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THREE NEW CAVERNICOLOUS SPECIES OF
FULGOROIDEA (HOMOPTERA) FROM MEXICO
AND WESTERN AUSTRALIA

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Three species of cavernicolous Fulgoroidea, *Cixius orcus* (Cixiidae), *Oeclidius hades* (Kinnaridae) and *Phaconeura pluto* (Meenoplidae) are described as new, the first two from Mexico, the last from Western Australia. All exhibit adaptation to a wholly underground existence: sclerotization is weak, eyes and ocelli are absent, the tegmina are brachypterous and the wings greatly reduced. The male genitalia, though sufficiently different from those of known species in the corresponding genera to justify the erection of new species, do not show much more than the usual degree of interspecific variation.

Through the kindness of Dr. J. P. Kramer, of the Systematic Entomology Laboratory, U.S. Department of Agriculture, and of Mrs. J. Lowry, of the University of New South Wales, Australia, the writer has been able to examine representatives of three populations of Fulgoroidea taken in caves in Mexico and Western Australia. They proved to belong to the families Cixiidae, Kinnaridae and Meenoplidae, and showed adaptations for a wholly underground existence that were similar between themselves and also similar to those recently noted by the writer (1973) in species of *Oliarus* (Cixiidae) from caves in Hawaii. These included loss of the eyes and ocelli, accompanied by reduction in the length of the upper part of the head, reduction in size of the tegmina, wings, and tarsal empodia, a lesser degree of sclerotization of the segments of the derm and virtual loss of pigmentation. Though the evi-

dence is so far meagre, it appears possible that the form of the head in part represents a persistence of that found in the nymphal stages. As far as is known, the immature stages of members of the three families mentioned are passed underground, with the nymphs feeding on roots. Where roots penetrate down into a cave far from its mouth, an opportunity is created for free underground movement and mating of adults, and no stimulus to move towards light is present. It is not improbable that this factor has served to initiate the isolation of cave-dwelling populations of species that range widely in their normal above-ground adult stage. If this is so, every cave in which such conditions exist may potentially harbor its own breeding population. Adaptation to total existence in darkness and a stable environment by regressive development may reasonably be expected to occur more rapidly than change in genital structure, and it is the latter that offers the best clue to the extent of divergence of a cave population from fraternal populations with fully winged adults.

FAMILY CIXIIDAE

Genus *Cixius* Latreille

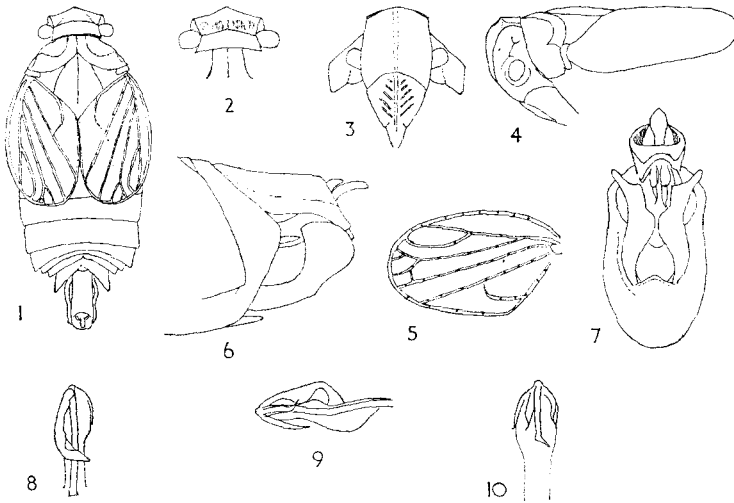
Cixius Latreille, 1804:310. Type-species, *Cicada nervosa* L., 1758:437.

Cixius orcus, new species

Figures 1-10

Holotype male: length, 2.5 mm.; tegmen, 1.3 mm.

