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Austronemoura auberti new species and other new Chilean Notonemouridae (Plecoptera)

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Austronemoura auberti sp.n., *A. flintorum* sp. n. and *A. decipiens* sp.n. from Chile are described, illustrated and distinguished from previously named species. The descriptions of *A. quadrangularis* AUBERT and *A. encoensis* AUBERT are extended and amended, respectively. An intriguing correlation of the shape of the male intromittent organ and the shape of the rod-shaped distal portion of the cement gland of females is described.

Keywords: *Austronemoura*, Andean stoneflies, new species, morphology.

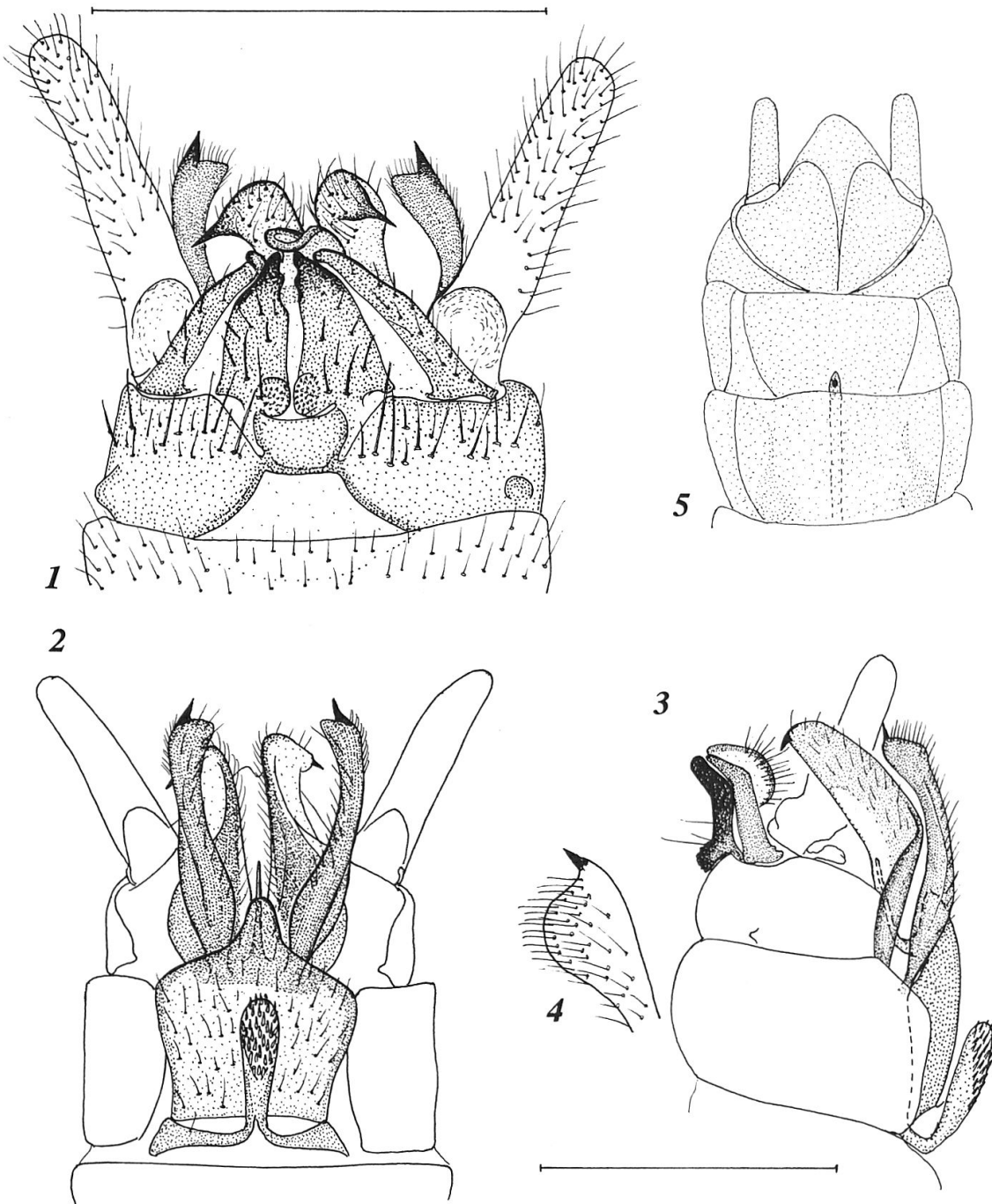
INTRODUCTION

During work on large collections of South American Plecoptera from the United States National Museum, Washington, D.C. (USNM; courtesy Dr. O.S. FLINT, Jr.) we came across a number of species of *Austronemoura*. This very distinct genus was established by J. AUBERT for five of the now known species of the genus. As is typical of the stonefly papers of the late Professor AUBERT, the text of his descriptions is concise and accompanied by the excellent illustrations of M^{lle} D. PETITPIERRE. This made the identification of the material easy. In addition to several named species we found three unnamed ones which we describe here. In ascertaining the distinctness of the new taxa, we profited by the fact that all previously named species, including syntypes of most, also of *A. eudoxiae* (FROELICH) were available to us, in the collection gathered mainly by the late J. ILLIES, at the Limnologische Fluss-Station at Schlitz.

