

Revision of European species of genus *Metaphycus* Mercet (Hymenoptera: Chalcidoidea: Encyrtidae), parasitoids of scale insects (Homoptera: Coccoidea)

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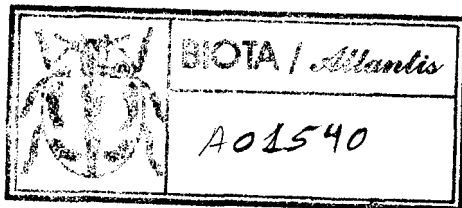
Abstract. Fifty-three European species of *Metaphycus* are revised. Three generic synonymies are proposed, nine species are described as new, sixteen new specific synonymies and four new combinations are proposed and lectotypes are designated for three species (*lounsburyi*, *philippiae*, *timberlakei*). A dichotomous key to the species is provided, each species is further characterized by a description and notes are provided on their distribution and known hosts. A host-parasitoid index for all known European species is provided as an appendix.

Introduction

Members of the hymenopterous family Encyrtidae are unquestionably among the most important natural enemies of scale insects (Homoptera: Coccoidea). Alongside Coccinellidae (Coleoptera) and Aphelinidae (Hymenoptera), Encyrtidae is one of the three most successful groups of insects to have been used in the biological control of pest scales (Noyes, 1985; Greathead, 1986). Indeed, members of this family have been utilized in some of the most successful biological control programmes in recent years, especially of mealybug pests such as the Rhodes grass mealybug (*Antonina graminis*, see Dean *et al.*, 1979) and cassava mealybug (*Phenacoccus manihoti*, see Neuenschwander *et al.*, 1989, 1990). Perhaps this is not surprising, as almost all primary parasitoids of mealybugs belong to Encyrtidae. In addition to mealybugs, many soft scale (Coccidae) pests have also been controlled by importing and releasing encyrtids (Noyes & Hayat, 1994; Ben-Dov & Hodgson, 1997), especially those of genus *Metaphycus* (Noyes & Hayat, 1994). Several species of *Metaphycus* have been imported into Europe or exported from Europe for the control of soft scale pests (see Table 1). It is also likely that many potential pests of fruit trees, ornamentals and agricultural crops are prevented from achieving pest status by the action of natural populations of species of this genus (see Ben-Dov & Hodgson, 1997).

Thus, given the importance of species of *Metaphycus*, it is perhaps surprising that very little has been done to facilitate the accurate identification of European species of the genus. Currently the only means available by which to identify them is by a direct comparison of material with the original, often inadequate species descriptions, or by using keys based largely on these original descriptions (Trjapitzin, 1975) or which treat only a small proportion of the known European species (Viggiani & Guemer, 1988a). In some cases it may be possible to use revisions of species occurring in other regions, but even the best of these can present some problems because some names have been incorrectly applied, e.g. *lounsburyi* Howard (see below). The present study is aimed at rectifying this situation by providing a reliable framework for the identification of all species of *Metaphycus* that are known to occur in Europe (here defined as those countries ranging from Finland and Norway in the north to the British Isles and Portugal in the west, northern Mediterranean countries and Turkey in the south and the Urals south to Armenia in the east). The study is based, wherever possible, on the examination of primary types or reliably determined material.

Abbreviations for depositories that house the material examined in the study include: BNMH, The Natural History Museum, London; CAS, California Academy of Sciences, San Francisco; DEZP, Università degli Studi di Napoli, Portici, Italy; FBUB, Facultat de Biologia, Universitat de Barcelona, Barcelona; HNHM, Hungarian Natural History Museum, Budapest; IEE, Instituto Español de Entomología, Madrid; KYUN, Kyushu University, Fukuoka, Japan; MJGC, M.J. Gijswijt Collection, Amsterdam; MKCF, M. Koponen Collection, University of Helsinki, Helsinki; NHRM, Naturhistoriska Riksmuseet, Stockholm; NIAS, National



Male. Length 0.5 mm. Very similar to female except for antenna (Fig. 40), genitalia and very slightly darker coloration. Head yellow with frons brown and occiput black; antenna with scape and pedicel yellow, scape with a brown streak along dorsal margin; funicle and clava brown; dorsum of thorax brown, sides and venter yellow; legs yellow; gaster black. Antennal torulus (Fig. 41) with a line of secretory pores along inner margin extending slightly past its dorsal margin. Scape 2X as long as wide, pedicel about as long as F1–4 combined, all funicle segments strongly transverse with F1–4 subequal and slightly smaller than F5 and F6, latter about 2.5X as wide as long and with linear sensilla; clava as long as funicle. Phallobase twice as long as wide.

