

A REMARKABLE NEW GENUS AND SPECIES
OF FULGOROIDEA (HOMOPTERA) REPRESENTING
A NEW FAMILY.

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Before discussing its systematic position and biology, we formally describe it as follows:—

HYPOCHTHONELLA, gen. nov.

Subterranean maggot-like fulgoroidea with ocelli absent and compound eyes obsolescent: tegmina reduced to mere pads extending only slightly onto base of abdomen.

Head elongate, evenly rounded at apex and covered with short erect pubescence: vertex as long as wide at base, broadly rounding into frons at apex: genæ feebly delimited by obsolescent lateral ridges of frons and vertex, slightly concave in front of the compound eye which is unpigmented and represented only by a circular prominence, weakly faceted anteriorly, but medially smooth without facets and with a few short bristle-like hairs: antennæ situated slightly caudoventrad of eye-prominence, first and second segments subequal in length, each widened from base to apex and about twice as long as wide at apex, second joint distally wider than first and rounded at apex: third joint distinct, ovoid, one-third as long as second joint, bearing a minutely quasi-jointed arista at apex: all antennal joints beset with sparse bristle-like hairs, and apex of second with minute placoid sensillæ; frons convex and rounded basally, flattened and pubescent between antennæ, and slightly concave before fronto-clypeal suture: clypeus elongate, smooth, devoid of lateral carinæ, extending to mesocoxæ, laterally moderately compressed so that loræ are oblique in anterior view; rostrum long, extending beyond middle of abdomen, four-segmented with the two basal very short, ill-defined and not reaching to apex of labrum, apical segment about half as long as sub-apical, bluntly rounded at tip.

Pronotum slightly longer in middle line than head, anteriorly produced between eye-prominences to level of their anterior margin: anterior margin strongly convex, lateral margins straight, posterior margin roundly excavate before anterior border of mesonotum, disc convex in middle with two almost obsolete broadly rounded lateral carinæ which diverge from apex to base, an elongate depression between each ridge and lateral margin of pronotum: the short, erect pubescence concentrated

along middle line and lateral ridges and at humeral angles. Mesonotum broader than long, smooth, devoid of carinae and with a trace of a median longitudinal furrow margined by short, erect pubescence; the scutellum demarcated by a shallow transverse impression, tegulae present, not large.

Tegmina about as long as broad, extending to apex of first abdominal tergite; apical margin broadly rounded, costal margin dilated beyond lateral margin of thorax and convexly rounded, fairly evenly covered with short, erect bristles and with a fringe of longer hairs along costal margin. Venation obsolete but claval suture indicated by glabrous line; *Sc* and distal branches of *M* faintly visible. Wings rather smaller than tegmina, fan-like, fringed with setae, venation not evident.

Legs not specialized, of normal relative length, pubescent, tibiae cylindrical, without spines; post-trochanters short, rocking in a mesad-lateral plane; post-tibiae with four or five short spines at apex, basal joint of metatarsus with four spines and about equal in length to third joint; second joint short, devoid of spines; tarsal ungues rather slender and elongate, with arolia delicate, small, and devoid of supporting sclerites.

Abdomen cylindrical, elongate, tapering to genital segment, each tergite with a narrow band of short, erect bristles; posterior margins of sixth, seventh and eighth tergites respectively with rows of four, five and four, small rounded or lenticular wax glands at each side.

Pygofer short, in lateral view about half as long as high, devoid of medioventral process; aedeagus comprising a broadly tubular phallus with distal appendages, ensheathed in a tubular phallobase; genital styles large, broad and spatulate at base, narrowed and hook-like distally.

Anal segment of female moderately short, broadly rounded. Pregenital sternite short, broadly excavate posteriorly. Ovipositor with first valvula stout, triangular, bearing a few teeth distally; second valvula small, acute; third valvula subquadrate, apical margin armed with a few short incurved spines. Subvaginal plate broad, short, feebly sclerotized; bursa copulatrix devoid of sclerites; vagina with delicate, unpigmented but distinct sclerotic support below.

Type-species, *Hypochthonella caeca*, sp. n.

Hypochthonella caeca, sp. n. (Figs. 1, a, b; 2, a-g.)