The genus *Austronemoura* is included in the *Spaniocercoides* group of Notonemouridae (MCLELLAN, 1991) with the New Zealand genera *Spaniocercoides*, *Spaniocerca*, *Cristaperla* and *Omanuperla*. It is typical of that group which all have the following characters: slender bodies, bulging eyes, recurved maxillary palps, wings flat over the abdomen and the single segmented cerci. The wings have the distinctive notonemourid transverse cord of crossveins extending from the tip of Sc across the base of the Rs fork and down through the base of the MA fork to Cu₁; there is a lack of crossveins distal to the cord. As usual in the family, Sc₂ is absent, i.e. the nemourid X is incomplete and the hindwings have five free anal veins.

The homology of the parts of the complex notonemourid genitalia is not fully understood. Our perception of the male tergite 10 and epiproct differs from the interpretation by J. AUBERT, who described the tergite 10 as forming a kind of posterior

cone with two dorsal and two lateral sclerite bars supporting the epiproct. The structure he terms as the epiproct we consider it to be the lower cup-shaped part of the epiproct. We regard the four sclerite bars as part of a highly modified presumably reduced epiproct and consider the dorsal and lateral bars homologous with the "Tragplatte" (supporting sclerite) and "Sclerite B", respectively, of the nemourid epiproct, in the sense of ZWICK (1973, p. 154; his figure 51).



Figs 1-5. *Austronemoura auberti* sp.n. ♂: abdominal tip: 1, dorsal view; 2, ventral view; 3, lateral view; 4, full view of apex of right upper branch of paraproct. 5: idem ♀, ventral view. Scale lines are 0.5 mm long. Figs 2-4, 6-8, 10-13 and 20 are to the same scale.

DESCRIPTIONS

Austronemoura auberti sp.n.

(Figs 1-5, 15-17)

Material: Holotype male, 22 male, 23 female paratypes: CHILE, Malleco, Nahuelbuta, Coimalin 37°48'S:73°01'W, 16 Dec 1993 C. and O.S. FLINT, Jr.. Additional paratypes: 22 males, 68 females, CHILE, Malleco, Nahuelbuta, bog outlet, 37°47'S:73°01'W, 16-19 Dec 1993, Malaise trap, C. and O.S. FLINT, Jr. (in USNM; paratypes also in colls McLELLAN and ZWICK)

Dimensions: Forewing length 6.0 - 7.5 mm.