Hosts. *Metaphycus kozari* has been recorded as a parasitoid of *Rhodococcus perornatus* (Homoptera: Coccidae).

Distribution. Hungary.

Material examined. Paratypes, HUNGARY: 19, 58, Csopak, ex *Rhodococcus bulgariensis*, *Rosa* sp., 22.v.1973 (Kozar) (ZISP, BMNH).

Comments. *Metaphycus kozari* might be closest to *Metaphycus dispar* and *helvolus*. The females of all three species having similar antennae. Females of *kozari* differ from those of both *dispar* and *helvolus* in the brown coloration of the dorsum of the thorax, from *helvolus* in the slightly narrower frontovertex and from both in the completely immaculate legs. In *dispar* and *helvolus* the thoracic dorsum is orange or greyish orange. In *helvolus* the frontovertex is about 1/3 head width, and in both *dispar* and *helvolus* the mid tibiae have a faint but distinct brown ring basally. The males of *kozari* have the pedicel relatively elongate and at least about as long as F1–4 combined (Fig. 40) and the clava as long as the funicle, whereas the pedicel of *dispar* and *helvolus* is relatively short and stout, shorter than F1–3 combined and the clava is clearly shorter than the funicle (Figs 35, 44).

Metaphycus dispar (Mercet) (Figs 42–45)

Euaphycus dispar Mercet, 1925: 25–27. Lectotype ♀, designated by Noyes (1981), Spain, IEE, examined.

Metaphycus dispar (Mercet); Sugonjaev & Babaev, 1971: 70–75.

Metaphycus tamakatakaigara Tachikawa, 1957: 28. Holotype ♀, Japan, KYUN, examined. Synonymised with *dispar* by Trjapitzin, 1989: 232.

Female. Length 0.7–0.9 mm. Head yellowish, occiput black; scape (Fig. 42) yellowish with an almost regular, large, brown, median band; base of pedicel and F1–F3 brown, F4 paler brown, basal 1/2 of clava black, remainder of antennae yellowish; pronotum white with a brown stripe on each side; mesoscutum, axillae and scutellum orange; tegulae whitish with a slightly infuscate apex; metanotum and propodeum dorsally brown; pleurae and ventral parts of thorax yellowish;

legs yellowish, mid tibiae each with a faint dark ring at base; forewing hyaline, venation pale brown; gaster brown dorsally, paler ventrally.

Head about 3.5X as broad as frontovertex; ocelli forming a strongly acute angle of less than 60°; antenna (Fig. 42) with scape slightly expanded medially, about 3X as long as broad, sometimes with a deep incision on ventral margin; all funicular segments but F1 wider than long, F5–F6 larger than preceding segments and with linear sensilla. clava with apex hardly truncate, almost rounded. Relative measurements: HW 35, FV 10, POL 4, OOL 2, OCL 3, EL 20 EW 20, MS 8, SL 16, SW 5.

Mesoscutum about 1.6X as broad as long, with notaular lines not reaching halfway; forewing about 2.5X as long as broad, setation and venation as in Fig. 43. Relative measurements: FWL 93, FWW 37, HWL 45, HWW 8.

Ovipositor not exerted and about as long as tibia. Relative measurements: OL 26, GL 5 (MT 31).

Male. Length 0.7–0.8 mm. Very similar to female except for antenna (Fig. 44), genitalia and darker coloration; torulus (Fig. 45) with several pores inside the lower margin.

Variation. In the female the scape can be conspicuously expanded and only 2.7 times as long as broad (see Annecke & Mynhardt, 1981) and may have a ventral incision. Sugonjaev & Babaev (1971) have noted that both latitude and host species can influence morphology.

Hosts. *Metaphycus dispar* has been recorded as a parasitoid of a variety of soft scales (Homoptera: Coccidae) associated with deciduous plants, i.e. *Eulecanium* sp., *E. douglasi*, *E. kunoense*, *E. rugulosum*, *E. secretum*, *E. tiliae*, *Ericerus pela*, *Parthenolecanium persicae*, *P. corni*, *Pulvinaria vitis*, *Pulvinaria* sp. and *Rhodococcus turanicus*.

Distribution. Finland, England, France, Spain, Italy. Canary Islands, Czech Republic, Slovakia, Hungary, Yugoslav Republic, Greece, Madeira, Russia, Armenia, Georgia, Kazakhstan, Kirgizia, Tadjikistan, Turkmenia, Uzbekistan, Mongolia, China, Japan and USA (California).

