1927), only known species of the genus, and to *Rhacodiaptomus* (both genera, Kiefer, op. cit.). Left exopodite of 5th leg ending in two digitiform processes, the distal one longer and with a spinous pad, the proximal one distinctly separated from segment. The presence of two digitiform processes agrees with *Dactyloidiaptomus* and *Leptodiaptomus*. Their shape differs greatly, particularly from the former, their armature differs from both. Basipodite of right 5th leg with smooth surface, in contrast to *Argyrodiaptomus* (Kiefer, op. cit.), *Notodiaptomus* and *Pectenodiaptomus* (Dussart, 1982), and without any processes, in contrast to all South American genera.

*Female*: last thoracic segment posteriorly produces asymmetric protuberances on both sides, each one with 3 spines.

*Etymology*: the prefix 'Colombo' refers to the country (Colombia) where it has been collected.

*Colombodiaptomus brandorffi* n.g., n.sp.

(Plate 1: figs. A–N; plate 2: figs. A–G)

*Material examined*: 142 males and 59 females from the following localities in the Cordillera Oriental (holotype: 1 male; allotype: 1 female; all other specimens from type-locality and from other localities are paratypes): 1) Lake Pozo Azul, type-locality, Páramo de Chingaza (Loc. 16), State of Cundinamarca, 4° 39' 39" N, 73° 44' 46" W. Dissected on slides: 1 male, holotype (NHMW 5979), 3 males (NHMW 5980–5982), 6 males; 1 female, allotype (NHMW 5983), 3 females (NHMW 5984–5986), 4 females. Alcohol preserved: 20 males (NHMW 5987), 10 males (ICN-MHN-CR-001). Formalin preserved: 10

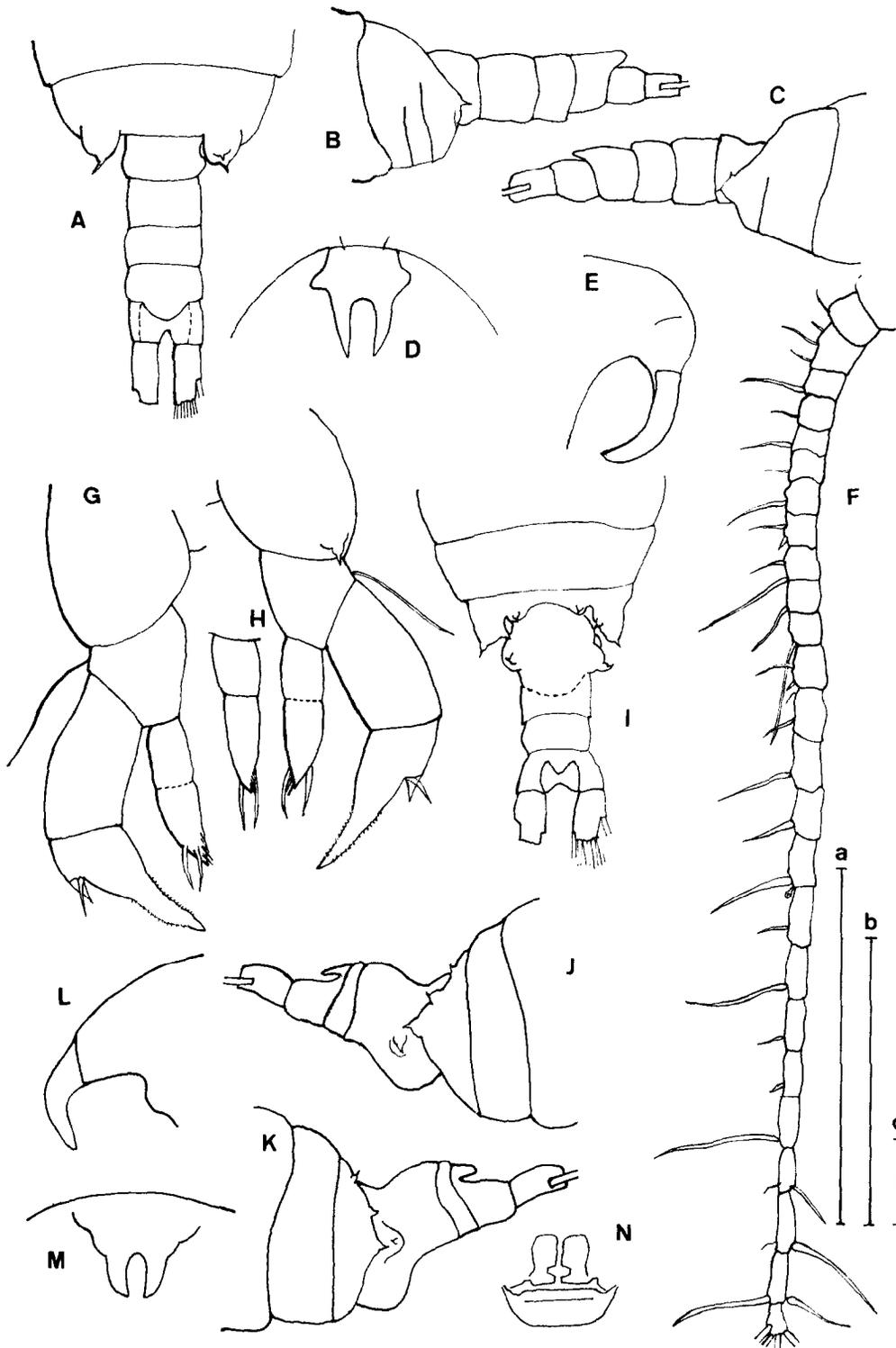


Plate 1. *Colombodiaptomus brandorffi* n.sp. (figs. A-E: ♂, holotype, figs. F-N: ♀, allotype) A; last thoracic segment and abdomen, dorsal; B, same, left side; C; same, right side; D, rostrum, ventral; E, rostrum, lateral; F, antenna 1; G, right leg 5, anterior; H, right leg 5 and left endopodite, posterior; I, Posterior part of thorax and abdomen, dorsal; J, same, right side; K, same, left side; L, rostrum, lateral; M, rostrum, ventral; N, genital operculum. Scale a - fig. L; scale b - figs. D, E, G, H, M, N; scale c - figs. A-C, F, I-K; each scale = 100  $\mu$ m.

