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Redescription of *Calohelcon* Turner (Insecta: Hymenoptera: Braconidae), Description of a New Species, and a Reappraisal of the Significance of Certain Character States in the Helconinae

D.L.J. QUICKE* & G.A. HOLLOWAY

1 Department of Animal Biology, University of Sheffield, Sheffield, England, S10 2TN
* Australian Museum Visiting Fellow
2 Division of Invertebrate Zoology, Australian Museum, 6-8 College Street, Sydney, NSW 2000, Australia

ABSTRACT. *Calohelcon obscuripennis* Turner is redescribed and illustrated for the first time. *Calohelcon roddi* n.sp. from New South Wales is described, illustrated and differentiated from *C. obscuripennis*. The hindwing of *C. roddi* possesses a distinct transverse vein m-cu, a feature unknown in any other Helconinae but present in many members of the ‘cyclostome’ subfamilies Doryctinae and Rogadinae, and in the apparently related Alysiinae, Betylobraconinae, Gnamptodontinae, Histeromerinae, Opininae and Telengaiinae. The presence of hindwing vein m-cu is interpreted as a plesiomorphous character state in the ‘cyclostome’ assemblage, but it is suggested that the presence of m-cu in some *Calohelcon*, represents a re-expression of genetic information, the expression of which had been previously suppressed. The phylogenetic significance of a number of other features of *Calohelcon*, and of Helconinae in general, are discussed.


Recently major advances have been made in our understanding of the phylogenetic relationships between the subfamilies of Braconidae (Capek, 1970; van Acterberg, 1984; Sharkey, personal communication), although there is as yet no clear consensus of opinion, and several subfamilies are problematical. Application of Hennigian cladistics (Hennig, 1966) has proved invaluable in that by consistently differentiating between
Calohelcon (monobasic). Additional species: Calohelcon roffi n.sp.

**Diagnosis.** Moderately large braconid wasps with wingspans greater than 2 cm. Maxillary and labial palps with 6 and 4 segments respectively. Antennal sockets with protruding lateral margin. Malar suture absent. Malar space large. Frons with a well-developed midlongitudinal carina. Eyes glabrous, not emarginate. Hypostomal and occipital carinae complete and lamelliform or the occipital carina largely reduced. Mesosoma smooth and shiny. Pronotum with a crenulate groove anteriorly. Propodeum with a lateral carina. Median lobe of mesocoxa not depressed relative to lateral lobes. Precoxal suture absent. Mesopleural suture crenulate. Propodeum without carinae, largely glabrous; not differentiated from the metapleural. Propodeal spiracle small and elliptical. Metapleural with a well-developed flange. Forewing with costal cell distinct for more than half length from tegula to pterostigma. Forewing with veins 1r-m, 2A and 3-1A. Hindwing with veins C and 2A well-developed; vein m-cu represented by a least a spur arising from 2-M; without veins r and r-m. Claws simple with small, rounded, non-pectinate basal lobes. Hind trochanter not slender. Hind femur smooth ventrally, without rugae. Metasoma smooth and shiny. First metasomal tergite large; without dorsal or dorsal-lateral carinae; strongly bulbously produced on each side anterodorsally. Ovipositor approximately as long as the body; with a preapical dorsal, circular notch in lateral aspect. Venom gland reservoir thin walled and weakly muscularised (Type II of Edson & Vinson, 1979).

**Description.** Terminal flagellomere pointed but not acuminate. All flagellomeres longer than wide. Lower margin of clypeus carinate, forming a narrow transverse ‘hypoclypeal depression’. Clypeus distinctly differentiated from the face by a groove. Face broadly setose medially; with a midlongitudinal raised area. Antennal sockets margined by a flange laterally. Frons depressed, with a well-developed midlongitudinal carina. Pronotum with a small pronope formed by the submedial pair of carinae. Notauli moderately well developed, not crenulate. Median lobe of mesoscutum distinctly protruding over the pronotum. Anterior scutellar sulcus broad and crenulate. Scutellum with a submarginalar, posterior row of pits. Epicominal area smoothly impressed, without sculpture. Episternal scrobe absent. Median area of metanotum with a medial and a pair of lateral anteriorly diverging carinae. Propodeum not differentiated from metapleuron.