Material examined. Lectotype ♀ of *dispar*, Arenas de San Pedro, 4.vii.1922, 'tipo' as designated by J. S. Noyes (1978) (IEE). Paralectotype of *dispar*, ♀, Madrid. G. Bolivar, 'tipo' (IEE). Holotype ♀ of *tamakatakaigara*, JAPAN: Matsuyama, Shikoku, ex *Lecanium kunoense*, 22–30.iv.1956 (T. Tachikawa) (KYUN) Paratypes of *tamakatakaigara*, 370, 178, same data as holotype but various dates (KYUN). Non-types, FINLAND: 1♀, Helsinki, 686 2.383, 20.vii.1981 (M. Koponen); 1♀, EH, Lahti, 6769:431, 4.ix.1987 (M. Koponen); ENGLAND: 1♀, Surrey, Kew, beaten from *Crataegus oxyacantha*, 25.vii.1975 (V. F. Eastop); 1♀, Surrey, Coulsdon Common, Happy Valley, 21.viii.1984 (J. S. Noyes); 1♀, Surrey, Coulsdon Common, Farthingdown, 25.viii.1984 (J. S. Noyes); FRANCE: 1♀, Corsica, Propriano, viii.1989 (J. S. Noyes); ITALY: 3♀, 2♂, Portici, da *Eulecanium coryli*, 9.iv.1920 (F. Silvestri); 1♀, Portici, su viburno, 12.vi.1980 (G. Viggiani); CANARY ISLANDS: 1♀, Tenerife, Sta Ursula, La

Quinta, 7.vi.1993 (M. Koponen); CZECH REPUBLIC: 1 ♀, Bohemia, **Dolní Poustevna**, 18.viii.1959 (A. Hoffer); SLOVAKIA: 2 ♀, Parkan, 2.ix.1962 (A. Hoffer); WGOSLAV REPUBLIC: 1 ♀, Serbia, Bukulja, Sumad., 27.vi.1968 (Z. Boucek); 2 ♀, Cma **Gora** (Montenegro), Ulcinj, 29.vi.1969, 7.vii.1969 (A. Hoffer); 1 ♀, Cma **Gora** (Montenegro), Pistula, 13.vii.1969 (A. Hoffer); 1 ♀, Montenegro, Kotor, **Krasici**, 29.vii.1982 (Z. Boucek); GREECE: 2 ♀, Peleponissos, Petalidon, 25.viii.1979 (Z. Boucek); 10, Corfu, **Ano Kourakiana**, 30.viii.1987 (J. S. Noyes); 2 ♀, **Corfu**, **Agios Markos**, 27.viii.1987 (J. S. Noyes) (BMNH, DEZP, MKCF, NMP).

Comments. The female of *dispar* can be identified reliably by the relatively narrow frontovertex, yellow legs with only a faint brown ring at the base of mid tibiae, and F5–F6 larger than preceding segments and with linear sensilla. In general colour and dimensions, *dispar* is very similar to *kozari*, from which it can be separated using the characters given in the key (see also comments under *kozari*). *Metaphycus dispar* is also somewhat similar in general habitus and coloration to *M. helvolus* (Compere) (see comments under *helvolus*).

Insidiosus group

***Metaphycus alami* Tachikawa**

Metaphycus eriococci **Alam**, 1957: 428. Holotype ♀, England, BMNH, examined.

Metaphycus alami Tachikawa, 1968: 111. Replacement name for *Metaphycus eriococci* **Alam**, 1957, nec Timberlake, 1916.

Female. Length, including ovipositor, 1.0 mm. Head dusky yellow, inconspicuously mixed brown at mouth margin and on genae; antenna with scape and pedicel dusky yellow, F1–F3 brownish, F4 testaceous-yellow, F5 yellow, F6 may be yellow but possibly brown, clava pale brown; thorax completely black, except posterior ½ of mesopleuron which appears to be whitish and tegulae greyish brown (according to **Alam**, the pronotum and tegulae are yellow); legs, including mid and hind coxae yellowish, colour of forecoxae unknown; wings hyaline; abdomen completely yellowish; ovipositor sheaths yellowish.

Head a little more than 4X as broad as frontovertex; ocelli forming an angle of about 45°; antenna with scape sub-cylindrical, about 5X as long as broad and about 2X as long as minimum frontovertex width; F1–F4 subequal and subquadrate, F5–F6 larger, slightly transverse and with linear sensilla, clava almost rounded at apex.