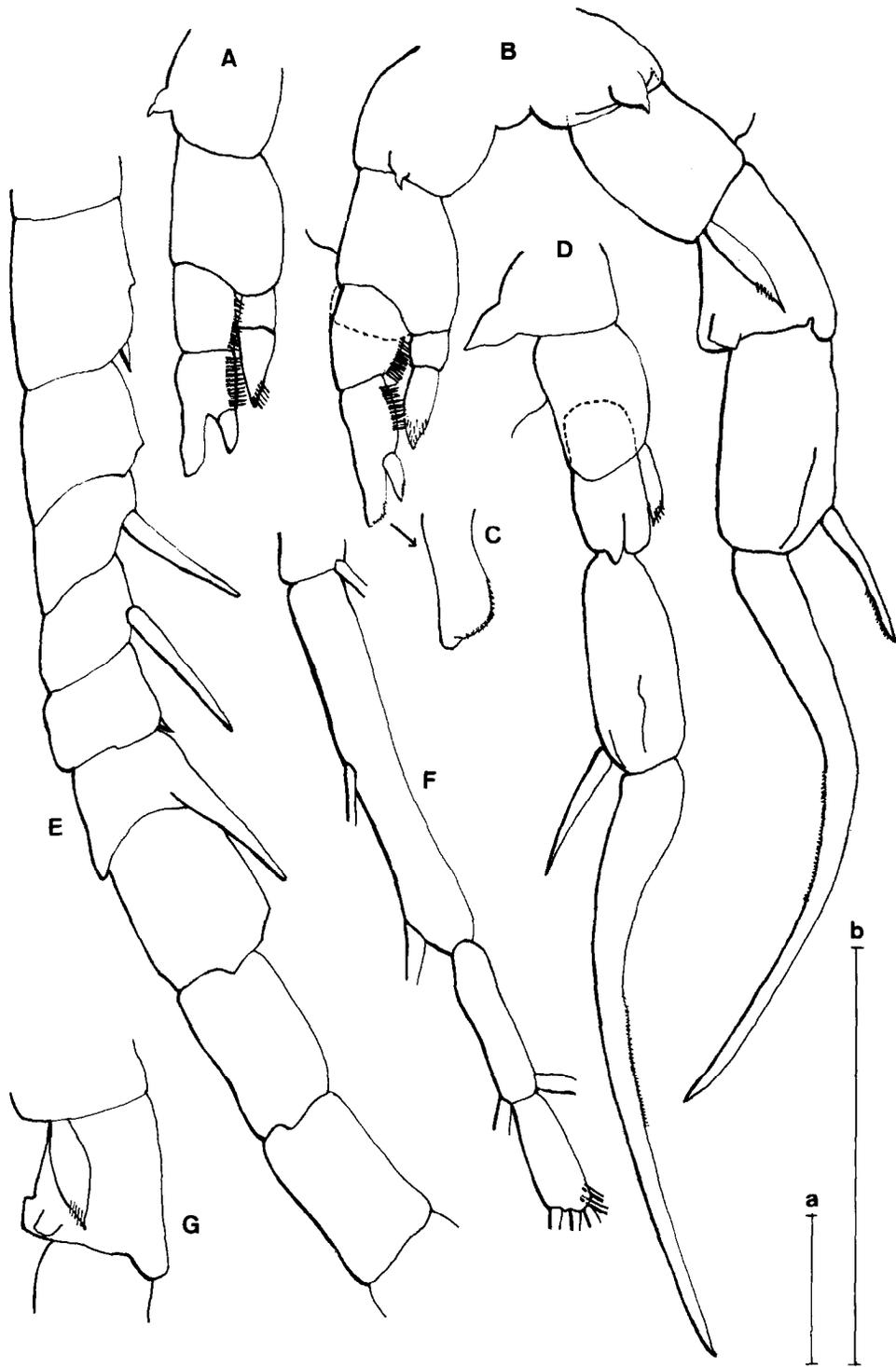


Plate 2. *Colombodiaptomus brandorffi* n.sp. (figs. A-F: ♂, holotype, fig. G: one ♂ from Loc. 17) A, left leg 5, lateral; B, leg 5, posterior; C, left leg 5, longer process of 2nd exopodite segment; D, right leg 5, lateral; E, right antenna 1, segments 8-16; F, same, last 3 segments; G, right leg 5, 1st exopodite segment. Scale a - figs. A, B, D-G; scale b - fig. C; each scale = 50  $\mu$ m.

males. 2) Loc. 18. Dissected on slides: 2 males (NHMW 5988, 5989), 2 males, 1 female (NHMW 5990). 3) Loc. 17. Dissected on slides: 2 males (NHMW 5991, 5992), 2 females (NHMW 5993, 5994), 5 males, 3 females. Alcohol preserved: 10 males (NHMW 5995), 4 males (ICN-MHN-CR-002), 6 females (ICN-MHN-CR-003) Formalin preserved: 5 males. 4) Loc. 14. Dissected on slides: 1 male (NHMW 5996), 2 females (NHMW 5997, 5998), 3 males, 5 females. Alcohol preserved: 8 males and 3 females (NHMW 5999). Formalin preserved: 8 males. 5) Loc. 13: 20.04.1983. Dissected on slides: 2 males (NHMW 6000, 6001), 1 female (NHMW 6002), 1 male, 2 females. Alcohol preserved: 7 males and 7 females (NHMW 6003). 25.09.1983. Dissected on slides: 2 males (NHMW 6004, 6005), 1 female (NHMW 6006), 1 male, 2 females. Alcohol preserved: 7 males and 7 females (NHMW 6003). 6) Loc. 15. Dissected on slides: 2 males (NHMW 6007, 6008), 1 female (NHMW 6009), 1 male, 1 female. Alcohol preserved: 7 males and 6 females (NHMW 6010). 7) Loc. 12. Dissected on slides: 1 male (NHMW 6011), 5 males. Alcohol preserved: 6 males (NHMW 6012).

#### *Description*

*Male*: total length: 1344  $\mu\text{m}$  (holotype).

Rostral points very well developed, curved backwards. Suture between 4th and 5th thoracic segments dorsally incomplete. Last *thoracic* segment posterolaterally produced into 2 asymmetrical protuberances, right one slightly larger; both terminate in a medium-sized spine, left spine more acute; dorsolateral margin of the right protuberance with a second, smaller spine (better to observe in lateral view).

*Abdomen* 5-segmented. Posterolateral part of the genital segment slightly expanded, right expansion larger than left, both without spines. Caudal rami without hairs.

*Right 1st antenna* with spines on segments 8, 10, 11, 12 and 13, those on segments 8 and 12 small, both 1/7 length of spine on segment 11; spine on segment 10 shorter than spine on segment 11, both directed obliquely outwards from axis of

antenna, the former more erect than the latter; spine on segment 13 more inclined than the others, without basal articulation, its base twice as broad as those of spines on segment 10 and 11. Antepenultimate segment without hyaline membrane.

*Right 5th leg*: posterior surface of coxopodite with a bulge ending in a relatively big spine located near to the outer margin (easier to recognize in lateral view). Distal margin slightly expanded over the following segment. Basipodite almost 1.5 x longer than wide, bearing a seta on the outer margin. Distal inner corner of 1st exopodite segment produced into a lobe, which bears a square hyaline lamella on its posterior surface; distal margin of segment with a narrow concavity near the outer corner. 2nd exopodite segment with a large lateral spine located at distal quarter of outer margin and as long as the width of the segment; lateral spine with short hairs on its distal third; anterior and posterior surfaces of segment with a fold. Base of terminal claw half as wide as 2nd segment; claw with basal section straight, then recurved inwards, its concave border with a row of fine hairs. Endopodite 1-segmented, reaching almost the distal margin of 1st exopodite segment, pointed at the end, bearing a subterminal row of short hairs.

*Left 5th leg* much shorter than right, not reaching midlength of its 2nd exopodite segment. Coxopodite as long as wide, with a small bulge bearing at the end a short spine (bulge much smaller than right leg). Basipodite distally broader, bearing a fine seta on outer margin. Exopodite 2-segmented, inner margin of both segments with a thick row of hairs; 2nd segment with two terminal digitiform processes, the inner one shorter, clearly delimited at its base and with subterminal row of short hairs, the outer continuous with segment and bearing on inner margin almost terminally a pad armed with little spines. Endopodite 2-segmented, almost reaching the base of shorter process of exopodite; 2nd segment pointed, bearing fine hairs on its distal third.

*Female*: total length: 1256  $\mu\text{m}$  (allotype).

Rostral points smaller than in the male. Suture

between 4th and 5th thoracic segments complete. 5th *thoracic* segment produced on each side into 2 asymmetric short wings, left one broader than right one, each one with 3 spines: outer spine of right wing much larger than middle one; outer spine of left wing just a little larger than middle one; inner spine of both wings smaller than the others, located on the proximal and dorsolateral part of the wings.

*Abdomen* 3-segmented. Genital segment asymmetric, ventral and lateral margins strongly produced anteriorly, right expansion with strong lateral spine directed anteriorly, left expansion with small spine located dorsolaterally. Form of genital operculum see on pl. 1, fig. N. Middle abdominal segment short. Caudal rami without hairs.

*1st antenna* with 25 segments, reaching past the caudal rami, but not the end of caudal setae; segments 10, 11 and 13–21 each with one seta, segment 8 with one seta and one small spine, segment 9 with two setae, segment 12 with two setae and one small spine.

*5th legs* with symmetric exopodites. Coxopodite with posterior process located on outer distal angle, tipped with posteriorly directed stout spine (easier to recognize in lateral view). Outer distal angle of basipodite with long, thin seta. 1st exopodite segment 2 x longer than broad. Both margins of distal half of terminal claw of 2nd exopodite segment bearing very short hairs. 3rd exopodite segment consists of one stout spine and one seta, the latter 1.5 x longer than the former. Endopodites slightly asymmetrical; left one 2-segmented, right one indistinctly 2-segmented; both endopodites (without setae) reaching to the base of terminal claw of exopodites, with pointed apical section directed backwards, bearing fine hairs on inner margin; with 2 subapical setae inserted in anterior surface, setae 0.5 x the length of left 2nd endopodite segment.

#### Variations

*C. brandorffi* was found in 7 different localities in Colombia. In order to study the morphological variability of the species, 142 males and 59 females

were measured; 36 males and 32 females were dissected on slides.

The largest adult specimens were found at Loc. 17, the smallest at Loc. 18. The mean length of males is 1251  $\mu\text{m}$  (944–1464  $\mu\text{m}$ ), of females 1379  $\mu\text{m}$  (1216–1636  $\mu\text{m}$ ).

*Male* specimens from the type-locality show differences in several details: length of spine on segment 8 of right 1st antenna varies between 1/7 and 1/2 of the length of spine on segment 11; length of right endopodite of 5th leg varies between 3/4 and the total length of 1st exopodite segment, its apical margin may be more or less pointed; in some specimens left endopodite of 5th leg does not reach the base of the small digital process of exopodite, in others it reaches well past it; lobe of 1st exopodite segment of 5th right leg can be small or large, its hyaline lamella square-shaped or rounded.

Male specimens from other localities differ from the holotype in the following details: spine on segment 12 on right 1st antenna longer than spine on segment 8, being 1/3 (2 specimens) and 1/4 (several specimens) of length of spine on segment 11 (animals from Loc. 13). Specimens from Loc. 14 and 17 with larger lobe in inner distal corner of 1st exopodite segment of 5th leg, forming almost a straight angle with the margin (see pl. 2, fig. G); in specimens from Loc. 13 this angle is more obtuse. Endopodite of same leg varies in size: in some animals from Loc. 13 it is smaller than half of 1st exopodite segment of 5th leg; in others, reaching its distal margin, as in holotype; in specimens from Loc. 14 it varies from just a little longer than half of 1st exopodite segment to past its distal margin. Endopodite of left 5th leg also varies in size: in the specimens from Loc. 12 it reaches over the middle of 2nd exopodite segment (without processes) of the same leg, in animals from all other localities it reaches the base of the small digital process of 2nd exopodite segment.