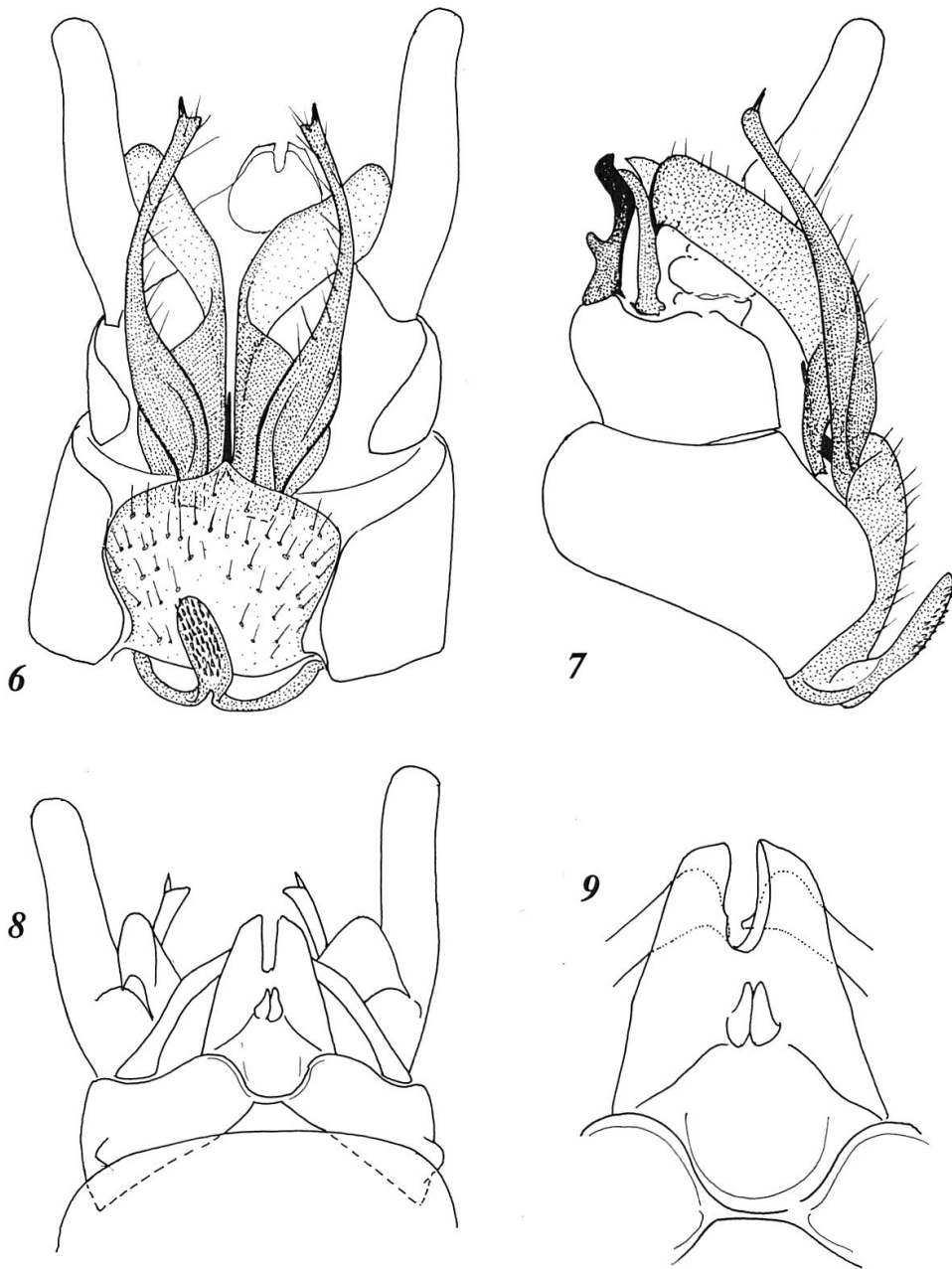
Description: Fully winged stonefly. Dark brown, central portion of femora sometimes lighter than rest, wings infusate, unicolorous. In very dark almost black specimens a spot between each compound eye and ocellus remains reddish brown; from these spots a dark reddish-brown band curves back to the forking point of the occipital suture.