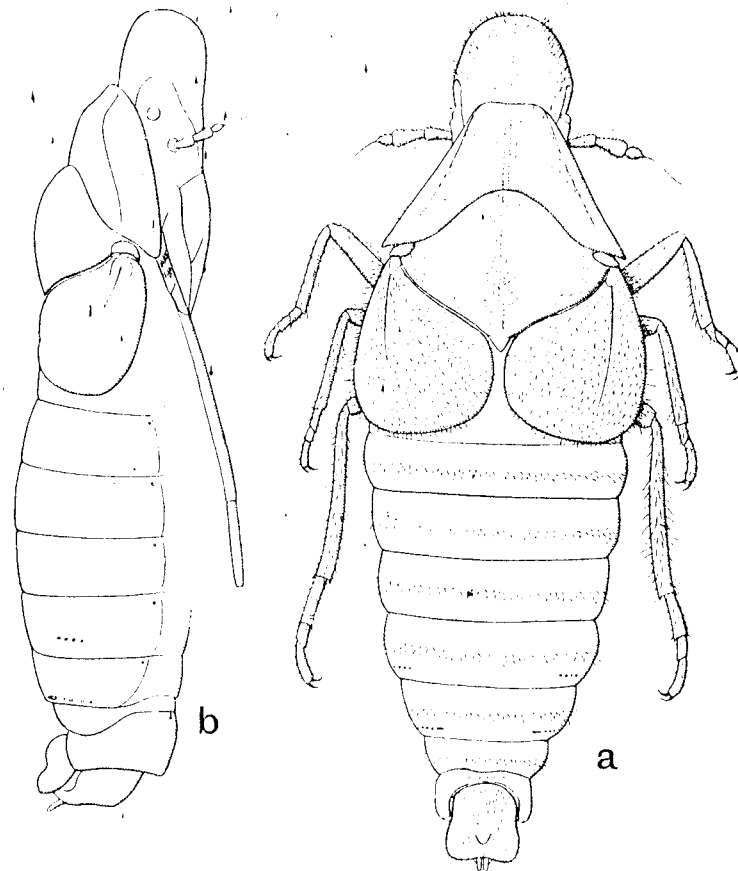
Male.—Length, 9.2 mm. *Female*.—Length, 10.7 mm.

Greatest width of vertex, in dorsal view, about 1.3 times length in middle line. Anal segment of male subquadrate, about as broad as long, in dorsal view expanding distad, lateroapical angles broadly rounded, apical margin weakly concave. Pygofer with laterodorsal angles rather shallowly rounded. Aedeagus bilaterally symmetrical, shallowly U-shaped, ascending distally, dorsoventrally compressed throughout, apically terminating in a pair of moderately long, porrect finger-like processes, blunt at tip; a second pair of finger-like processes, short, directed ventrad then recurved cephalad, emerging from a cleft at base of foregoing processes.

White or sordid white; sclerotized parts of body feebly suffused stramineous; pubescence light brown; male genitalia light testaceous or stramineous; first valvulae of female more or less castaneous.

Ten males and 19 females and 53 nymphs taken at the roots of tobacco, Breechin Farm, Salisbury, Southern Rhodesia, by Dr. G. H. Bunzli (Mar. 21, 1951). The nymphs closely resemble the adults, but are devoid of mature genitalia and wings, while the early instars have only two-jointed post-tarsi. The post-trochanters, unlike those of the adult stage, are furnished with a series of parallel sclerotized ridges.

Fig. 1.



Hypochthonella caeca, gen. et sp. n. Male

(a) dorsal view; (b) lateral view with legs and pubescence omitted.

A further female is in the collection of the British Museum, gummed on a card along with two workers of the ant *Dorylus (Typhlopone) fulvus*

rhodesiae Forel, which are labelled "tending fulgorids on roots of maize, Marandellas, S. Rhodesia, R. Jack, 13.5.1912". Workers of the same ant were taken along with the material from Brechin Farm.