Head in dorsal view broader at base than long (1.5 : 1) with lateral margins concave; vertex with posterior compartment flat, posterior margin shallowly concave, a fine shallowly angulate transverse carina bounding posterior compartment anteriorly; anterior compartment of vertex slightly declivous, almost curving smoothly into base of frons, bounded apically by a feeble broad transverse callus, disc shallowly impressed on each side of middle line, a faint indication of a median fossette present; frons in middle line as long as broad, transversely and in profile convex, basal margin convex, lateral margins shallowly convex, produced laterad, apical margin strongly concave; median carina percurrent, thick; clypeus tricarinate, with median carina thickened, rostrum surpassing post-trochanters. Eyes and ocelli absent. Antennae with basal segment very short, ringlike, second segment subovoid. Pronotum with posterior margin rectangulately excavate, disc in middle line as long as posterior compartment of vertex, medially carinate; lateral carinae well developed, each



FIGS. 1-10, *Cixius orcus*, new species: 1. Head, thorax and abdomen, dorsal view; 2. head and portion of pronotal carinae, dorsal view; 3. frons, clypeus and lateral lobes of pronotum; 4. head, thorax and tegmen, side view; 5. tegmen; 6. male genitalia, left side; 7. the same, posterior view; 8. aedeagus, dorsal view; 9. the same, right side; 10. aedeagus, ventral view.

directed caudad then curving laterad to join a horizontal carina at lateral margin. Mesonotum broader than long, median disc flat, tricarinate, with lateral carinae converging anteriorly almost to meet median carina at apex. Post-tibiae with two minute teeth laterally, one at base, the other in basal third, and six teeth apically; basal metatarsal segment with four teeth apically, second segment with three teeth. Tarsal claws slender. Tegmina brachypterous, with apical margin broadly rounded, Sc + R, M and Cu 1 present, claval suture obsolete, second claval vein bent abruptly to unite with first claval vein near its middle. Wings scarcely half as long as tegmina, with a few longitudinal veins.

Frons, clypeus, vertex, pronotum and mesonotum pallid yellow, polished, body otherwise pallid, almost white. Tegmina and wings hyaline, colorless, with pallid veins.

Anal segment twice as long as broad, in dorsal view with lateral margins parallel, apical margin transverse, anal foramen situated in apical quarter. Pygofer moderately long, lateral margins obtusely angulately convex, medioventral process mucronate, as long as broad at base. Aedeagus relatively long, directed caudad, an unequal pair of spinose processes arising ventrally at apex, that on right side half as long as aedeagus, that on left slightly shorter, both directed laterocaudad at apex,

pair of short spinose processes arising dorsally at apex, directed cephalad, a submembranous tubular lobe arising dorsally on right at apex, directed cephalad then curving shallowly towards left. Genital styles rather long, simple, each rather narrow basally, expanding in distal third, with distal margin shallowly convex.

Type-data: Holotype ♂, MEXICO: Queretaro, Cueva de Emilia, 14 km. NNW Ahuacatlan, 24.xii.72 (R. Jameson) in the National Museum of Natural History, Smithsonian Institution.

The arrangement of spines laterally and apically on the post-tibiae, the relative length of the rostrum, the form of the frons and clypeus and the carination of the head agree with the condition found in species of *Cixius*, and ignoring the adaptive features of eyelessness, brachyptery, lack of pigment and slender tarsal claws, there is no reason why this species should not be referred to *Cixius*. The dentition of the post-tibiae and the form of the medioventral process of the pygofer rule out any close relationship with *Haplaxius* and the long rostrum and slender legs any similar relationship with *Microletrida*. Of the Central American genera nearly related to *Cixius*, *Pachyntheisa* has a rostrum just attaining the post-trochanters, and *Oliarus* has a differently shaped frons. The genitalia of *C. orcus* differ from those of such Central American species of the genus as it has been possible to examine.

FAMILY KINNARIDAE

Genus *Oeclidius* Van Duzec

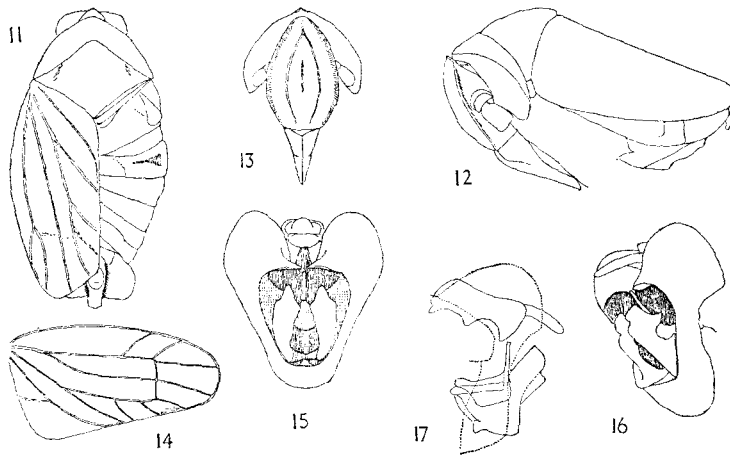
Oeclidius Van Duzec, 1914:40. Type-species, *Oeclidius nanus* Van Duzec, 1914

***Oeclidius hades*, new species**

Figures 11-17

Holotype male: length, 2.0 mm., tegmen, 1.7 mm.