Within the *females* from the type-locality exist only variations in the morphology of the 5th leg: 1st endopodite segment of the left leg distinctly (like on allotype) or indistinctly separated from 2nd endopodite segment. On right leg, endopodite

always indistinctly 2-segmented, sometimes the suture between segments almost not recognizable. In some specimens, setae of both endopodites shorter than in the allotype (1/3 of the length of 2nd endopodite segment), in others one of the setae shorter than the other (relation 2:3).

Female specimens from the other localities also show variations in the morphology of the 5th leg: some specimens from Loc. 15 and 17 vary in segmentation of both endopodites like females from type-locality; in one animal from Loc. 13, right endopodite distinctly one-segmented. Specimens from Loc. 13, 15 and 17 show differences in size between setae of endopodites; in those from last pond, length of longer seta between 1/2 and the total length of 2nd endopodite segment. Specimens from Loc. 15 with seta of 3rd exopodite segment just a little longer than spine, in specimens from all other localities 1.5 x longer than spine.

#### *Brief diagnosis*

*Male*: right first antenna with spines on segments 8, 10, 11, 12 and 13; antepenultimate segment without hyaline membrane and process. Right protuberance of last thoracic segment slightly larger than left one, each ending in a midsize spine, the left one more acute; right protuberance dorsally with second small spine. Exopodite of left 5th leg 2-segmented, last segment ending in two digitiform processes, the longer one with a spinous pad, the short one distinctly separated from segment, bearing short hairs at its distal inner margin; both segments with row of hairs on inner margin.

*Female*: 5th thoracic segment distally produced into 2 short asymmetric wings, left one broader, each one with 3 spines. Genital segment asymmetrical, anterior part of ventral margin strongly produced, with large lateral expansions anteriorly located, right one with big spine directed forward, left one with small spine located dorsolaterally. Caudal rami without hairs.

*Etymology*: the new species is named in honour of Dr. Gerd-Oltmann Brandorff, in recognition of

his valuable contribution to the study of South American diaptomids.

#### *Remarks*

*C. brandorffi* shows more affinities with the North American genus *Leptodiaptomus*, which extends south to El Salvador (Marsh, 1931), than with South American or West Indian diaptomids. Males of *C. brandorffi* resemble *Leptodiaptomus siciloides* (Lilljeborg, 1889) in having a similar shape of the basipodite of the right 5th leg, in the possession of a square-shaped hyaline lamella on the distal portion of inner margin of 1st exopodite segment of same leg, in the presence of 2 distal processes on 2nd exopodite segment of left 5th leg (however, with different shape and armature) and in the distribution of the spines on 1st right antenna. They differ from species of *Leptodiaptomus* in the absence of a hyaline lamella or a process on the antepenultimate segment of this antenna and in the shape and size of the lateral spine of 2nd exopodite segment of right 5th leg.

Females resemble species of *Leptodiaptomus* in having the exopodite 3 of 5th leg represented by only one seta and one spine; they differ especially in the armature of the last thoracic segment.

It may be identified by a combination of distinguishing characters: the shape and armature of last thoracic and genital segment, the structure of 5th leg on both sexes, and the armature of right 1st antenna on males. The most striking characteristic in the male is the shape of both processes of the left exopodite of 5th leg, particularly the spinous pad of the longer one; in the female, the shape of last thoracic and genital segments.

#### *Distribution*

The species is distributed on the central region of Colombian Cordillera Oriental (fig. 1), between 2900 and 3700 m altitude: all 'Páramos' where this species was collected are located in the State of Cundinamarca: P. de Chuza-Chingaza (Loc. 12, 13, 14, 16), P. de Palacio (Loc. 15), P. de Guasca (Loc. 17) and Páramo NW of Neusa reservoir (Loc. 18).

The range of temperature of the water bodies where the species was found is between

14–18 °C; the lakes should have a warm polymictic type of circulation with several stratification periods (Löffler, 1968), as it has been observed in the Chuza reservoir (Gaviria, 1984). Ponds have thermostatic conditions due to their shallow morphology. All water bodies studied have low conductivity and alkalinity (table 1).

*Colombodiaptomus brandorffi pilosus* n.ssp.

(Plate 3; figs. A–C)

**Material examined:** 13 males and 16 females from 2 localities in the cordillera Oriental (holotype: 1 female; allotype: 1 male; all others are paratypes): 1) Laguna de Los Tunjos III (Chisacá lakes), type-locality, Páramo de Chisacá (Loc. 6), State of Cundinamarca, 4° 18' 03" N, 74° 12' 19" W). Dissected on slides: 1 female, holotype (NHMW 6013), 1 male, allotype (NHMW 6014), 3 females (NHMW 6015–6017), 2 males (NHMW 6018, 6019), 4 females, 5 males. Alcohol preserved: 7 females and 5 males (NHMW 6020). 2) Laguna El Rincón (Loc. 9). Dissected on slide: 1 female (NHMW 6021).

Female specimens from Loc. 6 and 9 show considerable differences from those of *C. bran-*

*dorffi*, so that it is reasonable to describe them as a new subspecies. Male specimens only differ in size (total length of allotype: 1248 µm, mean length (13): 1325 µm, range: 1168–1464 µm). Males are 8% larger than those of *C. brandorffi*, females 6%.

**Description**

**Female:** total length: 1536 µm (holotype), mean length (16): 1439 µm, range: 1357–1536 µm.

Both spines on expansions of genital segment equal in size, both laterally inserted. In *C. brandorffi* left spine very small and latero-dorsally inserted. Distal half of inner margin of caudal rami with hairs; in *C. brandorffi* caudal rami without hairs. The other characters are the same as in female of *C. brandorffi*.

**Etymology:** the subspecies epithet is derived from the latin term 'pilosus', meaning 'covered with hair', due to the hairy inner margin of the caudal rami of the female.

**Distribution**

The subspecies has been found only in 2 small lakes located in the SW of the Cordillera Oriental (fig. 1), in Páramo de Chisacá and P. de Curubital, between 3680 and 3730 m altitude. In both lakes, *C. brandorffi pilosus* was the only calanoid found.

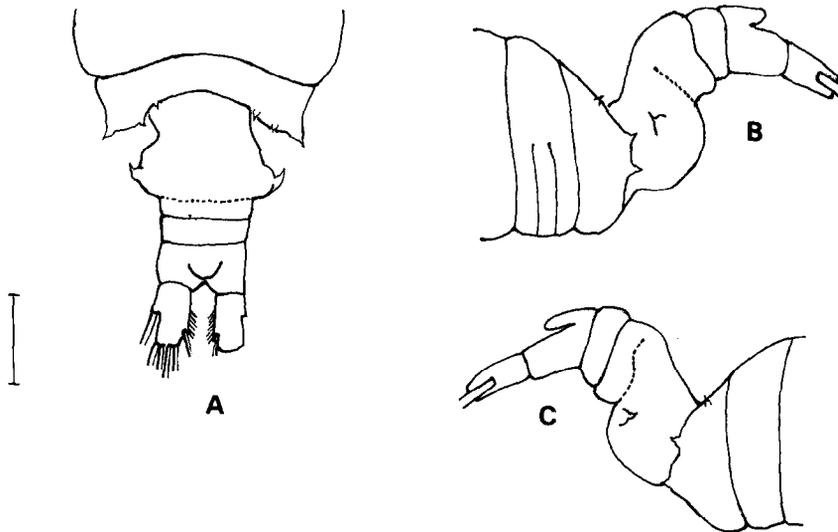


Plate 3. *Colombodiaptomus brandorffi pilosus* n.ssp. (♀, holotype) A, last thoracic segments and abdomen, dorsal; B, same, left side; C, same, right side. Scale = 100 µm.

*Prionodiptomus colombiensis* (Thiébaud, 1914)

(Plate 4; figs. A–K)

*Diptomus colombiensis* Thiébaud, 1914: 162; figs. 1–5;*Diptomus marshi* Marsh, 1913: 10, pl. 3, figs. 1–5; Juday, 1914; 803, figs. 1–2; Pearse, 1915: 540; Marsh, 1919: 545–546; Dodds, 1926: 24; Wright, 1927: 76–77, figs. 7–9; Marsh, 1931: 208–209;'*Diptomus*' *colombiensis* Kiefer, 1936: 309; Kiefer, 1956: 243–244, figs. 19–24; Herbst, 1960: 27–28, figs. 1–2; *Diptomus* (*Prionodiptomus*) *marshi* Light, 1939: 481, figs. 13, 16, 17, 23;*Diptomus* (*Prionodiptomus*) *colombiensis* Wilson Yeatman, 1959: 775–776, figs. 29, 58;*Prionodiptomus colombiensis* Brandorff, 1976: 617–618.