Dr. Bunzli reports that this fulgorid was also found with ants (not *Dorylus*) on the roots of groundnut plants at Hartley, S. Rhodesia, by Mr. P. Clement on the 2nd May, 1916. This species has been confused with nymphal Membracidae. A tube of specimens taken by Mr. Clement on roots of potato with *Dorylus* on the same day in 1916 proved to be membracid nymphs. The fulgorids on groundnut were, however, *H. caeca*.

This genus does not belong to any existing family of Fulgoroidea according to the characterization used by Muir (1930, p. 464) or by Fennah (1949, p. 117).

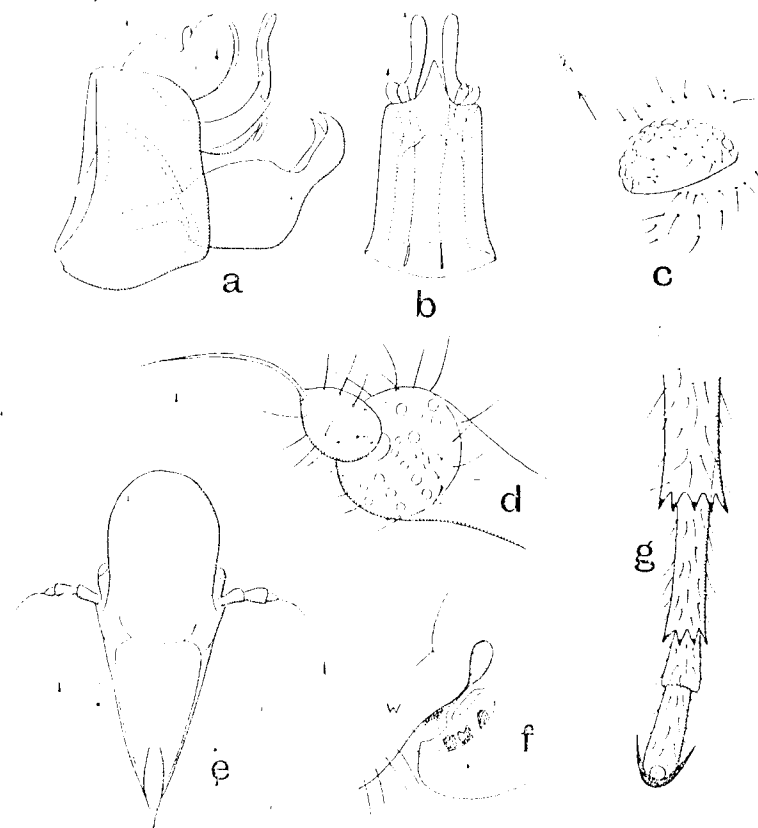
The structure of the male genitalia shows affinity with that found in Issidae, Acanaloniidae, Nogodinidae, Flatidae, Ricaniidae, Lophopidae, Eurybrachyidae and Gengidae; the female genitalia recall with striking fidelity those of certain flatid genera (*Riculiflata*, *Epormenis*, *Flatoides*), but a similar structure is found in some Issidae (*Togoda*, *Ivinga*), while it is approached in Lophopidae (*Symplana*, *Hesticus*) and Gengidae (*Gengis*), where the main difference lies in the structure and function of the third valvula. The unarmed short second post-tarsal joint ostensibly indicates an affinity with the ricanioid group of families.

Hypochthonella differs from all Issidae in shape of head, suppression of carinae, shape of antennae, reduced eyes, relative length of rostrum, shape of pronotum, relative size of mesonotum and of tegulae, shape of tibiae, number of teeth on post-tibia and basal two metatarsal joints, and in form of pretarsus: within Issidae the shape of the genitalia is most closely approached by *Ivinga* and its allies, and the number of post-tibial and basal metatarsal spines by those of Caliscelinae. The resemblances, however, go no further in either of these groups.