**Forewing.** Costal cell narrow but distinct for at least the apical half of vein C. Second submarginal cell short. Vein r-m moderately curved, with one posterior bulla. Vein 1-SR+M sigmoid, with or without a short posteriorly directed spur. Vein 2-SR+M longitudinal. Vein cu-a postfurcal. Vein 1A reclivous.

**Hindwing.** Vein C well developed, without especially thickened bristles apically (see Quicke, 1982). Costal cell distinctly though weakly sclerotised posteriorly. Vein 2-SC+R longitudinal, without distinct large, erect bristle(s). Anterior margin of wing reaching vein SC+R1 considerably before the hamuli proper (= distal hamuli).
Vein R1 with 8 to 10 hamuli, the basal 3 being somewhat larger than the remainder. Vein M+CU much longer than 1-M. Vein m-cu sometimes represented by a short spur or a distinct short vein arising from near the base of vein 2-M. Vein cu-a approximately perpendicular to 1-M. Plical cell moderately large. Vein 2-A well developed. Setaosity of wing membrane considerably less dense basally than apically.

Claws with a small rounded basal lobe, without pectination. Legs moderately slender. Tarsi without an obvious midventral, longitudinal row of setae.

Metasoma smooth and shiny, largely glabrous; inserted above hind coxae. First tergite large, without dorsal or dorsolateral carinae, strongly bulbously swollen on either side, anterodorsally; with a distinct lateroventral. First spiracle small. Laterotergites of all tergites well developed.

**Key to the Species of Calohelcon**

(females only)

1. First metasomal tergite constricted submedially in dorsal aspect (Fig.1a); mesoscutum and metasomal tergites 5-9 black; wings yellowish on basal half, grey-brown apically ................................................................. *C. obscuripennis*

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First metasomal tergite not constricted submedially in dorsal aspect (Fig.3f); mesoscutum and metasomal tergites 5-9 orange; wings more or less evenly light brown ............................................................................................................................................ *C. roddi* n.sp.

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**Calohelcon obscuripennis** Turner

*Fig.1*

*Calohelcon obscuripennis* Turner, 1918: 165.

**Material examined.** **Holotype** female (BMNH, 3c 901): “Australia. R.E. Turner. 1909 - 220.”, “Calohelcon obscuripennis” Type Turn. “. “B.M. TYPE HYM. 3c. 901” & “Type H.T.”. **Paratype** male (BMNH): “c7.2.01 Victoria”, “Australia R.E. Turner 1909 - 220” & “Calohelcon obscuripennis” cotype Turn.”.


**Description.** **Females.** Length of body 14.0-14.5 mm, of forewing 14.0-15.0 mm, of ovipositor (part extended beyond the metasomal tergites) 165.19.0 mm and afo antenna (broken in holotype) 16.0 mm.

Antenna with 47 flagellomeres, slightly longer than the forewing. Terminal flagellomere partially fused to the penultimate flagellomere. Median flagellomere parallelogram-shaped in profile; 1.35 x longer laterally than wide. First flagellomere 1.2 x longer than both the 2nd and 3rd separately, the latter being 2.2 x longer than maximally wide. Ratios of height of clypeus: intertentorial distance: tentorio-ocular distance = 17:26:30. Malar space 0.61 x height of eye. Ratio of height of eye: width of face: width of head = 41:69:112. Facial ridge densely punctuate, bordered laterally by grooves. Antennal sockets with crenulate margins anteriorly and laterally. Frons largely without carinae except anteriorly.

Ratios of distance between posterior ocelli: transverse diameter of posterior ocellus: shortest distance between posterior ocellus and eye = 12:8:27.

Mesosoma 1.6-1.68 x longer than high. Scutellar sulcus with 5-6 transverse crenulae. Scutellum sometimes with a short midlongitudinal row of fine pits.


**Hindwing.** Vein M+CU 2.73 x longer than 1-M. Vein R1 with 9 hamules.


First metasomal tergite approximately as long as maximally wide; distinctly narrowing behind the
basodorsal lobes. Second tergite 3.0 wider than long.
Largely black; the head largely yellow except for a
mark on the stemmaticum and the centre of the frons;
posterior third of propodeum, posterior half of
metapleuron, first tergite except for a medial mark
subposteriorly, ivory white. Basal half of both wings
yellowish becoming gradually grey-brown apically;
venation brownish (paler basally); pterostigma brown
except for a small yellowish mark basally.