Mesoscutum 1.7X as broad as long with notaular lines reaching about halfway; wings reduced, forewing reaching to about posterior margin of first gastral tergite, apex produced to a median point; hindwing strap-like and about ½ as long as forewing. Relative measurements: FWL 51, FWW 21, HWL 29, HWW 4.5.

Gaster with ovipositor slightly exerted, exerted part slightly longer than mid tibial spur. Relative measurements: OL 58, GL 14 (MT 46).

Male. Unknown.

Hosts. *Metaphycus alami* has been recorded as a parasitoid of *Eriococcus greeni* (Homoptera: Eriococcidae).

Distribution. England.

Material examined. Holotype, ♀, ENGLAND: Berkshire, Silwood Park, endoparasite of *Eriococcus greeni* on *Festuca rubra*, 15.ix.1953 (S. M. Alam) (BMNH).

Comments. The holotype of *Metaphycus eriococci* is in poor condition with one antenna, the prothorax and right legs missing. The parts were evidently mounted separately on a slide which has since been lost. The discrepancies between the coloration noted in the original description and that seen in the holotype possibly results from the species being originally described from the unique holotype while it was still in alcohol and subsequently being mounted dry, resulting in a change in its appearance. This is most notable in the colour of the head, antennae and tegulae.

Metaphycus alami is very close to *ater* Mercet and may be an aberrant form of that species. It can be separated easily from all material of *ater* that we have examined by the completely yellow gaster and forewings medially pointed at the apex. In *ater* the gaster is completely dark brown or at most with basal two tergites yellowish and in brachypterous forms the apex of the forewing is rounded or truncate.

***Metaphycus nitens* (Kurdjumov) (Figs 46–50)**

Aphicus [sic] nitens Kurdjumov, 1912: 6. Syntypes ♀ ♂, Ukraine, **ZIL?**, not examined.

Anaphycus nitens (Kurdjumov); Sugonjaev, 1960: 372.

Metaphycus nitens (Kurdjumov); Trjapitzin, 1975: 12.

Female. Length 0.8 mm. Head entirely black; antenna (Fig. 46) largely brown to black, following parts somewhat paler: 2 small areas at base and at apex of scape, apical ⅓ of pedicel, F4–F6 and apex of clava; thorax entirely shining black, tegulae brownish with apex a little paler, legs largely brown with base and apex of femora, tibiae, tarsi (save tips) somewhat paler; forewing hyaline venation brown; gaster black.

Head 3X as broad as frontovertex; ocelli forming an acute angle with POL a little longer than OOL; antenna (Fig. 46) with scape almost cylindrical, 4X as long as broad, F5–F6 larger than preceding segments and with linear sensilla, clava almost pointed at apex. Relative measurements: HW 36, FVW 12, MS 10, SL 16, SW 4.

Mesoscutum about 2X as broad as long, notaular lines well visible and developed, almost reaching halfway, sculpture similar in depth and mesh size to that of scutellum (Fig. 48), both appearing shiny; scutellum as long as mesoscutum and as long as wide; forewing about 2.5X as long as broad, venation and setation as in Fig. 47. Relative measurements: FWL 99, FWW 38, HWL 64, HWW 12.

Mugla, Tlos, c. 300 m, 28.viii.1992 (J. S. Noyes); GEORGIA: 5♀, Tbilisi, 26.vi.1957 (A. Hoffer) (BMNH, MKCF, NMP, PBJC).

Comments. Our interpretation of *petitus* is based on material collected in England and which was identified initially by the late M. W. R. de V. Graham, who had examined the type of *petitus*.

Hoffer (1954) did not select a holotype for *erythraeus*, and therefore we regard Tjapitzin's (1975) use of 'holotype' as a valid lectotype designation. We have examined four females with the same label data as that recorded by Tjapitzin for the 'holotype', but unfortunately none of these has been marked as the holotype. We are unwilling to select any of these females as lectotype, as it is possible that the material referred to by Tjapitzin is not amongst them. Among the material listed above are large numbers of specimens which could be placed in either *petitus* or *erythraeus* based on general coloration or minor morphological differences. However, there seems to be an amount of overlap in the character states observed in the two groups and therefore we have no hesitation in treating *erythraeus* as synonymous with *petitus*.