Male Genitalia: Tergite 9 simple. Tergite 10 with conical dorso-lateral tubercle. Antecosta 10 distinct, medially deeply curved back towards small median sclerite in front of epiproct. Dorsal plates of epiproct, elongate triangles with base transversely across anterior margin. The plates separated by a distinct narrow gap and each with a hemispherical, coarse textured callus on its basal medial angle. The blackish apices of the dorsal plates are obliquely bent up and taper to blunt tips. Lateral epiproct bars, originating on rear margin of tergite 10 above cercus, are almost straight, little tapered, converging but ending separate from each other as upcurved knobs slightly lateral to and below the dorsal plates. Lower cup of epiproct soft, base with long setae, distal face sclerotised forming an upcurved scoop-like sclerite behind apices of dorsal epiproct plates. Cerci long and very slender slightly bent downward from base in side view, inner face with soft basal callus clothed with minute setae.

Sternite 9 with detached basal bars converging to support the slender ventral vesicle which carries short strong spines on its apical half. Body of sternite 9 forming a pentagonal subgenital plate; its apex initially curved up and forward but then turned back to form a straight obliquely directed needle-like tip.

Each paraproct deeply divided into independent branches (for homology, see ZWICK, 1973). The medial branches originate on the recurved upper face of the apical part of the subgenital plate. They are stout gently curved up, outward and then mediad, terminating in a broad densely pilose lobe with a sharp dorso-apical spine. Depending on the angle of vision, the apex of the medial (= lower) branch may appear truncate with a dorsal spine, or bifid with unequal points. The dorso-lateral (= upper) paraproct branches originate in the membraneous area above the medial ones and form a horizontal cordiform base, then are twisted near mid-length so that the distal half of the branch has its sclerotised ventral face turned towards the median line and the soft membraneous dorsal side faces outwards. Apex of dorso-lateral lobe broadly tongue-shaped with an apical spine pointing antero-laterally and reminiscent of a bird's head in dorsal view. In side view, the dorsal branches are gently bent at a very blunt angle near mid-length.

Female Genitalia: Sternite 8 not produced; its surface uniformly brown apart from a comma-shaped dark brown marking on either side. A sclerotised rod-like structure extends medially the length of the sternite below the ventral surface of the genital cavity. Towards the genital opening it bends slightly postero-ventrally for a



Figs 6-9. *Austronemoura flintorum* sp.n. ♂: abdominal tip: 6, dorsal view; 7, lateral view; 8, dorsal view; 9, epiproct in dorsal view, enlarged.

short distance then posteriorly and just clear of the opening tapers to a point with a small sub-apical ventral pore. The distal edge of sternite 7 is very shallowly excised around the protruding rod. Sternites 8, 9 and the subanal lobes are more heavily sclerotised than the anterior sternites. Cerci resemble male.

Similar Species: Among the previously named species, male *A. chilena* AUBERT are most similar. We have studied *A. chilena* from a number of localities over a wide range, also from very close to the localities of *A. auberti*. *A. chilena* always agrees with the original description (AUBERT, 1960), and differs from the new species as follows:

- Cerci short, stout;
- Epiproct with very high basal callus, remainder flat, hardly upturned at apex;
- Dorsolateral/upper branch of paraproct simply upcurved (as opposed to twisted, i.e., basally flat, distally turned into the dorsoventral plane), apically tapered to a small spine in prolongation of main axis of branch (as opposed to wide apex with spine at an angle with main axis);
- Medial/lower branch of paraproct with narrow upcurved apex ending in a simple point.

Female *A. chilena* differ by the long pointed projection on sternite 8. Compare also *flintorum* and *decipiens* for distinction from *A. auberti*.

Remark: We take pleasure in naming this most distinct species in honour of the late JACQUES AUBERT, a great master of Plecopterology.

Austronemoura flintorum sp.n.

(Figs 6-9)

Material: Male holotype, 2 female paratypes: CHILE, Chiloe, 4km E Cucao, 42°39'S:74°05'W, 26 Dec 1993, C. and O.S. FLINT, Jr. (in USNM).

General Description and Dimensions: Similar to preceding species, wing length 8.0 - 8.5 mm.