Head in dorsal view comprising a very short transverse compartment of vertex and basal part of frons, separated by a short strong narrow transverse carina; frons in middle line longer than broad (about 1.5 : 1), convex transversely and in profile, basal margin very short, lateral margins obliquely elevated, rather strongly convex, apical margin short, only slightly longer than basal margin, a pair of arcuate carinae, united a little before base of frons, percurrent to apex, or nearly so, not meeting distally; frontoclypeal suture impressed; clypeus relatively small, medially and laterally carinate, with median carina prominent, almost foliaceous; rostrum long, slender, surpassing apex of abdomen, gradually tapering at apex; eyes and ocelli absent, antennae with basal segment broader than long, collarlike, second segment longer than broad (1.8 : 1), cylindrical, truncate apically. Pronotum relatively large, anterior margin strongly carinate, angulately convex and overlapping vertex medially, posterior margin sinuately excavate, median carina strongly developed;



FIGS. 11-17, *Oeclidius hades*, new species: 11. Head, thorax, left tegmen, right wing, and abdomen, dorsal view; 12, adult, except legs, left side; 13, frons, clypeus and lateral lobes of pronotum; 14, tegmen; 15, male genitalia, posterior view; 16, the same, posterolateral view from right; 17, the same, left side, with pygofer shown in broken line.

lateral lobes of pronotum almost flat, facing cephalad; mesonotum broader than long (about 1.5 : 1), strongly transversely convex, with faint indication of median and lateral carinae. Post-tibiae long, slender, laterally unarmed, apically with seven teeth, basal metatarsal segment with five teeth, second segment with four teeth, tarsal claws set close together, slender. Tegmina reaching to apex of abdomen, broadest at base, tapering distad and narrowly rounded at apex, Sc + R, M, Cu 1, claval veins and a few supernumerary transverse veins present, claval suture absent. Wings each reduced to a scale.

Pallid yellowish brown; abdominal membrane sordid white.

Anal segment rather long, tongue-like in distal half with apical margin convex, sides moderately deep, each produced ventrad at middle in a narrowly rounded lobe. Pygofer moderately long, dorsolaterally much inflated, with angles acute and inflexed mesad, lateral margins concave, ventral margin entire. Aedeagus relatively long, in basal half with a broad phallobase (periandrial tube) which is suspended from sides of pygofer by oblique struts; a narrowly tubular phallus directed caudad through phallobase, then abruptly bent dorsocaudad at its point of emergence. Genital styles moderately long, broad, produced mesad at base to meet in middle line, in posterior view with outer margin sinuate, inner margin foliaceous, almost straight, apical margin deeply convex, inner apical angle acute.

Type-data: Holotype ♂, MEXICO: San Luis Potosi, Cueva de Valdosa, 8 mi. E. Valles, 24 Nov. 1967 (J. Reddell & S. Fowler), in the National Museum of Natural History, Smithsonian Institution.

The general form of the male genitalia is similar to that found in species of *Oecliidius*, but in finer detail they do not agree with those of any known species. The most curious feature is the enlargement and inflation of the dorsolateral areas of the pygofer: a rather similar development, though less pronounced, is to be found in a Cuban population of *O. fuscus* Van Duzee (sensu Myers 1928:18), which also has genital styles of the same general pattern as *O. hades*.

Superficially, *O. hades* is readily distinguishable from all species known that in the adult stage emerge above ground by the absence of eyes and ocelli, and the general form of the head. Another external feature in which the present species differs appreciably from other adults of this genus is in the fewer teeth on the basal and second metatarsal segments (these usually being 7,7 or 6,6 as compared with 5,4).