*Calohelcon roddi* n.sp.

**Type material.** Female **HOLOTYPE** and **PARATYPE** in the
Australian Museum collected by Norman Rodd from Lane

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**Fig.1.** *Calohelcon obscuripennis* Turner, female: a, first metasomal tergite, dorsal aspect; b, first metasomal
tergite, lateral aspect; c, head, dorsal aspect; d, head, lateral aspect.
Fig. 2. *Calohelcon roddi* n.sp., female: a, head, frontal aspect; b, head, lateral aspect; c, head, dorsal aspect; d, head, oblique aspect of posterior, lower left part (mandible black); e, anterior of mesosoma, lateral aspect; f, mesosoma, dorsal aspect; g, median area of metanotum and posterior of scutellum, dorsal aspect. Scale line a,b,c,d,e = 1 mm; f = 2.0 mm; g = 0.5 mm.
Fig.3. *Calohelcon roddi* n.sp., female: a, terminal 2 flagellomeres; b, right forewing; c, right hindwing; d, apex of hind tarsus, lateral aspect; e, posterior of mesosoma and anterior of metasoma, lateral aspect; f, metasoma, dorsal aspect; g, metasoma and ovipositor, lateral aspect; h, vein 1-SR+M of right forewing; i, vein 1-M of right hindwing. Scale line: a = 0.25 mm; b,c,e,f,g = 2.0 mm; d = 0.5 mm; h,i = 0.1 mm.
Cove, Sydney, NSW; holotype collected 17 July 1943; paratype collected on 11 Aug. 1946.

**Description. Females.** Length of body 13.3-13.5 mm, of forewing 11.3-12.5 mm, of ovipositor (part exerted beyond metasomal tergites) 14.5-16.0 mm and of antenna 12.5 mm.


Mesosoma 1.64 x longer than high. Scutellar sulcus with 6 or 7 transverse crenulae. Scutellum sometimes with a short midlongitudinal row of fine pits.

**Forewing.** Ratios of lengths of veins r: 3-SR : SR1 = 4 : 3 : 24. Ratios of lengths of 2-SR : 3-SR : r-m = 6 : 3 : 5. Vein m-cu 2.5 x longer than shortest distance between 1st discal cell and 2nd submarginal cell. Vein 3-CU1 very weakly expanded posteriorly.

**Hindwing.** Vein M+4-CU 2.9 x longer than 1-M.


First metasomal tergite 1.1 x longer than maximally wide, not narrowing behind the basadorsal lobes. Second tergite 2.35 x wider than long.

Antennae, apical 3 segments of both pairs of palps, stellmaticum, tegulae, scutellum, mesopleuron, mesosternum, metanotum, anterior half of propodeum and metapleuron, forelegs (except for coxae), ventral side of femur, mid- and hindlegs, metasomal tergites 2-4, metasomal sternites (except for hypopygium) and ovipositor sheaths, black. Posterior halves of propodeum and metapleuron, first metasomal tergite except for a small dark mark medioposteriorly, ivory white. Remainder of head and body, orange-red. Wing venation piceous brown, wing membrane more or less evenly light brown.

**Discussion**

Members of the Helconinae possess many plesiomorphic character states, and the subfamily as whole is difficult to characterise on the basis of apomorphous character states and tends to fall out at the end of keys to braconid subfamilies (van Achterberg, 1976). The presence of a distinct forewing costal cell (Fig.2b), forewing veins 1A and 2A, hindwing vein 2A, complete ocellipalp, hypostomal (Fig.1d) and prepectal carinae (Fig.1e) and having metasoma inserted above the hind coxae collectively indicate an early origin from the remainder of the family. Nevertheless, the Helconinae appears to be clearly associated with the majority of non-cyclostome, braconid subfamilies on the basis of their endoparasitism, of the presence in young larvae of an evaginated rectum (both apparently apomorphous character states) and by the possession of a weakly musculated, thin walled venom gland reservoir (type II of Edson & Vinson, 1979) (a plesiomorphous character state).