Male Genitalia: Dorsal epiproct plates fused medially for 1/5 length; anterior margins oblique; median calluses conical and overhanging arising about midway along the plates. The plates with slightly overhanging tips. Lateral epiproct bars not distinctly upcurved at apices which are expanded and hidden under dorsal plates. Cerci slender and sinuous. Apex of sternite 9 with a very short medial extension. Lower paraproct branches, connected to sternite 9, are basally narrow, much wider in basal third, then long, slender and gently upcurved with apex narrow and tooth-like with a dorso-distal spine. Upper paraproct branches twisted similarly to *auberti* but with horizontal basal part distinctly shorter than the vertical distal part and with a relatively small apical tooth.

Female Genitalia: Similar to *auberti* except distinct, almost semicircular small notch of sternite 8 around protruding rod. Cerci slightly sinuous, not quite as long as in male.

Similar Species: Males are more similar to *auberti* than *chilena*. They differ from *auberti* most obviously in the shape and position of the dorsal epiproct plate calluses which are conical and are halfway along the plates and also by the long slender lower paraproct branches with narrow bases and the wide apices of the upper paraproct branches. Females are very similar to *auberti*, but have shorter cerci.

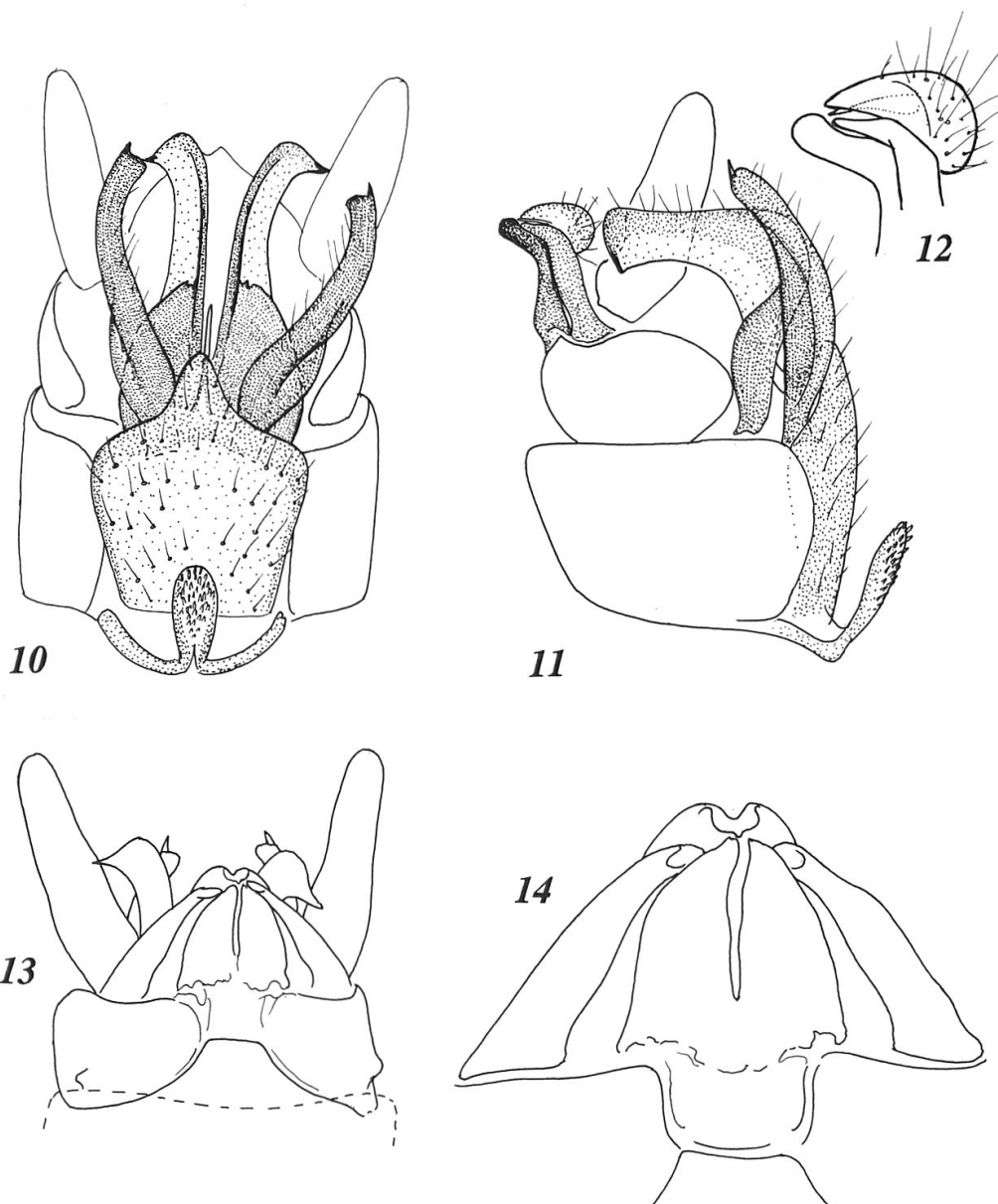
Remarks: The species is named after the collectors, C. and O. S. FLINT, Jr, who collected large numbers of interesting South American stoneflies and kindly made them available to us for study.