FAMILY MEENOPLIDAE

Genus *Phaconeura* Kirkaldy

Phaconeura Kirkaldy, 1906:427. Type-species *Phaconeura froggatti* Kirkaldy

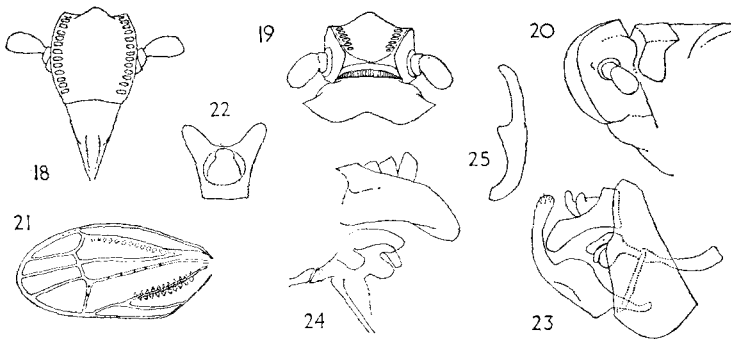
***Phaconeura pluto*, new species**

Figures 18–25

Holotype male: length, 2.5 mm., tegmen, 1.6 mm.

Head in dorsal view about as long as broad at base, with vertex evenly and obtusely rounding into frons, lateral margins carinate, apical margin strongly convex, basal compartment of vertex represented by an ill-defined triangular facet on each side laterobasally; frons in middle line only slightly longer than wide at widest part, widest at middle, lateral margins arcuate, median carina absent, median ocellus obsolete; clypeus at base as wide as frons at apex, postclypeal disc tumid, shorter in middle than broad at base, ecarinate medially and laterally, anteclypeus in profile straight, rostrum reaching at least to middle of abdomen; antennae short, basal segment broader than long, second segment longer than first (about 3 : 1) and longer than broad (about 1.7 : 1), eyes and lateral ocelli absent. Pronotum with disc shorter in middle line than broad at anterior margin (about 1 : 2.5), a shallow impression on each side of middle, carinae feeble, lateral carinae strongly diverging basad. Total length of mesonotum equal to length of vertex and pronotum combined. Posttibiae laterally unarmed, apically with eight small spines, basal metatarsal segment with six spines, second segment with five; tarsal claws slender. Tegmina reaching to apex of abdomen with distal venation reduced and claval suture obscure or absent. Wing absent.

Sordid white, with sclerites slightly darker than membrane. Tegmina



FIGS. 18-25, *Phaconeura pluto*, new species: 18. Frons and clypeus; 19, head and pronotum, dorsal view; 20, head and upper part of thorax, left side; 21, tegmen; 22, anal segment of male, dorsal view; 23, male genitalia, right side; 24, anal segment of male and aedeagus, left side; 25, genital style, posteroventral view.

with apical cells, and clavus posterior to anterior vein, with a very dilute yellowish-brown suffusion.

Anal segment moderately long, in dorsal view with lateral margins diverging caudad, apical margin deeply excavate, anal foramen situated at about middle of total length. Pygofer ventrally moderately long, dorsally short, posterior opening laterally compressed, dorsolateral angles not produced, lateral margins sinuate. Aedeagus very short, comprising a broad horizontal lobe dorsally, a decurved tubular process, and a pair of short lobes ventrolaterally. Genital styles moderately long, broad in basal half, each abruptly narrowed at middle and upcurved in distal half, and narrowly rounded apically, styles contiguous ventrally at base, then separating but reuniting at middle, then abruptly separating again and thence converging to meet, or almost meet, at apex.

Type-data: Holotype, male, WESTERN AUSTRALIA: Nambung National Park, Quandong Cave, 25.xi.72 (J. Lowry) in collection of C.S.I.R.O., Canberra. Other material examined. WESTERN AUSTRALIA: 2 ♂♂, with same data as holotype.

This species belongs to the *pallida* group of *Phaconeura* but differs from its members, *P. pallida* Kirk. (1906), *P. brimblecombei* Woodward and *P. smithi* Woodward (1957), in the relatively longer lateroapical angles of the anal segment and the structure of the aedeagus. The most obvious distinguishing features are those associated with adaptation to a wholly subterranean existence, such as the absence of eyes and ocelli and the reduction of the tegmina and wings. The collection included also two nymphs labelled "Nambung National Park, Cadda Cave, 25.xi.72 (J. Lowry)." These appear to belong to *Phaconeura* but cannot be specifically identified in the absence of adults from the same population.

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