The combination of the relatively slender scape and almost complete notaular lines separate this species from all others of the *insidiosus* group, although some specimens of *petitus* can be very similar to *garmon* in general coloration and conformation of the female antenna. The two species can be separated on the position of the black stripe on the scape and the colour of the forewing. In *petitus* the dark stripe on the scape is in the middle and the forewings are hyaline or weakly uniformly infuscate, whereas in *garmon* the dark stripe is along the dorsal margin and the forewing is infuscate at the base and middle below the stigmal vein. See also comments under *piceus*.

Metaphycus stanleyi Compere (Figs 71–74)

Metaphycus stanleyi Compere, 1940a: 10, 20. Lectotype ♀ (designated by Compere, 1940b: 418), South Africa, BMNH (lost), not examined.

Aphycus stanleyi (Compere); Peck, 1951: 495.

Female. Length 0.8–1.0 mm. Head orange. genae yellowish, unmarked, occiput largely black; antenna (Fig. 71) with scape entirely blackish save a small white area at base and one at apex connected dorsally, basal ½ of pedicel, F1–F4 (this latter somewhat paler) and clava (save apex) blackish, remaining parts of antenna yellowish; pronotum white with a brown spot on each side, mesoscutum, axillae and scutellum orange, tegulae white with apex brown, metanotum and propodeum blackish, pleurae and ventral parts of thorax white; legs yellowish, all knees and tarsal tips brownish, fore tibiae almost uniformly infuscated, mid and hind ones each with 2 dark nngs; forewing hyaline, venation brown; gaster dorsally black, ventrally white.

Head about 3× as wide as frontovertex, in side view about 2X as long as deep; ocelli forming an acute angle of clearly

less than 60°; antenna (Fig. 71) with scape ventrally expanded, about 2.2× as long as broad, F5–F6 abruptly larger than preceding segments and with linear sensilla, clava almost rounded at apex. Relative measurements: HW 30, FV 10.5, POL 5, OOL 1, OCL 2, EL 20, EW 17, MS 8, SL 13, SW 6.

Mesoscutum about 1.3× as broad as long, notaular lines incomplete and clearly not reaching halfway; scutellum about ¼ longer than mesoscutum, and as long as broad; forewing about 2.4× as long as broad, venation and setation as in Fig. 72. Relative measurements: FWL 84, FWW 35, HWL 65, HWW 14.

Gaster with ovipositor shorter than mid tibia and not exerted. Relative measurements: OL 21, GL 6 (MT 26).

Male. Length 0.6–0.8 mm. Very similar to female except for antenna (Fig. 74), genitalia and darker colour; torulus (Fig. 73) with a large well defined area containing many scattered pores that extends well beyond the upper limits of its inner margin.

Variation. Very little in the available material.

Hosts. *Metaphycus stanleyi* has been recorded as a parasitoid of many species of soft scales (Homoptera: Coccidae), including *Ceroplastes* sp., *C. brevicauda*, *Chloropulvinaria psidii*, *Coccus alpinus*, *C. celatus*, *C. hesperidum*, *C. pseudomagnoliarum*, *C. subhaemisphaericus*, *Eucalymnatus tessellatus*, *Lichtensia chilianthi*, *Parasaissetia* sp., *P. nigra*, *Protopulvinaria pyriformis*, *Pulvinariella mesembryanthemi*, *Saissetia coffeae*, *S. nigrella*, *S. oleae* and *S. somereni*.

Distribution. Spain, Italy, Greece, Israel, Canary Islands, St. Helena, Ethiopia, Uganda, Kenya, Namibia, South Africa, Canada, USA (California), Bermuda, Peru, Chile and Hawaii.

Material examined. **Paralectotypes, ERITREA:** 1♀, Nefasit, ex *Saissetia eunetormis* on *Oleae chrysophylla*, 4.iv.1930 (H. Compere); **USA:** 29, 213, California, University of California, iii.1938 (H. Compere); 9♀, California, Santa Paula, Bryant orchard, ex *Saissetia oleae* on citrus, x.1937; 7♂, California, Riverside insectary, xii.1937 (H. Compere) (BMNH). **Non-types. CANARY ISLANDS:** 10♀, 9♂, Gran Canaria, Henneman/Kole ex *Saissetia coffeae*, xi.1987 (Henneman, Kole); **ST HELENA** 1♀, 10, Scotland, ex scale on citrus, 7.iii.1995 (S. V. Fowler); 1♀, Wilma's nursery, ex scale on croton, 28.ii.1995; **KENYA:** 1♂, Kiambu, Mchana, ex star scale on coffee, 5.x.1984 (CIE 17534); 39, Kisii, ex green scale on coffee, 8.i.1985 (CIE A17534); 19, 10, Machatos, Kithangaini, ex green scale on coffee, 14.iii.1985 (CIE A1734); 19, Kiambu, Mchana, ex star scale on coffee, 5.x.1984 (A 17534); 29, 20, Kiambu, Mchana Estate, assoc. with *Ceroplastes*, 2.iii.1986 (CIE 18009); 4♀, 1♂, Mchana, ex *Coccus alpinus* on coffee, 16.v.1986 (CIE 18015); 1♀, 1♂, Kakusi, ex star scale on coffee, 24.iv.1986 (CIE 18015); 4♀, 2♂, Nairobi, ex culture green scale, v.1989 (CIBC); **SOUTH AFRICA:** 29, Natal (= Kwazulu Natal), Muden, ex *Coccus hesperidum*, v.1961 (D. P. Annecke); 1♀, 1♂, Cape Province (= Eastern Cape), Addo, ex *Coccus hesperidum*, 2.iii.1964 (W. Hanekom); 3♀, 2♂, Cape Province (= Western Cape), Stellenbosch,