Austronemoura decipiens sp.n.

(Figs 10-14, 18, 19)

Material: Holotype male, 2 male, 5 female paratypes: CHILE, Osorno, Puyehue, Xi.61, with a label "*Austronemoura eudoxiae* ?" (in coll. J. ILLIES, Limnologische Fluss-Station Schlitz).

General Description and Dimensions: Generally similar to congeners, differs only in genitalia. Wing length 6.5 - 8.5 mm.



Figs 10-14. *Austronemoura decipiens* sp.n.: ♂ abdominal tip: 10, dorsal view; 11, lateral view; 12, enlarged detail of epiproct, lateral view; 13, dorsal view; 14, epiproct in dorsal view, enlarged.

Male Genitalia: Dorsal epiproct plates without callus; apex more rounded than in the previous two species and the plates fused for their basal third. Lateral epiproct bars similar to *auberti*. Lower cup of epiproct with a small, anteriorly projecting median ridge which has the appearance of a spine from lateral view. Cerci short and in dorsal view almost conical.

Ventrally the genitalia are very similar to *auberti*, but the twist from horizontal to vertical in the upper paraproct branch is abrupt with a minute tooth at the extremity of the horizontal part and a ventral ridge on the distal vertical part. In lateral view the upper paraproct branch has an abrupt knee-like bend which directs the distal half dorsally, its wide apex has a short blunt anteriorly projecting tooth.

Female Genitalia: Similar to *flintorum* (i.e., with distinct notch of sternite 7), but apex of rod truncate, not tapered. Cerci similar to male, straight, a little shorter.

Similar Species: Affinities of *decipiens* with *A. auberti* are obvious. However, the lack of a callus on the epiproct plate, presence of a median ridge of the lower cup of the epiproct and the strong bend in the upper paraproct branch remind one of *A. eudoxiae*. That species differs distinctly in the very short thick cerci with sub-terminal dorsal hump, and the very slender lower paraproct branch ending in two obliquely divergent spines. Identification of females will be difficult, although the short straight cerci distinguish females from *flintorum*; the genitalia are similar.

Remark: The partial resemblance of the present species with *eudoxiae* may be deceiving (as is also suggested by the old label, despite the questionmark), hence the specific name.