*Material examined*: from Laguna de Ubaque, Cundinamarca (Loc. 11). All specimens examined are topotypes. Dissected on slides: 3 males (NHMW 6022–6024), 2 females (NHMW 6025, 6026), 6 males and 3 females. Alcohol preserved: 10 males and 5 females (NHMW 6027).

*Completion of the original description*

*Male*: greatest body width at 2nd thoracic segment. Suture between head and 1st thoracic segment, and between 4th and 5th thoracic segment complete. Abdomen posteriorly away from 4th segment turned to the right; 2nd segment rather longer than others. Inner margin of caudal rami hairy. Segments 13 to 17 of right 1st antenna broad; segments 8, 10–13, 15 and 16 each with one spine, longest spine on segment 11, smallest on 12, spines on segments 10 and 11 with blunt tip, those on 15 and 16 without articulation with segment.

Right 5th leg: inner margin of basipodite trapeze-like, slightly turned backward (easier to see in lateral view); outer margin of basipodite with one hair inserted distally. Lateral spine of 2nd exopodite segment longer than segment, with stout teeth on concave margin. Endopodite single-segmented, small and rounded, completely covered by the inner corner of the basipodite.

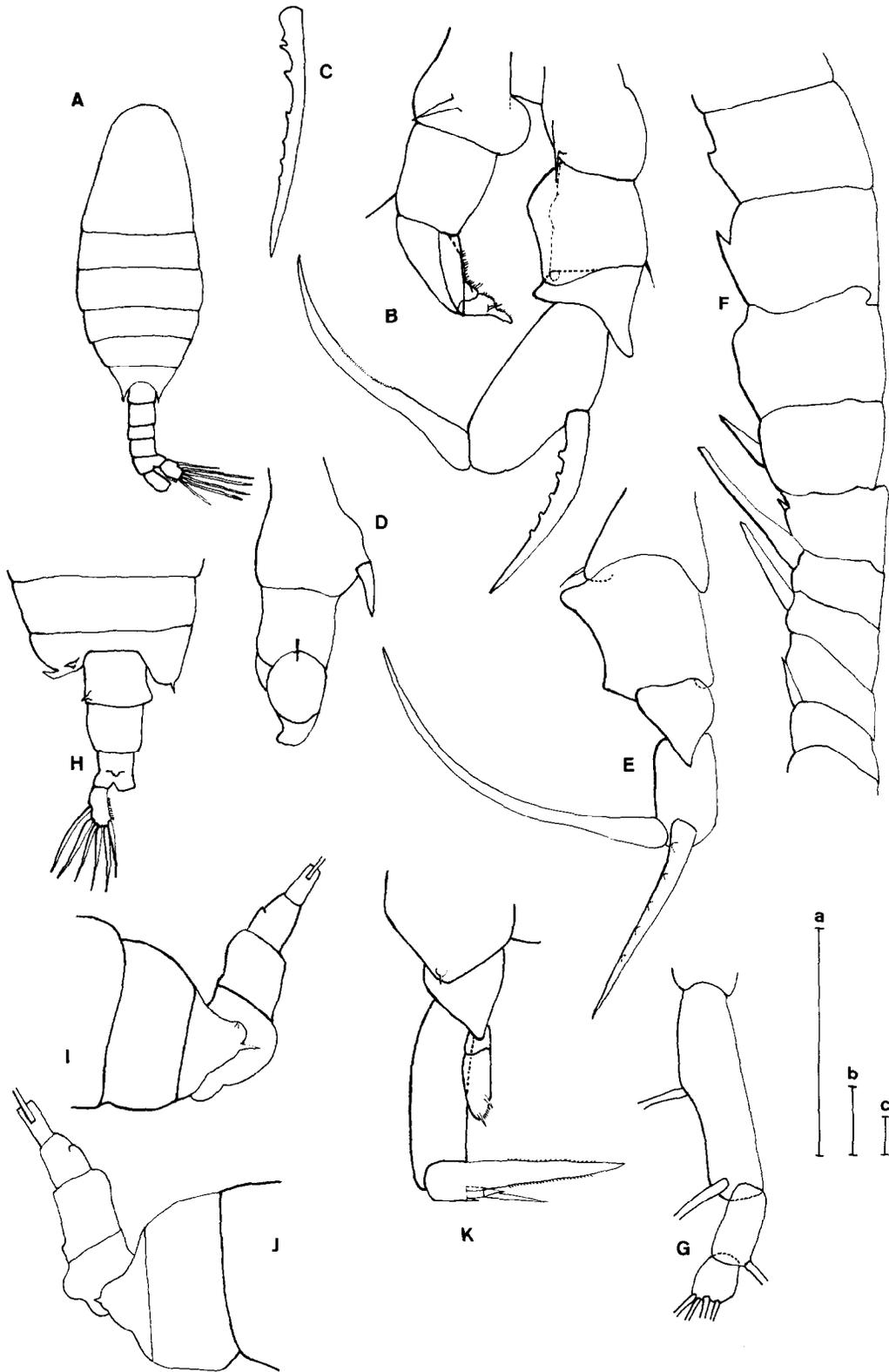
Basipodite segment of left 5th leg with hair inserted on distal outer margin. Inner margin of 1st exopodite segment with a row of hairs. 2nd exopodite segment ending in digitiform process with short hairs on its convex margin; distal inner margin of segment with pad bearing short hairs; slender spine inserted near the midlength on posterior face of the segment.

*Female*: 1st and 2nd abdominal segments equal in length; 1st segment with lateral spine inserted on distal left margin, distal right margin slightly expanded. Inner margin of caudal rami hairy.

5th legs symmetric; 2nd half of coxopodite decreasing in width distally, distal margin partially overlapping basipodite, bearing a spine on posterior face. Coxopodite proximally broad, with distal margin forming a lobe. Exopodite 3-segmented, 2nd exopodite segment (including terminal claw) equal in length to 1st exopodite segment. 3rd exopodite segment rather longer than broad, with 2 spines, the longer one reaching until midlength of terminal claw, the shorter 1/3 of the longest. Endopodite 2-segmented.

*Variations*

*Male*: the mean length (including caudal setae) of 19 measured specimens is 1298  $\mu\text{m}$  (1184–1404  $\mu\text{m}$ ). Thiébaud (1914) found 1400  $\mu\text{m}$ , Wilson & Yeatman (1959) gave a value of 1150  $\mu\text{m}$ ; both values correspond with the observed range. Variations were found in the number of teeth on the lateral spine of 2nd exopodite segment of 5th right leg. Original description: 5; present collection: 8 (3 specimens), 7 (1) and 6 (5); from Barranquilla's pond (Kiefer, 1956): 5; from Nicaragua (Herbst, 1960): 7; from Guatemala: 5 (Wright, 1927), 3–6 (Juday, 1914); from Panamá (Marsh, 1913): 5–7. In the original description like in most of the studied specimens, the largest tooth is located near the base of the spine (pl. 4, fig. B); however, in 2 specimens the 2nd tooth was the largest (pl. 4, fig. C), in one specimen the 3rd, like in Marsh's illustration (op. cit.). The trapeze-like process of the basipodite of 5th right leg varies in size. Left 5th leg reaching to the end of 1st exopodite seg-



*Plate 4. Prionodiptomus colombiensis*

(figs. A-G: ♂, figs. H-K: ♀) A, habitus, dorsal; B, leg 5, posterior; C, right leg 5, lateral spine of 2nd exopodite segment, from other specimen; D, left leg 5, lateral; E, right leg 5, lateral; F, right antenna 1, segments 8-16; G, same, last 3 segments; H, last thoracic segments and abdomen, dorsal; I, same, left side; J, same, right side; K, leg 5, posterior. Scale a - figs. B-G, K; scale b - figs. H-J; scale c - fig. A: each scale = 100  $\mu$ m.

ment of right 5th leg; in the description from Thiébaud (1914) just reaches the end of the basipodite of 5th right leg; 2nd exopodite segment bearing one (topotypic material and Kiefer, 1956) or two (Thiébaud, op. cit.) slender spines. In contrast to Kiefer (op. cit.), antepenultimate segment of the right 1st antenna without hyaline lamella (original description and topotypic material). In specimens from Barranquilla, spine on segment 16 of same antenna larger than spine on 15, in specimens from Laguna de Ubaque reversely.

*Female*: the mean length (including caudal setae) of 15 measured specimens is 1362  $\mu\text{m}$  (1232–1552  $\mu\text{m}$ ). Thiébaud (1914) measured lengths of 1500–1700  $\mu\text{m}$ ; Wilson & Yeatman (1959) gave a value of 1300  $\mu\text{m}$ . Specimens from Barranquilla's pond (Kiefer, op. cit.) show the following differences to those from Laguna de Ubaque of the present collection: right wing of last thoracic segment with a second spine; abdomen 2-segmented; genital segment with spine on right margin; 2nd exopodite segment of 5th leg without hyaline spine near the base of 3rd exopodite segment; endopodite single-segmented, as in Wright's (1927) specimens from Guatemala and Thiébaud's (op. cit.) specimens from Laguna de Ubaque; Wright's specimens from Panama have this endopodite 2-segmented like those from the present collection.