Coccus hesperidum on *Ficus retusa*, v.1978 (S. Nesar); USA 309, 5♂, California, 'imported from South Africa, now established in California, parasitic in black, soft brown and citricola scales'; 19, California, University of California, iii.1938 (H. Compere); HAWAII: 1♀, Oahu, Wailuoe Val., ex *Saissetia hemisphaerica*, xii.1960 (J. W. Beardsley); 2♀, Oahu, Barbers Pt., 22.iv.1966 (J. W. Beardsley); 19, Oahu, Ewa, 22.xii.1965 (J. W. Beardsley) (BMNH).

Comments. Compere (1940a) did not select a holotype for *M. stanleyi*. His statement in a publication later that year (Compere, 1940b) that he had examined 'forty females, thirty-five males, holotype' must be regarded as a lectotype designation under Article 74(b) of the *International Code of Zoological Nomenclature* (1985). No single specimen labelled as 'type' or 'holotype' can be located in the BMNH, CAS, UCR or USNM and therefore we can only assume that the lectotype was not labelled or has since been lost.

Metaphycus stanleyi is very similar to both *insidiosus* and *swirskii*, in coloration and structure of the antennae. Females of *stanleyi* can be separated from those of the other two species by the unmarked genae, those of both *swirskii* and *insidiosus* being at least slightly infuscate (see also key). The males of *stanleyi* are very similar to those of *swirskii* but can be separated by the less expanded scape. In *stanleyi* the male scape is about 2.5× as long as broad, whereas in *swirskii* it is slightly less than 2× as long as broad.

Metaphycus lounsburyi (Howard) (Figs 75–78)

Aphycus lounsburyi Howard, 1898: 244. Lectotype ♀, South Africa, here designated, USNM, examined.

Metaphycus lounsburyi (Howard); Smith & Compere, 1928: 240–242, 245, 275–292; a misidentification of *Metaphycus anneckei*, see below.

Metaphycus bartletti Annecke & Mynhardt, 1972: 255. Holotype ♀, South Africa (lab reared USA, California), PPRI, examined. Syn.n.

Female. Length 0.7–0.9 mm. Head orange with a distinctive, narrow brown stripe on each gena not reaching lower margin; occiput black; antenna (Fig. 75) with scape whitish, with a blackish rhomboidal area on ventral margin; base of pedicel and F1–F4 (latter somewhat paler) brownish, clava (save apex) blackish, remaining parts yellowish; pronotum whitish with a brown spot on each side; mesoscutum, axillae and scutellum orange; tegulae (save brownish apex), sides and venter of thorax whitish, metanotum and propodeum blackish; legs yellowish, all tibiae with 2 almost complete dark rings; forewings hyaline, venation brownish; gaster dorsally blackish, venter whitish with outer plates of ovipositor brown.

Head about 4.3× as wide as frontovertex, in side view 1.5× as long as deep; ocelli forming an angle of clearly less than 60°; antenna (Fig. 75) with scape slightly expanded, about 3× as long as broad; F1–F4 transverse, F5–F6 abruptly larger than preceding segments and with linear sensilla; clava slightly truncate at apex. Relative measurements: HW 35, FV 8,

POL < 3, OOL < 1, OCL 2.5, EL 22, EW 17, MS 8, SL 16, SW 5.5.

Mesoscutum a little less than 2× as broad as long, with a hint of notaular lines, clearly not reaching halfway; scutellum 1.5× as long as mesoscutum, and as long as broad; forewing about 2.5× as long as broad, venation and setation as in Fig. 76. Relative measurements: FWL 81, FWW 32, HWL 53, HWW 10.