DISCUSSION

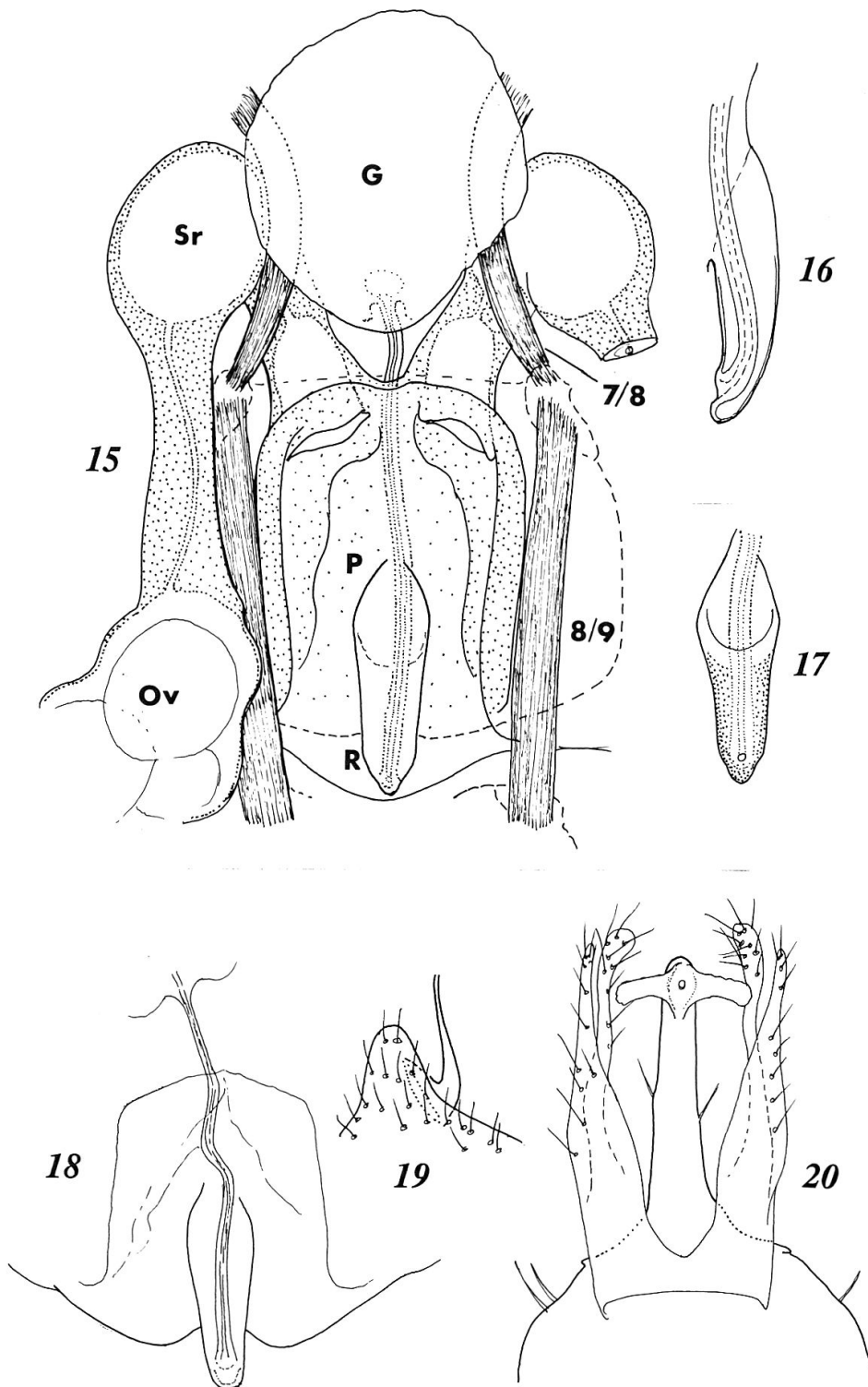
The morphological differences between the various species of genus *Austronemoura* appeared to be very clear cut at the time of AUBERT's pioneer study (1960). The taxa described here are less strikingly different but the distinguishing characters are distinct and uniform. This is in keeping with what has been found with other notonemourid genera. McLELLAN (1991) experienced the same with the New Zealand genera *Spaniocerca* and *Spaniocercoides* where there are easily identified species groups and within each group the species have less striking but nevertheless distinct specific characters. Of course any decision on creating species groups in *Austronemoura* must wait until a revision of that genus is undertaken. In view of the uniform general structure within the genus, details of genitalia will probably be of prime importance.

Since their structure and function are not yet sufficiently understood we add some notes on our observations.

AUBERT provided an elegant illustration of a detached male subgenital plate (SGP) of *chilena* showing how its apex is curved upward, forward and then back, so that its needle-like sclerotised tip is displaced anteriorly and situated on the dorsal face of the SGP; the needle is only partly visible in ventral view. The new species are similar in this respect, and so are *A. caramavidensis* AUBERT, *araucoana* AUBERT, and *eudoxiae*.