#### *Brief diagnosis*

*Male*: coxopodite of both 5th legs with one spine; inner margin of basipodite of right 5th leg with trapeze-like process, 1st exopodite segment with acute distal corners, lateral spine of 2nd exopodite segment inserted in the middle of outer margin, with 3–8 teeth; 2nd exopodite segment of left 5th leg with hairy pad on distal inner margin, terminal digitiform process hairy on inner margin and 1–2 slender spines inserted on the middle length.

*Female*: last thoracic segment with asymmetric wings, left one broader and with 2 spines, right one with 1–2 spines. Abdomen 2- or 3-segmented; left distal margin of genital segment with one spine; right distal margin slightly produced, with

or without spine. 1st exopodite segmented of 5th leg 3 x longer than broad; 2nd exopodite segment with hyaline spine near the base of 3rd exopodite segment; 3rd exopodite segment with 2 spines, the longer reaching the midlength of claw; endopodite 1- or 2-segmented, reaching up to 2/3 of the length of 1st exopodite segment.

#### *Distribution*

*P. colombiensis* is known from the following countries of Central America and the northeast of South America: Nicaragua (Herbst, 1960), El Salvador (Marsh, 1931), Honduras (Marsh, 1919), Guatemala (Juday, 1914), Panama (Marsh, 1913; Dodds, 1926), Venezuela (Dussart, 1984) and Colombia (Thiébaud, 1914; Pearse, 1915; Kiefer, 1956). It has been found between sea level and 2070 m of altitude (fig. 1), the latter corresponding to the type-locality in the Colombian Andes (and not 2800 m as it was erroneously reported by Thiébaud).

Little is known about its ecology. The water of the Laguna de Ubaque has a low conductivity and a pH value of 8.4 (table 1).

#### *Boeckella occidentalis* Marsh, 1906

(Plate 5: figs. A–Q)

*Boeckella occidentalis* Marsh, 1906; 179–183, pl. 18, figs. 1, 3–6; Brehm, 1924: 15–20, figs. 20–26; Marsh, 1924; 11, fig. 15; Harding, 1955: 223–230, figs. 7–12; Löffler, 1955: 734–739, figs. 20–29; Kiefer, 1957: 128–130, figs. 1–5; Löffler, 1963: 207–208, fig. 7a; *Pseudoboeckella godeti* Delachaux, 1928: 50–51, figs. 2–9.

*Material examined*: from several localities from the Cordillera Oriental and one locality from the Cordillera Central: 1) Loc. 3. Dissected on slides: 1 male (NHMW 6028), 1 female (NHMW 6029), 6 males, 1 female. Alcohol preserved: 9 males and 5 females (NHMW 6030). Formalin preserved: 24 males, 5 females. 2) Loc. 4. Dissected on slides: 1 male (NHMW 6031), 1 female (NHMW

6032), 3 males, 3 females. Alcohol preserved: 10 males and 10 females (NHMW 6033). Formalin preserved: 10 males, 25 females. 3) Loc. 5. Dissected on slides: 4 females. 4) Loc. 2. Dissected on slides: 1 male. Formalin preserved: 1 male. 5) Loc. 1. Dissected on slides: 2 males. Formalin preserved; 12 males. 6) Loc. 7. Dissected on slides: 2 males. Formalin preserved: 8 males. 7) Loc. 8. Dissected on slides: 2 males. 8) Loc. 23. Material found in stomach content of *Salmo gairdneri*. Dissected on slides: 3 males, 3 females.

The original description made by Marsh (1906) was extended by Brehm (1924), Delachaux (1928) and Löffler (1955). Here some new morphological details and variations of the Colombian specimens are reported.

**Male:** the mean length (without caudal setae) of 95 measured specimen from 8 sampling sites is  $143\ \mu\text{m}$  ( $1080\text{--}1624\ \mu\text{m}$ ) specimens. Differences in length are relatively large in both sexes, but smaller than in specimens from Peru (Löffler, 1955). Values given by other authors are:  $1430\ \mu\text{m}$  (Marsh),  $1410\ \mu\text{m}$  (Delachaux),  $900\text{--}1740\ \mu\text{m}$  (Löffler),  $1400\text{--}1800\ \mu\text{m}$  (Kiefer),  $850\text{--}1800\ \mu\text{m}$  (Harding). Including caudal setae, Colombian animals have a mean length of  $1769\ \mu\text{m}$  ( $1368\text{--}1976\ \mu\text{m}$ ).

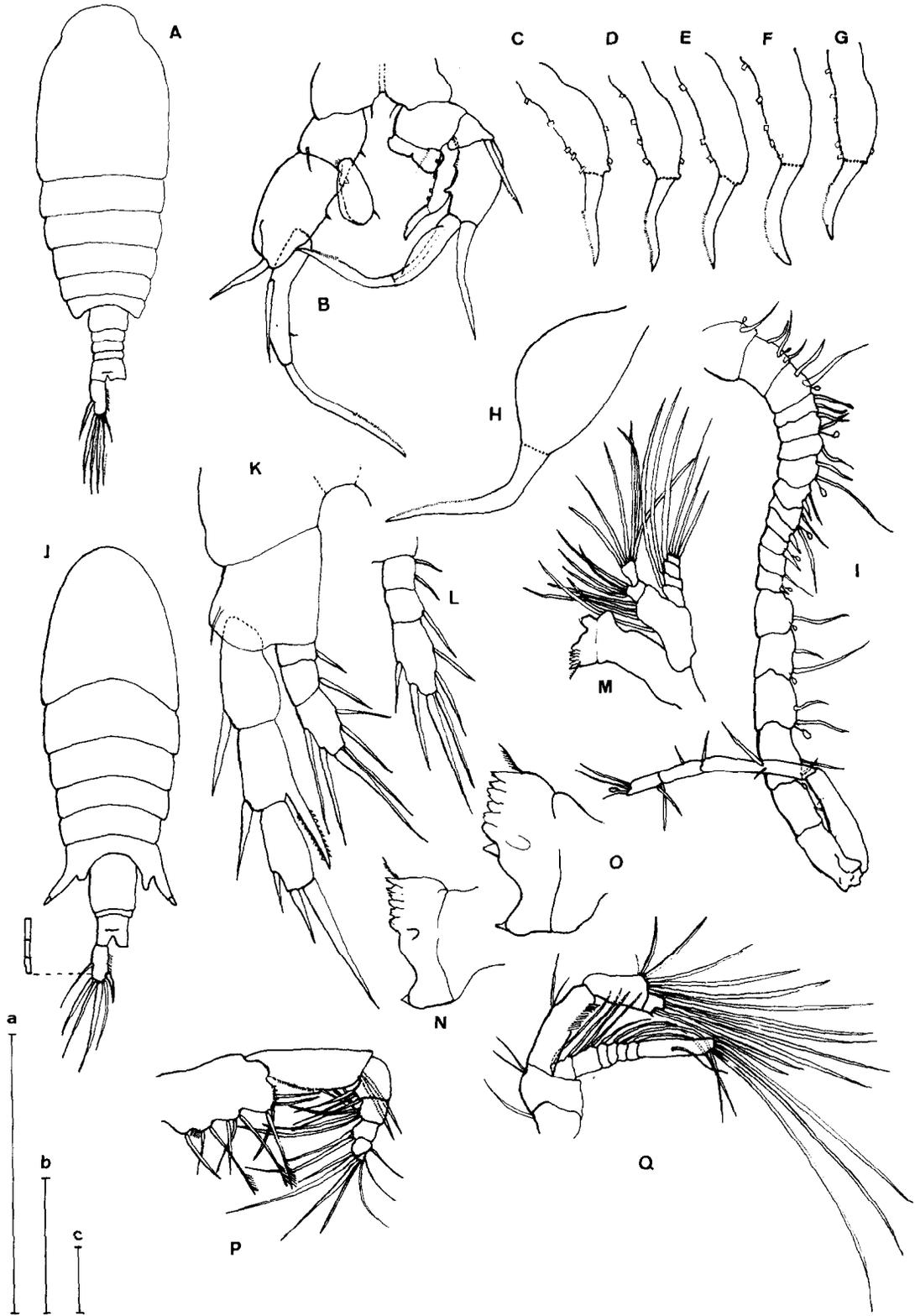
Body with short, sparsely distributed hairs; greatest body width at the end of cephalic segment, anterior lateral part of this segment slightly compressed, cephalic segment longer than 5 thoracic segments together. Distribution of aesthetascs on both 1st antennae agree with Löffler (1955).