Gaster with ovipositor hidden, as long as mid tibia. Relative measurements: OL 28, GL 6.5 (MT 28).

Male. Length 0.5–0.8 mm. Very similar to female except for antenna (Fig. 77), genitalia and darker colour; torulus (Fig. 78) with 2 well defined areas, one along lower and outer margin, with many pores, one in apical inner corner with only 2 pores.

Variation. Very little in the available material.

Hosts. *Metaphycus lounsburyi* has been reported as a parasitoid of the following soft scales (Homoptera: Coccidae): *Ceroplastes floridensis*, *Coccus capparidis*, *C. hesperidum*, *C. pseudomagnoliarum*, *Lichtensia viburni*, *Saissetia coffeae* and *S. oleae*,

Distribution. South Africa, introduced into USA (California), France, Spain, Italy, Greece, Cyprus and Israel.

Material examined. Lectotype ♀ of *lounsburyi* (here designated), card point, '66305 Par on Lec. oleae' 'on Acacia C.P. Lounsbury Cape Town S.Afr.' 'antenna mounted' HymSlide 469' 'Type no. 5042 U.S.N.M.' 'A. lounsburyi n.sp.', slide, 'Aphycus lounsburyi How. Antenna Type ♀ Par *Saissetia oleae* on Acacia Cape Town So Africa 66305 C.P. Lounsbury Coll.' (USNM). **Paralectotypes**, 1♀ (card point) 'Wing mounted' 'HymSlide 470' 'Cotype' '66305 Par on Lec. oleae' 'on Acacia' C.P. Lounsbury Cape Town S.Afr.' (slide) 'Aphycus lounsburyi How. wing of cotype ♀ on *Saissetia oleae* on Acacia Cape Town So Africa 66305 C.P. Lounsbury' (specimen lacking head); 1♀ (slide) '66305 Par on Lec. oleae' 'on Acacia C.P. Lounsbury Cape Town S. Afr.' 'Cotype' (lacking antenna and remounted February 1998 by J. S. Noyes) (USNM). **Holotype** ♀ of *bartletti*, 'Metaphycus bartletti spec. nov. HOLOTYPE Det. D. P. Annecke & M. J. Mynhardt' '♀ N T3622–2US.A. Fontana, Calif. Oct. 91958 Legace Lab Culture' (PPRI). **Non-types**, FRANCE: 149, 68, Corsica, Propiano. viii.1989 (J. S. Noyes); SPAIN: 3♀, Balears, Ibiza, Santa Ines, 24.viii.1986 (J. S. Noyes); 20♀, Valencia, Moncada, iii–iv.1992 (F. Luna, M. Verdu); 1♀, Valencia, La Barraca d'A.V., v.1993 (F. Luna, M. Verdu); ITALY: 789, 65♂, Campania, ex *Saissetia oleae* on olive, citrus and oleander, 1985–86 (G. Marrazzo); 449, 278, lab culture, DEZP, Portici, 1987; GREECE: 1♀, Corfu, Tebloni, 27.viii.1987 (J. S. Noyes); 1♀, Corfu, Acharavi, 28.iv.1984 (M. Koponen); 19, Rhodes, Ixia, 15–29.viii.1984 (M. C. Day) (BMNH, DEZP, MKCF).

Comments. Howard initially described *lounsburyi* from four females, but only three are extant, the fourth having been lost

Metaphycus insidiosus (Mercet) (Figs 81–85)

Aphycus (*Metaphycus*) *insidiosus* Mercet, 1921: 218–220. Lectotype ♀ (designated by Noyes, 1981: 168), Spain, IEE, examined.

Metaphycus insidiosus (Mercet); Mercet, 1925: 28.

Metaphycus taxi Alam, 1957: 426–428. Holotype ♀, England. BMNH, examined. **Synonymy with *insidiosus*** by Noyes, 1981: 168.

Female. Length 0.6–1.2 mm. **Head** orange. genae ventrally with a large brown mark extending to **oral** rim, occiput almost entirely blackish; antenna (Fig. 81) with scape almost entirely blackish save 2 small whitish areas at base and at apex and a narrow **dorsal** stripe connecting them. sometimes paler (Fig. 83); basal $\frac{1}{2}$ of pedicel, F1–F4 (latter slightly paler) and clava (save paler apex) blackish, remaining parts yellowish; pronotum white with a brown spot on each side, mesoscutum axillae and scutellum orange, tegulae whitish with brownish apex, metanotum and propodeum blackish, pleurae and ventral parts white; legs yellowish, all **knees** and tarsal tips brownish, fore tibiae with one dark ring, mid and tibiae each with 2; forewing slightly infuscate, venation **brown**; dorsum of gaster largely blackish, ventral parts whitish.