Further, in all of van Achterberg’s (1984) groups III (excluding the Betylobraconinae which belong elsewhere) and IV comprising the subfamilies Helconinae (except for Calohelcon), Meteorinidae, Blacinae, Euphorinae, Cercobraconinae, Trachypetinae, Xiphozelinae, Homolobinae, Sialphinae, Cenococelinae, Agathidinae, Macrocentrinae, Amicrocentrinae, Orgilinae, Cheloninae, Neoneurinae, Cardiochilinae, Khoikhoiinae and Microgastrinae, hindwing vein m-cu is absent. In contrast, m-cu is present, albeit with a rather reticulate distribution in the Alysiinae, Betylobraconinae, Doryctinae, Gnaopodontodinae, Histeromerinae, Opiniinae, Rogadinae and Telegasinae. Clearly, m-cu has been repeatedly lost within the Doryctinae and Rogadinae but it is represented in many distantly related genera in both of these subfamilies. It is never present in the Braconinae although a possible remnant may be present at the base of the poorly developed distal abscissa of the cubital vein (37-CU) present in some Calcaribracon Quicke. It is also absent from the Mesostoinae which show a marked reduction in venation (van Achterberg, 1975).

The presence of a trace of m-cu in Calohelcon firstly reinforces the notion that the Helconinae is a group that has diverged relatively little from the ancestral braconid groundplan. Secondly, it raises the problem of whether its presence in Calohelcon should be regarded as plesiomorphic or apomorphic. If plesiomorphous, then the assumption is made implicitly that it has been retained in all the ancestors of the taxon under consideration. Thus, considering what we know of the relationships of the Helconinae and the relationships within the Braconidae in general, would appear to be less parsimonious than assuming a re-expression of a gene or genes for vein m-cu is also absent in the Ichneumonidae. Riegel (1948) and Tobias & Belokobylsky (1983) similarly use the occurrence of aberrant wing venation features in the Braconidae as a means of interpreting phylogeny. Forewing vein 2m-cu is a good example. It is present in the vast majority of Ichneumonidae (it is only absent in a few species) but has also been found as an aberrant condition in Histeromerus Wesmael (Histeromerinae) and Orgilus.
complex venational state as seen in the Symphyta and condition for the Hymenoptera as it represents a more Apozyx Trachypetinae. An open costal cell is undoubtedly the plesiomorphous partly open cell is also found in some Helconinae and presence of a lateral mesoscutal carina is a plesiomorphous carinae (e.g. many Pimplinae, Tryphoninae). Closure of the costal cell is usually considered a developed (even if somewhat obscured) lateral mesoscutal carina is present in most, if not all Helconinae, and therefore, since this subfamily undoubtedly had an ancient origin, it seems reasonable to consider that the absence of a lateral mesoscutal carina in several other characters occurring in Calohelcon and other Helconinae warrant further discussion and are considered below.

Lateral carina of mesoscutum. Van Achterberg (1979a) states that the absence of a lateral mesoscutal carina in his new subfamily, the Amicrocentrinae, should be considered as plesiomorphous. However, a well-developed carina is present in most, if not all Helconinae, and therefore, since this subfamily undoubtedly had an ancient origin, it seems reasonable to consider that the presence of a lateral mesoscutal carina is a plesiomorphous character state for the Braconidae, otherwise it has to be assumed to have arisen independently. Further, it should be noted that many Ichneumonidae have a well-developed carina (even if somewhat obscured) lateral mesoscutal carinae (e.g. many Pimplinae, Tryphoninae).