We verified that the short unpaired ejaculatory duct enters the apex of the male subgenital plate (SGP) and opens at its tip, even in those cases where this has the form of a fine needle. This structure is the functional penis; in *auberti*, its tip is ca 8 μm , the gonopore about 3-4 μm wide (Fig. 19).

Females (compare Fig. 15). Dorsal to sternite 8 there is a flat but wide sub-rectangular pouch. A distally sclerotised rod traversed by a fine duct with cuticular lining originates from the ventrodorsal face of this pouch. The duct extends between the ventral side of the pouch and sternite 8 into sternite 7 where its funnel-shaped end is connected to a sac-like reservoir containing some amorphous material. This reservoir is the median structure shown in FROEHLICH's (1961) figure of *eudoxiae*, and ILLIES (1961) called it a cement gland. The reservoir lies in front and partly on top of the oviducts. Just laterally to longitudinal muscle 7/8 and the gland reservoir, each duct expands into a sphere. These expansions act as seminal receptacles and contain a sperm mass like silvery densely packed cotton with often an egg at the same time. From the seminal receptacle each oviduct, equipped with strong circular muscles, is initially narrow where it passes under the curved longitudinal mus-



Figs 15-17. *Austronemoura auberti* sp.n., ♀: 15, dissected specimen, dorsal view of sternites 7 and 8 with genitalia (G, gland reservoir; Ov, thin-walled part of oviduct; P, pouch; R, rod; Sr, seminal receptacle; 7/8, 8/9, longitudinal sternal muscles connecting sternites 7 and 8 and 8 and 9, respectively); 16, 17 genital rod in lateral (ventral side is left) and ventral views, respectively. Fig. 18: *Austronemoura decipiens* sp.n., ♀: cleared sternite 8 with genital pouch and rod. 19: idem ♂, oblique view of apex of subgenital plate with needle-like apex. Figs 18 and 19 are to the same scale. 20: *Austronemoura encoensis*, ♂, dorsal view of tip of detached subgenital plate with attached lower branches of paraproct.

cle 7/8 but then becomes bell-shaped before entering the pouch. Apparently, all eggs pass through the seminal receptacle on their way to the pouch, where up to three may rest before they are extruded. We have never seen an unpaired dorsal receptacle on the pouch as shown by ILLIES (1961). On the other end of the seminal receptacle, there is a long posteriorly directed section of oviduct with strong circular muscles before the oviduct bends forward, widens and becomes thin walled.

Details of sternite 8 in front of the rod are distinctive. In females of most species, the rear edge of sternite 8 is folded up and forward, so that sternite 8 overlies the rod; the edge may be entire or variously notched. *A. chilena* differs only in that the surface of sternite 8 is not folded but is in continuity with the base of the rod which originates directly from the sternite. The minute pore of the duct may be at the very tip of the rod (*chilena*, *eudoxiae*, *caramavidensis*) or subterminal, like in the three new species; this detail is not known for *araucoana*.

A. quadrangularis differs by the shorter and wider, sharply bifid female rod. Males also differ in that the needle-like apex of SGP is a continuation of the exposed part of the SGP and set off against it only on the ventral side, by a small ventro-distal tooth.

In female *encoensis*, the rod seems to be so much displaced to the anterior part of sternite 8 that it reminded ILLIES (1961) of the male vesicle on sternite 9. Unfortunately, females described by him are no longer available and details remain unknown. Male *encoensis* are fundamentally different in lacking the fine needle-like tip of SGP; instead, the apex of SGP is a long slender upcurved tube. AUBERT described its apex as rounded; however, he overlooked two almost transparent little wings on the sides of the minute oval gonopore, which measures approximately $8 * 7 \mu\text{m}$ (Fig. 20). They are also present in the holotype (Mus. Lausanne).

Apparently, structure of the male intromittent organ and the shape or position of the female rod are correlated; in all species except *encoensis*, the size of the rod and the diameter of its canal are intriguingly similar to the length and diameter of the male functional penis.

ACKNOWLEDGMENTS

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