The gross structure of the head and thorax, excluding the appendages, matches in very reasonable degree that of *Flatoides*, the resemblance being most pronounced in the shape of the head and pronotum. The antennae are of a type not infrequent in Flatidae, with the first and second joint subequal cylindrical, distally expanding in girth and with placoid sensilla at the apex of the second joint. The third joint, however, is quite different: in Flatidae it is minute, more or less barrel-shaped, and the arista is borne at one edge of the distal margin; in *Hypochthonella* it is large, ovoid, pubescent in the same degree as the two preceding joints, and bears the arista distally at the apical mid-point. The elongate rostrum, the mesad laterad plane of movement of the post-trochanters, the cylindrical legs, the number of spines on post-tibiae and the basal two post-tarsal joints and their comparatively slight excavation for the reception of the next joint distad, the relatively longer and more slender ungues and greatly reduced arolia, and the type of wax glands on the sixth, seventh, and eighth abdominal tergites differ from the corresponding structures in adult Flatidae, though some of these characters are found in nymphs.

The differences which separate *Hypochthonella* from Acanaloniidae and Nogodinidae include all the foregoing, while the female genitalia cannot be matched in either family.

Fig. 2.



Hypochthonella caeca, gen. et sp. n. Male.

(a) male genitalia from left; (b) aedeagus in anterior dorsal view; (c) eye; (d) apex of second antennal segment to show sensory organs; (e) head in ventral view; (f) process on base of wing (*w*), metathoracic spiracle and adjacent tooth-like processes; (g) apex of hind tibia and hind tarsus in ventral view.

According to the current concepts of higher taxonomy in Fulgoroidea, the absence of spines from the second post-tarsal joint, and its relatively small size, suggest that *Hypochthonella* is naturally most closely allied to the ricanioid families Ricaniidae, Lophopidae, Eurybrachyidae and Gengidae. It cannot, however, be placed in any of these. Its points of resemblance to the first of these families comprise only the cylindrical abdomen, which is approached in several genera (e.g. *Carmentalia*) but

not fully matched, the general features of the male genitalia, including the rather short anal segment, and in comparison with *Cobrades* only, an almost equal number of post-tibial and basitarsal spines. It differs in shape of head and antennae, pronotum and legs: the rostrum is far longer than in any ricaniid, the post-trochanters rock transversely, not obliquely, the legs are not angulate in cross section, the unguis and arolia are quite different, as is also the whole structure of the post-tarsus; moreover no ricaniid has third valvula shaped or armed as in *Hypochthonella*.

This genus differs from all Eurybrachyidae and the great mass of Fulgoroidea in the structure of the female genitalia and of the tarsi, as well as in almost every detail of shape and bodily proportions. The only genera with which comparison may usefully be made are those with a narrow cylindrical abdomen: *Hesticus*, *Symplana* and *Augila*. All three differ markedly in the form of the antennae and the length and shape of the rostrum, as well as in the shape of the head, pronotum and in the relative size of the mesonotum. In *Hesticus* the aedeagus bears a broad general resemblance to that of *Hypochthonella*, but the female genitalia are of lophopid type, as also are the post-tibiae and post-tarsi. In *Augila* the male genital styles are rather similar to those in *Hypochthonella*, and in both *Augila* and *Symplana* the post-tibial spines (6 at apex) and cylindrical spineless basal metatarsal joint resemble the corresponding arrangement in *Hypochthonella* more than that in the majority of Lophopidae. The shape of the female genitalia, however, is markedly different.

The Gengidae, known, like *Hypochthonella*, only from South Africa, broadly agree in the structure of the rostrum, the male genitalia, and in the number of spines at the apex of the post-tibiae and basal metatarsus. Both genera of the family, however, differ profoundly from *Hypochthonella* in the shape of the antennae, pronotum and mesonotum, in the laterally spined post-tibiae, the deeply inserted second metatarsal joint, and the large arolia with prominent supporting sclerites. In *Gengis* the wings, though large, lack the anal area: in *Hypochthonella* the wings, though greatly reduced, have not lost their anal area, as is shown by the long line of attachment to the metathorax. The two genera differ also in the entire shape of the female genitalia.

As *Hypochthonella* falls outside the limits of all current family concepts, and in the present state of knowledge cannot be satisfactorily accommodated by any simple adjustment of such limits, the writers consider it necessary to propose a new family for its reception.

Hypochthonellidae, fam. nov.