The 5th legs of the Colombian specimens show variations of the following characteristics: right leg: inner margin of coxopodite and basipodite with one seta (not observed in other descriptions); spine of 1st exopodite segment as long as 2nd segment (Marsh:  $3/4$  of 2nd segment; Brehm:  $1/2$ ); 2nd exopodite segment  $1\ 3/4\times$  longer than broad (Marsh;  $3\times$ ), with 2 tubercles on inner margin, distal one stout, proximal one sometimes absent (other descriptions do not report the latter), strong spine on distal corner of outer margin, curved outwards, as long as first two

segments of exopodite; terminal claw with not clearly defined suture between flattened and narrow section (pl. 5, figs. B, H); horn-like endopodite longer than first 2 exopodite segments, with 3–5 tubercles on inner and 0–2 on outer margin (pl. 5, figs. C–G) (Marsh: endopodite almost as long as the first 2 exopodite segments, with one tubercle on inner margin; Brehm: until midlength of 2nd exopodite segment; Delachaux: both margins with 3 or 4 teeth with articulated base). Distal part of endopodite indistinctly separated, spine-like, directed outwards, with short hairs on convex margin. Left leg: coxopodite with one seta on inner margin (not reported in other descriptions), inner distal corner of basipodite produced into a small lobe (Marsh: rounded and blown-up); spoon-like endopodite bigger than in Delachaux's description.

**Female:** the mean length (without caudal setae) of 72 measured animals is  $1602\ \mu\text{m}$  ( $1304\text{--}1992\ \mu\text{m}$ ). Values given by other authors are:  $1505\ \mu\text{m}$  (Marsh),  $1740\ \mu\text{m}$  (Delachaux),  $1090\text{--}2070\ \mu\text{m}$  (Löffler),  $1470\text{--}2200\ \mu\text{m}$  (Kiefer),  $1150\text{--}2100\ \mu\text{m}$  (Harding). Including caudal setae, Colombian females have a mean length of  $1951\ \mu\text{m}$  ( $1624\text{--}2400\ \mu\text{m}$ ).

Body with short, sparsely distributed hairs; greatest body-width on 1st thoracic segment. Cephalothorax divided into cephalic and 5 thoracic segments (Brehm: 4 thoracic segments); terminal wings of last thoracic segment variable in length: reaching almost from distal margin of genital to 3rd abdominal segment. Distribution of aesthetascs on 1st antennae like in animals from Peru (Löffler, 1955); in some specimens, aesthetascs on segments 1, 3, 11 and 15 absent. Exopodite of 2nd antenna 3-segmented, endopodite 7-segmented (Löffler: some specimens with 6 segments); distribution of setae on both branches agree with Löffler (pl. 5, fig. Q); protopodite represented by coxopodite (with one seta) and basipodite (with 2 setae) (Löffler: protopodite reduced to basipodite with 2 setae). Specimens from Páramo de Sumapaz (Cordillera Oriental: Loc. 1, 3, 4, 5) with dentition of gnathal lobe of mandible as illustrated by Delachaux (pl. 5,



*Plate 5. Boeckella occidentalis*

(figs. A-I: ♂, figs. J-Q: ♀) A, habitus, dorsal; B, leg 5; C, right leg 5, endopodite, Loc. 3; D, same, Loc. 3 from other specimen; E, same, Loc. 1; F, same, Loc. 23; G, same, Loc. 4; H, right leg 5, terminal claw, lateral; I, right antenna 1; J, habitus, dorsal; K, left leg 5, Loc. 3; L, left leg 5, endopodite, Loc. 3, from other specimen; M, mandible; N, same, gnathal lobe, Loc. 3; O, same, Loc. 23; P, maxilliped; Q, antenna 2. Scale a - figs. A, J; scale b - figs. C-H, K, L, N, O; scale c - figs. B, I, M, P, Q; scale a = 1 mm, scale b and c = 100  $\mu$ m.

fig. N); animals from Páramo de Curubital (C. Oriental: Loc. 7, 8) and from Laguna del Otún (C. Central: Loc. 23) with one additional hyaline spine (pl. 5, fig. O). Maxilliped 7-segmented (Brehm: 7, Delachaux: 6 segments).

Armature of swimming legs agree with animals from Peru (Brehm, 1924), but some Colombian specimens show variability and asymmetry. Armature of 5th legs symmetrical and without variability (pl. 5, fig. K), except one specimen from Loc. 3 (inner margin of left endopod: 2, 1, 2 instead of 1, 1, 2 setae: pl. 5, fig. L). Spine on inner margin of 2nd exopodite segment of 5th legs variable in length: on left of leg reaching almost to terminal margin of 3rd exopodite segment, on right leg just reaching its midlength; spine on both margins with secondary spines.

#### *Brief diagnosis*

**Male:** right 5th leg: inner margin of basipodite produced into wide bilobulated hyaline membrane; endopodite one-segmented, horn-like, its spine-like distal part indistinctly separated from segment; endopodite extending past distal margin of 2nd exopodite segment, with 4–5 tubercles on inner and 1–2 on outer margin; 2nd exopodite segment with at least one tubercle on inner margin.

**Female:** 1st antenna extending almost to the end of caudal rami. Last thoracic segment posteriorly produced into 2 long wings, each ending in one spine; inner margin of each wing with one lobe, right lobe more slender and longer than left one. Abdomen symmetrical. 3rd exopodite segment of 5th leg bearing 3 spines. Endopodite of 2nd antenna 6- or 7-segmented.

#### *Distribution*

The species is known from high mountain lakes in Ecuador (Löffler, 1963), Peru (Marsh, 1906; Brehm, 1924; Löffler, 1955; Harding, 1955) and Bolivia (Marsh, 1906). In the Colombian Andes it appears in the Cordillera Central and in the SW of the Cordillera Oriental in the Páramos de Sumapaz and Curubital (fig. 1). Its altitudinal distribution in Colombia is between 3375 m (Laguna de La Guitarra) and 4085 m (Laguna

Corazón Partido); in Peru it is found its highest elevation (4800 m) in lakes of the Cordillera Apolobamba (Löffler, 1955).

*Boeckella gracilis* (Daday, 1902)

(Plate 6: figs. A–Q; plate 7: figs. A–U)

*Pseudoboeckella gracilis* Daday, 1902; 227–231, pl. IX, figs. 1, 9–17;

*Boeckella gracilis* Ekman, 1905: 602; Marsh, 1924: 8, fig. 7; Löffler, 1955; 727–728; Brehm, 1956: 22–25, figs. 11–17; Ringuelet, 1958; 64–65; Löffler, 1961: 166–167, figs. 64–70; Löffler, 1963: 207, figs. 6a–1;

*Boeckella schwabei* Brehm, 1937: 304–307, figs. 1–5; Thomasson, 1957: 63, fig. 5;

*Boeckella camjatae* Harding, 1955; 221–223, figs. 1–6.

**Material examined:** from several localities of the Cordillera Oriental: 1) Loc. 5. Dissected on slide: 1 male. 2) Loc. 22. Dissected on slides: 5 males, 3 females. Alcohol preserved: 5 males and 7 females (NHMW 6034). 3) Loc. 20. Dissected on slides: 3 males, 3 females. Formalin preserved: 7 males, 5 females. 4) Loc. 21. Dissected on slides: 2 males, 2 females. Formalin preserved; 2 males. 5) Loc. 19.a. Pelagic zone, collected by Arango, 1983. Dissected on slides: 2 males, 2 females. Formalin preserved: 8 males, 8 females. b. Pelagic zone, 1984. Dissected on slides: 2 males (NHMW 6035, 6036), 3 females (NHMW 6037–6039). Alcohol preserved: 8 males and 8 females (NHMW 6040). c. Litoral zone, 1984. Dissected on slides: 2 males, 3 females. Formalin preserved: 8 males, 7 females. 6) Loc. 10. Dissected on slides: 7 males, 9 females. Formalin preserved: 3 males.

Regional variations and description of new details were added to the original description (Daday, 1902) by Brehm (1937), Harding (1955) and Löffler (1955, 1961, 1963). Here are reported some new morphological details and variations of Colombian specimens.