Forewing with an open costal cell. An open forewing costal cell (Fig.2b) is known to occur in only a few subfamilies of Braconidae, it is best developed in the Amicrocentrinae (van Achterberg 1979a, 1983a) but a partly open cell is also found in some Helconinae and Trachypetinae. It is unknown among the Ichneumonidae. An open costal cell is undoubtedly the plesiomorphous condition for the Hymenoptera as it represents a more complex venational state as seen in the Symphyta and also in the extinct Praeichneumonidae (Rasnitsyn, 1983). Closure of the costal cell is usually considered a synapomorphy for the Braconidae + Ichneumonidae and it should be pointed out that it is highly unlikely that the somewhat open costal cell found in these three braconid subfamilies represents a continuity in evolution from the Symphyta all the way through to the Braconidae; if that were the case then one requires multiple independent closures of the costal cell at least in three lineages of braconid subfamilies and also in the Ichneumonidae. It seems to us more likely that, as argued for hindwing vein m-cu above, an open costal cell represents the re-expression of genes which have previously been suppressed. Thus, strictly speaking, such character re-expressions should be regarded as apomorphous rather than plesiomorphous character states, albeit that they may be more likely to be re-expressed in groups showing a large proportion of other, truly plesiomorphous character states such as in the Helconinae.

Position of spiracles of second metasomal tergite. Van Achterberg (1984) regards the plesiomorphous character state for the Braconidae to be with the spiracles located in the tergum as is the case in its sister group, the Ichneumonidae rather than in the latero-tergite (= epipleuron). Care has to be taken when examining this character in some Braconidae, because the lateral crease of the second metasomal tergite does not necessarily coincide with the border between the tergum and the laterotergite (e.g. in the Histeromorinae). However, in Calohelcon, KOH treatment of the metasoma reveals a distinct zone of reduced sclerotisation corresponding with the lateral crease of the second metasomal tergite and corresponding zones in the less distinctly creased or uncreased posterior tergites. Thus, in this genus there can be no doubt that the spiracles are located in the true laterotergites (Fig.3g). Given this and the overall assemblage of plesiomorphous character states displayed by the Helconinae, the possibility that the Helconinae display the plesiomorphous character state for the Braconidae should also be considered. The alternative is that migration of the spiracle into the laterotergite has occurred independently in the Braconidae in at least four lineages (van Achterberg, 1984), viz. in the Alysinae, in the Aphidiinae, in the Ypsistocerinae + Mesostoxinae, and in van Achterberg’s proposed lineage III + IV which includes the Helconinae and the majority of non ‘cyclostome’ subfamilies. Since there appears to have been no such trend in the Ichneumonidae and because the second metasomal spiracle is also situated laterally in the Stephanidae, it would be more parsimonious to consider this to be the plesiomorphous condition. This view was proposed by Mason (1981) who additionally cites the fact that the second and subsequent metasomal spiracles are situated in the laterotergites in the Symphyta, and that in the primitive subfamilies, Xyelidae and Pamphiliidae, the first metasomal spiracle is also in the laterotergite. Assuming that Mason was correct in his polarity decision, then we see that the majority of cyclostome and related subfamilies of
Braconidae are united by an apomorphous migration of the spiracle to the tergum (subfamilies Braconinae, Vaepellinae (nearly - see Quicke, 1987), Telengaiinae, Doryctinae, Rogadinæ, Opiinae, Gnamptodontinae, Histeromerinae (the statement in van Achterberg, 1984 is incorrect) and Betylobraconinae (the placement of this subfamily in van Achterberg’s, 1984 cladogram is considered erroneous; Tobias, 1979; Sharkey, personal communication). The placement of the remaining subfamily with a notal spiracle van Achterberg’s (1984) Dirrhopinae needs further consideration but it appears to be close to the Microgastrinae (Sharkey, personal communication). With this arrangement three reversals only have to be cited: for Alysiinae which has the second spiracle in the epipleuron, in the Dirrhopinae and in the peculiar subfamilies Ypsistocerinae and Mesostoinae. The Ypsistocerinae are associated with termites and may be derived from the Doryctinae. The Mesostoinae are very small wasps and too poorly known for further comment.

Number of hamules. The plesiomorphous number of hamules on vein RI of the hindwing of Braconidae is approximately ten as indicated by outgroups comparison with the Ichneumonidae (Townes, 1969) and other equivalent sized Hymenoptera. However, in the majority of Braconidae, the number is usually reduced to three or sometimes up to six. Few braconids other than Calohelcon have eight to ten. Among these are members of the endemic Australian subfamilies, the Cercobarconinae and the Trachypetinae, and it may be significant that Trachypetus is one of the few braconids with a partially opening forewing costal cell. Thus, the number of hamules indicates another possibly atavistic character state in Calohelcon and in the Trachypetinae.

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