Form cylindrical; derm weakly sclerotized, with sparse pubescence of microtrichia. Vertex, including occiput, moderately elongate, parallel-sided, shallowly convex, apically rounding into frons, frons longer than broad, lateral margins not or obsoletely carinate, clypeus elongate triangular, ecarinate; ocelli absent, compound eyes reduced, rostrum elongate with subapical joint longer than apical. Pronotum long, anterior margin strongly convex, posterior margin concave, carinae weak

or absent; mesonotum relatively large. Tegmina and wings present, reduced, not covering abdomen. Legs of normal length and proportions, joints terete; post-tibiae laterally unarmed, with about five short spines apically; post-tarsi slender, basal and second joint only shallowly excavate distally, basal joint with about four spines distally, second joint unarmed; tarsal unguis of all legs relatively long and slender, arolia delicate, small, devoid of supporting sclerites.

Abdomen cylindrical, spiracles very small, a few wax-glands latero-distally on the sixth, seventh and eighth abdominal tergites. Aedeagus comprising a tubular phallobase and a tubular phallus with distal appendages.

Ovipositor not elongate, first valvula serrate, third valvula stout, devoid of ceriferous areas. Anal segment of female not specialized.

Type-genus, *Hypochthonella* China & Fennah.

The family may be separated as follows from those of the ricaniid section of Fulgoroidea to which it runs in conventional keys:—

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| 1 (2) Tegulae small, partly overlapped by pronotum; post-tibiae with five spines at apex, basal metatarsal joint not inflated, with four or five spines apically | 3. | |
| 2 (1) Tegulae moderately large to large; post-tibiae almost invariably with 8–10 spines at apex, basal metatarsal joint inflated; minutely and densely pilose, or with more than five spines distally (if with five, both on post-tibiae and basal metatarsi apically, then vertex short, tegminal venation not reduced and wings ample) | 5. | |
| 3 (4) Abdominal spiracles large and exposed; antennae with third joint minute; tarsal arolia large, fully two-thirds as long as unguis, with supporting sclerites; compound eyes normal | | Gengidae. |
| 4 (3) Abdominal spiracles minute and obscure; antennae with third joint exceptionally large; tarsal arolia minute, delicate, devoid of supporting sclerites; compound eyes reduced | | Hypochthonellidae. |
| 5 (6) Mesonotum relatively long, with lateral discal carinae curving strongly mesad anteriorly; post-trochanters normally rocking in an oblique (mesoventrad-laterodorsad) plane, rarely transversely; basal metatarsal joint normally shorter than second plus third, rarely equal. Anal segment of female and valvulae of ovipositor not ceriferous. Tegmina with basal cell normally large, broad and polygonal, giving off three or four sectors; costal area usually containing only a few large quadrate cells, rarely very many | | Ricaniidae. |
| 6 (5) Mesonotum short, broadly triangular; post-trochanters rocking in a horizontal (mesad-lateral) plane; basal metatarsal joint normally longer than second plus third; anal segment of female and/or third valvulae of ovipositor normally ceriferous, or if not then tegmina more than twice as long as broad and third valvulae not denticulate; tegmina with basal cell normally not large; if distinct, then at least twice as long as broad, oval-subrectangular, giving off three sectors; costal area, when present, with oblique and often narrow cells, or without cross veins | 7. | |
| 7 (8) Vertex not three times as broad as long in middle line; head with eyes normally narrower than pronotum, abdomen rarely broad and depressed | | Lophopidae. |
| 8 (7) Vertex fully three times as broad as long in middle line, head with eyes as wide as pronotum; abdomen broad, dorso-ventrally depressed | | Eurybrachyidae. |

If the characters of *Hypochthonella* in combination are without equal, they can, at least to some extent, be matched individually. The projecting dome-like apex of the head is similar to that of short-headed species (or subspecies) of *Rhinotettix* (Delphacidae). The head, as already mentioned, is like that of some *Flatoides*, as are also the antennae, apart from the third joint, which is unique in its size and structure. Absence of ocelli is relatively common in Fulgoroidea, but reduction of the compound eyes in the adult stage is without parallel: it is reasonable to consider this development as adaptive. Loss of the carina between vertex and frons has taken place many times (*Nelidia* (Achilidae), *Nisia* (Meenoplidae)), as has also reduction of the lateral carinae of the clypeus: absence of the lateral carinae of the frons is uncommon in adult Fulgoroidea (though it is universal in Tettigometridae) but is frequent, if not general, in early nymphal instars. In *Hypochthonella*, if the distribution of the microtrichia may safely be taken as a guide, it would seem that, before reaching its present ecarinate form, the adult head was carinate exactly in the manner of *Flatoides*. The elongate rostrum, both in size and proportions is closely similar to that of the Nogodinid *Riancia*.