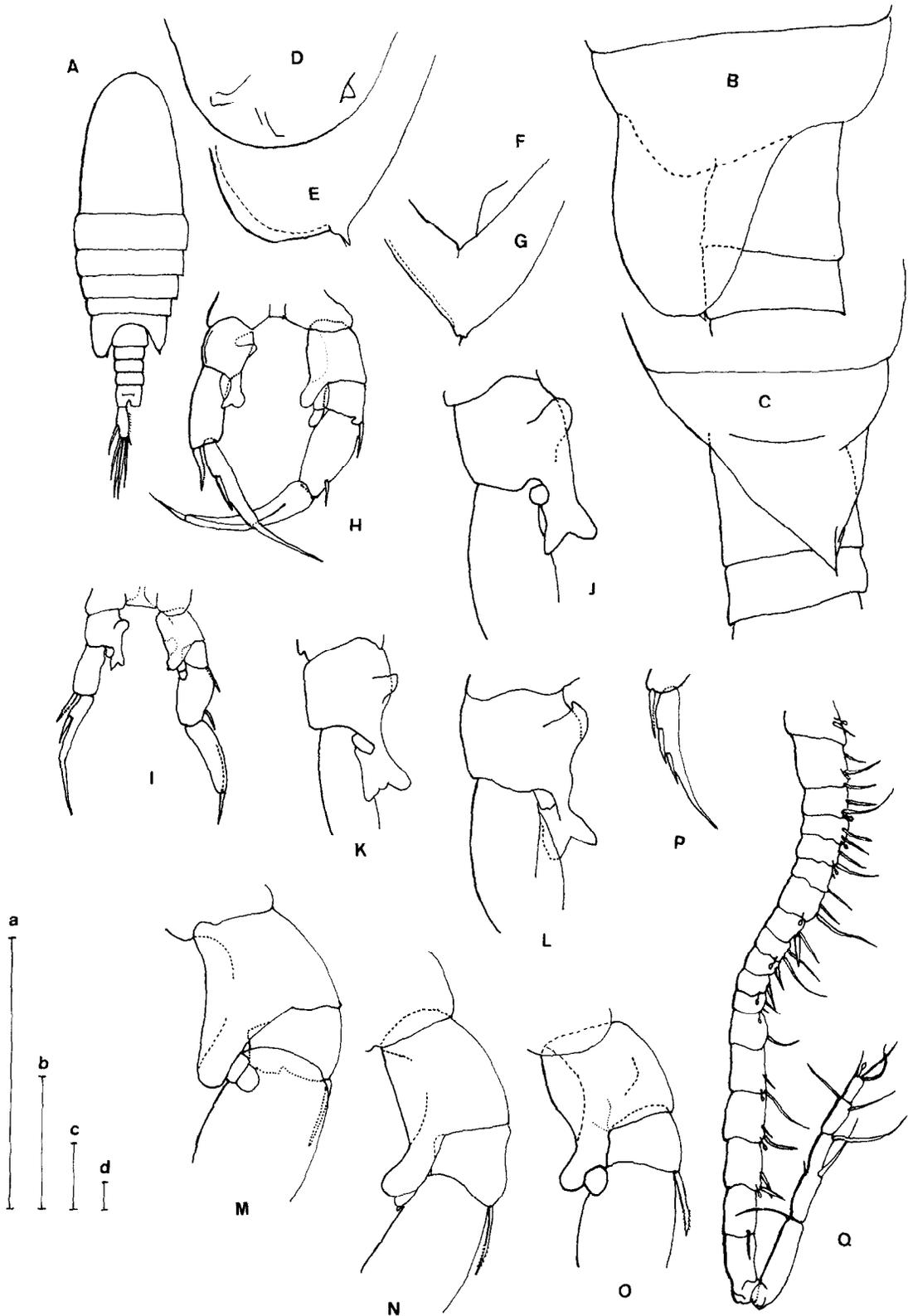


Plate 6. *Boeckella gracilis* (♂)

A, habitus, dorsal; B, last thoracic segment, left, Loc. 22; C, same, right side, Loc. 22; D, distal part of left wing, last thoracic segment, lateral, Loc. 20; E, same, Loc. 22, from other specimen; F, distal part of right wing, last thoracic segment, lateral, Loc. 20, from other specimen; G, same, Loc. 22, from other specimen; H, leg 5, Loc. 22; I, same, Loc. 19; J, left leg 5, basipodite and endopodite, Loc. 10; K, same, Loc. 5; L, same, Loc. 22; M, right leg 5, basipodite and endopodite, Loc. 22; N, same, Loc. 10; O, same, Loc. 5; P, left leg 5, 2nd exopodite segment, Loc. 22, from other specimen; Q, right antenna I. Scale a - figs. D-G; scale b - figs. B, C, J-O; scale c - figs. H, I, P, Q; scale d - fig. A; each scale = 100  $\mu$ m.

*Male*: the mean length (with caudal setae) of 65 measured specimens is 1353  $\mu\text{m}$  (1112–1658  $\mu\text{m}$ ); other author's measurements are: Brehm (Peru: 1000  $\mu\text{m}$ . Argentina: 1400  $\mu\text{m}$ ), Daday (Patagonia: 1400–1600  $\mu\text{m}$ ). Mean length of Colombian animals (without caudal setae) is 1172  $\mu\text{m}$  (960–1444  $\mu\text{m}$ ). Harding found 1000–1500  $\mu\text{m}$  (Peru), Löffler (Chile: 880  $\mu\text{m}$ . Peru: 885–1074  $\mu\text{m}$ , pond W from Puno; 790–964  $\mu\text{m}$ , Lago umayo; 1074–1326  $\mu\text{m}$ , pond by Juliaca; 1154  $\mu\text{m}$ , Lago Sillacunca. Ecuador: 1200  $\mu\text{m}$ ). Body widest on 1st thoracic segment.

Head as long as 5 thoracic segments together, not laterally compressed as in original description. Right wing of last thoracic segment slender, posteriorly pointed (or blunt in one specimen, pl. 6, fig. G), with a short terminal hair. Left wing rounded, with hyaline spine on inner margin (not observed in other South American specimens). Furcal rami 2.5–3.0  $\times$  longer than broad, inner margin hairy.

Right 1st antenna with spines on segments 8, 10 and 11, not on segments 9 and 12, like in Daday's description, but in agreement with Brehm (1937) and Harding (1955). Aesthetascs distribution as in original description. Left 1st antenna 25-segmented, aesthetascs distribution like in specimens from Peru (Löffler, 1955).

5th leg: exopodites of specimens from small water bodies strongly curved inwards and crossing each other; from large water bodies, just slightly curved and not crossing each other (pl. 6, figs. H, I). Left 5th leg: basipodite as long as wide, with a hyaline membrane in midlength of inner margin, round or proximally pointed, distally produced into cuticular membrane extending to midlength of 1st exopodite segment. Cuticular membrane distally wider and divided in 2 lobes, outer lobe in almost all animals pointed, inner lobe rounded (one specimen from Loc. 5, pl. 6, fig. K and one from Loc. 21, with a small intermediate lobe). Exopodite 2-segmented, in agreement with Daday's original description. 2nd exopodite segment bearing one lateral spine inserted on 1st quarter of outer margin, two specimens (Loc. 22) with 2 spines: 1st one extending beyond the base

of 2nd spine, 2nd spine inserted on 2nd quarter of segment (pl. 6, fig. P). Endopodite with different shapes (pl. 6, figs. H–K): longer than wide and distally tipped, distally with median sinus, almost round, or wider than long. Right 5th leg: specimens from Lago de Tota, with small protuberance on the tip of fingerlike process of the basipodite (pl. 6, fig. I). Exopodite as in Daday's description. Endopodite small, but longer than left one, inserted in outer distal margin of distal process of the basipodite, single-segmented in all specimens from 2 localities (Loc. 5, 10; pl. 6, figs. N, O) as in Marsh's description (1924), or 2-segmented in specimens from 4 localities (Loc. 19, 20, 21, 22; pl. 6, figs. I, M) like some animals from Ecuador (Löffler, 1963). Endopodite carrying a small spine on the tip (one specimen, Loc. 10), also described in specimens from Argentinian Patagonia (Daday, 1902) and Ecuador (Löffler, 1963).

*Female*: the mean length (with caudal setae) of 55 measured specimens is 1689  $\mu\text{m}$  (1248–2162  $\mu\text{m}$ ); other author's measurements are: Brehm (Chile: 1300  $\mu\text{m}$ . Argentina: 1700  $\mu\text{m}$ , Cordoba; 1800  $\mu\text{m}$ , State of Buenos Aires), Daday (Patagonia: 1700–2200  $\mu\text{m}$ ). The mean length (without caudal setae) of the Colombian specimens is 1499  $\mu\text{m}$  (1200–1907  $\mu\text{m}$ ); Harding found 1350–2000  $\mu\text{m}$  (Peru), Löffler (Chile: 1100–1210  $\mu\text{m}$ . Peru: 1027–1185  $\mu\text{m}$ , Lago Umayo; 1169–1406  $\mu\text{m}$ , pond W from Puno; 1588  $\mu\text{m}$ , Sillacunca; 1580–1814  $\mu\text{m}$ , pond by Juliaca. Ecuador: 1380–1900  $\mu\text{m}$ ). Body widest at midlength of cephalic segment.

Abdomen agrees in essential details with description of Daday (1902). Anterior part of genital operculum wider than posterior, shape of operculum as in pl. 7, fig. Q. Caudal rami 3  $\times$  longer than wide, inner margin hairy, longest caudal seta as long as caudal rami and last abdominal segment together.