The elongate pronotum is an uncommon structure, but a similar development is found in a few genera of several families (*Karna* (Tropiduchidae), *Rhotula*, *Myconus* (Achilidae), *Zezeja* (Lophopidae) and *Flatoides monilis* Van Duzee (Flatidae)). The mesonotum is of normal shape, but is not overlapped anteriorly by the hind margin of the pronotum. This relationship of the two nota is general in nymphal Fulgoroidea, but elsewhere unknown in adults. The cylindrical unarmed legs are of normal proportions in relation to the size of body, and may be broadly compared with those of adult Tettigometridae, or of most early fulgoroid nymphs. The latter comparison is the more illuminating, as the structure of the hind tarsi and the pretarsus of all legs is unquestionably juvenile. As far as the tarsal joints are concerned, this is best seen in the metatarsus, where the first joint is only shallowly excavated distally to receive the second, which is little narrowed basally, and in turn, only weakly excavate distally for the reception of the third joint. In conjunction with this structure must be considered the exceptionally low number of post-tibial and basal metatarsal marginal spines (5 or 4, and 4 respectively); such figures are approached in the calisceline genera *Fitchiella*, *Bruchomorpho* and *Asarcopus*, the Flatidae *Cenestra*, *Poeciloflata*, *Paraflata*, *Siscia* and *Paraflatoptera*, the Ricaniid *Cotrades intricata* Wlk., the Gengid *Gengis*, and many Tropiduchidae: the absence of spines from the second metatarsal joint is, of course, characteristic of the ricaniid group of families, but, in the present connection, it must not be overlooked that it is also general in nymphal Fulgoroidea at some stage. The structure of the pretarsus is unusual in three features: the reduction of the arolia in proportion to the size of the unguis, the absence of supporting sclerites, and the relative slenderness of the unguis themselves. The first of these is

found in the larger members of the Fulgoridae, and, outside the superfamily, in Cicadidae, and its possible significance has already been discussed (Fennah, 1945, p. 125); the absence of supporting sclerites is a nymphal feature: it is presumed that the slenderness of the unguis may be adaptive.

The cylindrical form of the abdomen, and its simple sclerotization are perfectly matched in many nymphal forms of Fulgoroidea, and are closely approached by such genera as *Hesticus* (Lophopidae) and *Paralasonia* (Nogodinidae). The spiracles, as so far examined, present no unusual features either in shape or position. The small wax-glands on the posterolateral margins of the sixth, seventh, and eighth tergites correspond to those in the same position in other Fulgoroidea and are not greatly different from those of prosotropane Kinnaridae. The similarities of the genitalia to those found in genera of other families have already been mentioned.

Reference has been made above to nymphal structures: and it is highly probable that the external shape of *Hypochthonella* has been determined by the persistence of these, far more than by evolution along an independent path remote from the remainder of the "Issoid" and "Ricanioid" families.

In Fulgoroidea which spend nymphal life below ground (Cixiidae, Kinnaridae) the compound eyes are almost vestigial in the first instar and increase in size, by multiplication of facets, at each instar, but even in comparatively late instars are substantially little different from those of *Hypochthonella*. They are, however, as far as is known, pigmented in the later stages. Again, the median line of the occiput, and pronotum, and, more obscurely, of the mesonotum is grooved. Under moderately high magnification it can be seen that the sides of the groove are relatively thickened (though unpigmented) while the floor of the groove is thin and hyaline. An exactly similar structure is found in fulgoroid nymphs, and forms the line of weakness along which the skin splits at ecdysis, and thus the opening through which the nymph emerges. Except in this genus, such a structure is unknown in adult forms.