Distribution of aesthetascs of 1st antenna as for Peruvian specimens (Löffler, 1955). Mandible with 7 teeth (Daday counted 5), 3 inferior teeth sharper than others; in addition to the hyaline

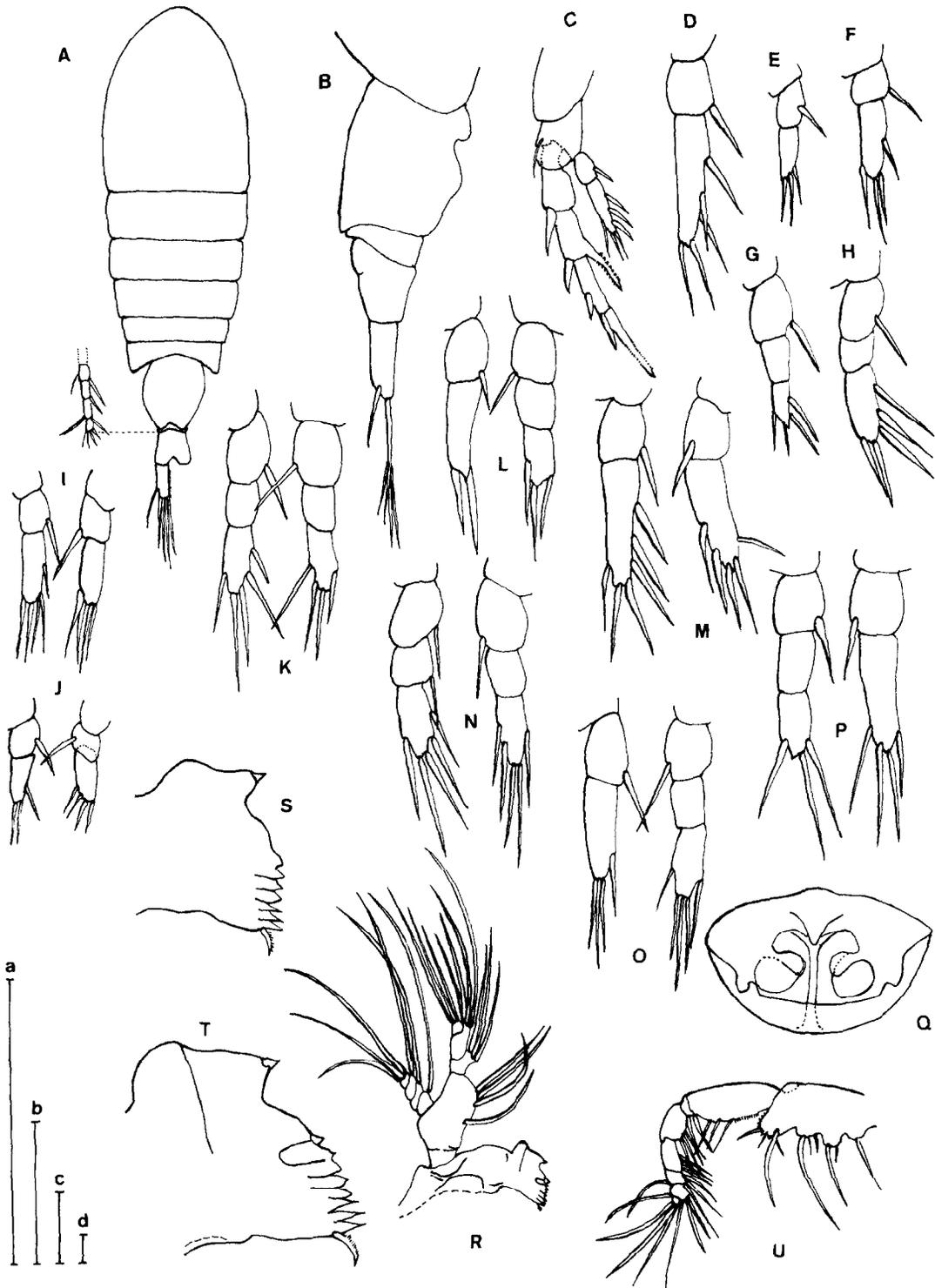


Plate 7. *Boeckella gracilis* (♀)

A, habitus, dorsal; B, abdomen, lateral; C, leg 5, Loc. 22; D-H, leg 5, endopodite; D, Loc. 22, from other specimen; E, Loc. 19, pelagic zone, 1984; F, Loc. 19, from other specimen; G, Loc. 10; H, Loc. 10, from other specimen; I-P, leg 5, endopodite pair: I, Loc. 19, littoral zone, 1984; J, Loc. 19, pelagic zone, 1983; K, N-P, Loc. 10, from different specimens; L, Loc. 20; Q, genital operculum; R, mandible, Loc. 22; S, mandible, gnathal lobe, Loc. 19, pelagic zone, 1984; T, same, Loc. 22; U, maxilliped. Scale a - figs. S, T; scale b - figs. D-Q; scale c - figs. B, C, R, U; scale d - fig. A; each scale = 100  $\mu\text{m}$ .

spine on the superior projection, several specimens bear a 2nd one beside the superior tooth, not reported elsewhere (pl. 7, figs. S, T).

Both branches of swimming legs 3-segmented. However, almost all specimens from Lago de Tota with endopodite of 1st leg 2-segmented (setation: outer margin -0,1; inner -1,4; apical -2). Armature of swimming legs in the specimens from Loc. 5, 10 and 21 as in original description, with exception of the outer margin of endopodite of 1st leg (setation: 0, 0, 1 instead of 0, 0, 2). Specimens from Loc. 19, 20 and 21 show great variation in setation and some in spination of the swimming legs. 5th leg: exopodites agree in essential details with Daday's description. Endopodites show great variation in symmetry, segmentation and setation, as it has been also noted by Löffler in specimens from Chile (1961) and Ecuador (1963).

In Colombian specimens, the following variations were observed: 1. on symmetrical endopodites; a) 2-segmented, 1st segment with one seta, 2nd with 5 or 6 (some specimens from Loc. 22: pl. 7, figs. C, D); b) 2-segmented, 1st segment with one seta, 2nd with 3 or 4 (some specimens from Loc. 19: pl. 7, figs. E, F); c) 3-segmented, 1st segment with one seta, 2nd without setae, 3rd with 4 or 5 (Loc. 10: pl. 7, figs. G, H). 2. on asymmetrical endopodites: 8 different combinations of endopodite pairs, with asymmetrical shapes were observed in specimens from 4 water bodies (pl. 7, figs. I-P).

#### *Brief diagnosis*

**Male:** last thoracic segment posteriorly produced into two asymmetric processes; left process rounded, reaching the distal part of 3rd abdominal segment, right one slender and pointed, reaching the midlength of 2nd abdominal segment. 5th leg: basipodite of both legs with cuticular projection on inner distal corner, left one bilobed; left endopodite one-segmented, very small; right endopodite 1- or 2-segmented, somewhat larger than left one.

**Female:** 1st antenna reaches 2nd abdominal segment. Posterior part of last thoracic segment slightly extended. Genital segment dorsally pro-

duced into 2 lobes that almost cover 2nd abdominal segment. 3rd exopodite segment of 5th leg with 3 spines.

#### *Distribution*

*Boeckella gracilis* has the widest distribution of the species of the genus in South America, between 50° S (Puerto Madryn, Chubut, Argentinean Patagonia) and 6° N (Laguna Alto de Las Cruces, Páramo de Guántiva, State of Boyacá, Colombia). In Colombia, it has been found in 'páramo' water bodies (fig. 1) in the states of Meta (1), Cundinamarca (1) and mainly in Boyacá (4). In the latter, no other calanoid copepods were observed. Only in one of the studied lakes, *B. gracilis* was found cohabiting with *B. occidentalis* (Laguna La Primavera, P. de Sumapaz), as also observed in Peru (Harding, 1955). Its altitudinal distribution in Colombia is between 3020 m (Lago de Tota) and 3775 m (Laguna Negra Superior, P. de la Rusia).

*B. gracilis* is smaller than *B. occidentalis*. Populations of *B. gracilis* inhabiting large lakes include specimens smaller in size than those inhabiting small water bodies, and males with the 5th pair of legs not crossing each other (exopods with smooth curvature). Populations inhabiting ponds show less morphological variation in symmetry, segmentation and setation of the legs in females; in those from large lakes, this variability is much greater. The size of the individuals of *B. gracilis* increase with the altitude; that seems to be correlated with a decrease on temperature.

Both species of *Boeckella* live in cold water bodies (table 1), but *B. gracilis* seems to resist higher temperatures (15 °C, Lago de Tota). Lakes where *Boeckella* was found show a cold polymictic type of circulation.

#### *Conclusions*

The Colombian Andes appear like a region of intersection between faunistic elements of austral-subantarctic origin represented by the boeckellids, and forms of holarctic origin, represented by the diaptomids. With exception of *Prionodiaptomus colombiensis*, no other South American genera of

diaptomids and no boeckellids extend to Central America. The other species of both families are endemic for South America. Colombia presents the northern limit of distribution of boeckellids possible due to the tertiary marine transgression between South and Central America. Distribution of boeckellids from the south of the continent to high mountain lakes of Colombia possibly occurred by passive dispersal of resting stages by birds.

The discovery of the new genus *Colombo-diaptomus* also show that diaptomids occur in high Andean lakes. However, species of both families do not cohabite the same water bodies; that only occur with species of both families in the Pampean region of Argentina (Ringuelet, 1968). In general, boeckellids are limited to the Cordillera de Los Andes, while diaptomids are distributed eastern from it, except *Diaptomus diabolicus* in Chile, *P. colombiensis* in Colombia and Venezuela and the new genus *Colombo-diaptomus* in Colombia.

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