The condition of the tegmina and wings is of interest. The former are quadrate, with the costal margin deeply rounded at the base; the venation, in the material examined, is obscure, but it would seem that *Sc* and *R* separate before the apex and that *M* is branched approximately as in Flatidae, while a claval sutural line is indicated, though no suture is developed. The wings, broadly rounded-triangular, are not very much smaller than the tegmina, and are attached to the mesonotum along the whole of their inner margin. This form of attachment is found in Fulgoroidea in which the wings have the anal area fully developed: in those genera where the wings are of normal length but the anal area has been lost (some Issidae, *Gengis*) the attachment involves only the basal sclerites. This means that *Hypochthonella* has almost certainly acquired its present wings by direct brachypterous development from a form with fully amplate wings, and not from a form with reduced wings.

The lack of pigment in the sclerites of the derm is general in subterranean nymphal Fulgoroidea: in *Hypochthonella* the development of pigment is

extremely feeble, but enough, under appropriate lighting and magnification, to distinguish sclerotized areas from membranous.

The biology of this species is unusual. Adults of both sexes and nymphs in various instars were taken below the soil surface on roots of maize and tobacco, and on the latter their presence, in great numbers, was associated with a decline of the plants. The fulgoroids were attended by ants. Similar outbreaks on a massive scale, also in the presence of ants, are seasonally common in rhizococcine coccidae on sugar cane in the West Indies, and, even within Fulgoroidea, substantial populations of nymphal *Oliarus maidis* Fenn. and *Paramyulus cocois* Fenn., may develop on the roots of grasses, though in the case of the last two ants are not necessarily present. The unusual feature as far as Fulgoroidea are concerned, is that the adults remain underground: they are constantly associated with a nymphal habitat and nymphal food. Mating presumably takes place below ground in or near the site of the parent colony, as the sexes have no means of flight and show no adaptation to traversing varied surfaces on foot, as is found in normal Fulgoroidea. Some degree of communication at relatively short range may be possible: the base of the costal margin of the hind wing is serrate or minutely denticulate, while the hollow in the metathorax which accommodates this part of the wing is minutely but stoutly toothed: this may be a simple strigil. The means of dispersal of the mated female are as yet conjectural: it may prove, as in rhizococcine coccidae, to be effected through the agency of ants.

Though direct observation is at present lacking, the close conformity between the genitalia of both sexes and those of Platidae justify a provisional assumption that copulation and oviposition take place as in their closest flatid counterparts. Here, in copulation, the male genitalia, in an inverted position, lock with those of the female by the curved distal processes of the genital styles becoming hooked mesad over the base of the upper side of the third valvule, while the apical margin of the male anal segment rests lightly against the sixth abdominal sternite of the female: during copulation the male may be completely inverted in relation to the female, or may assume anteriorly a normal posture, facing in the opposite direction to the female, while the abdomen is twisted through 180°. In oviposition the female takes a very firm grip of the substrate by means of the stout spines on the pincer-like third valvule, and then cuts a deep slit into the substrate by means of the first valvule, and eggs are guided through the second valvule into the slit before the first valvule are withdrawn.

In assessing the relationships of Hypochthonellidae with other fulgoroid families two interpretations are possible. In one, it is to be assumed that the spineless condition of the second metatarsal joint represents a true adult character, and that the family is one of the "ricanioid" groups. On this basis the family would appear to be most nearly related to Ricaniidae or argiline Lophopidae, the latter being the more probable of the two (on post-trochanteral characters), but in either case the gap is wide. In the alternative interpretation the condition of the second metatarsal joint is considered to be immature, as are many other characters,

and accordingly not indicative of the true phylogenetic position of the family. On this basis the family can be placed with scarcely any hesitation close to the Platidae. It cannot, on present evidence, be sunk as a sub-family in the Platidae, since, both in the adult and nymphal form, it lacks certain characteristic features of all known flatid nymphs (dorso-ventral compression: distribution and types of wax-glands) and possesses features which are not found in Platidae (pubescence: metathoracic strigil-like organ). Though the second interpretation is the more satisfactory, in that it indicates both the line of evolution taken by Hypochthonellidae (neoteiny) and the stock from which it could have arisen, final judgment must be deferred until further species of this family are discovered.

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