Head about 4X as broad as frontovertex, in profile almost 1.6X as long as deep; ocelli forming a strongly acute angle of less than 60°; antenna (Fig. 81) with scape ventrally expanded and about 2.4X as long as broad. sometimes narrower (Fig. 83), F5–F6 larger than preceding segments and with linear sensilla, clava slightly truncated at apex. Relative measurements: HW 33, FV 8, POL 3, OOL 2, OCL 3, MS 9, SL 16, SW 6.5.

Mesoscutum about 1.5X as broad as long, with notaular lines incomplete and not reaching halfway; scutellum a little longer than mesoscutum, more or less as long as broad; forewing about 2.5X as long as broad, venation and setation as in Fig. 82. Relative measurements: FWL 90, FWW 35, HWL 59, HWW 12.

Gaster with ovipositor hidden and a little shorter than mid tibia. Relative measurements: OL 26, GL 6 (MT 29).

Male. Length 0.5–0.8 mm. Very similar to female except for antenna (Fig. 84). genitalia and generally darker coloration with mesoscutum brownish; torulus (Fig. 85) with a well defined area of pores at dorsal apex of inner margin.

Variation. The long sensae from Andorra shows a remarkable degree of variation in the relative width of the scape, with some of the smallest specimens having the scape a little more than 3 times as long as broad (as in Fig. 83).

Hosts. *Metaphycus insidiosus* is reported as a parasitoid of several coccids (Homoptera: Coccidae). i.e. *Eulecanium* sp., *E. tiliae*, *Parthenolecanium corni*, *P. pomeranicum*, *P. rufulum*, *Pulvinaria* sp. and *P. vitis*. Recorded below from *Sphaerolecanium prunastri* (New Record) (Homoptera: Coccidae).

Distribution. Finland, Denmark, Wales, England, France, Andorra, Spain, Austria, Italy, Switzerland, Czech Republic, Slovakia, Hungary, Romania, Bulgaria, Greece, Russia (European), Canary Islands, Georgia, Moldova, Azerbaijan and Kazakhstan.

Material examined. Lectotype ♀ of *Aphycus insidiosus*, SPAIN: Vaciamadrid (designated by Noyes, 1981: 168) (IEE). Holotype ♀ of *Metaphycus taxi*, ENGLAND: Bk. Silwood Park, endoparasite of *Eulecanium taxi* on *Taxus baccata*, 8.v.1953 (S. M. Alam) (BMNH). **Non-types**, FINLAND: 1 ♀, PH, Rautalampi. 6957:490, 15.vii.1983 (M. Koponen); 69, 68, Finström, 6705:103, vii.1984 (M. Koponen); 1 ♀, ST, Vammala, 6821:289, 3.vii.1993 (M. Koponen); DENMARK 5 ♀, 1 ♂, EJ, Mols, Strandkaer. Hvid, ex coccid on *Sarothamnus*, 6.9/1.9, 30.v.1985 (P. B. Jensen); 3 ♀, Mols, Strandkaer, *Quercus*, 1.viii.1983 (P. B. Jensen); WALES: 169, 28, W. Glamorgan, Oxwich NNR, 8.vi.1982, 29.vii.1984, viii.1986 (J. S. Noyes); 1019, 218, W. Glamorgan, Whitford Burrows, 11.vi.1982 (J. S. Noyes); 29, W. Glamorgan, Whitford Burrows, 1.viii.1984 (J. S. Noyes); 179, 4 ♂, Mid Glam., Kenfig Pool, 24.v.1975, 31.vii.1984, vii.1988, 28.v.1990 (J. S. Noyes); ENGLAND: 4 ♀, 1 ♂, Berks, Silwood Park, *Pulvinaria oxyacanthae/Crataegus*, vi.1951 (K. Boratynski); 3 ♀, 2 ♂, Berks, Silwood Park, ex *Pulvinaria rufulum*, 11.vii.1974 (A. Komeili); 2 ♀, 28, Berks, Silwood Park, ex *Pulvinaria corni* (2nd instar) on blackberry, 16.v/15.v.1975, 3/9.vi.1975, 12.vi/30.vi.1975, 26.ix/4.x.1975 (A. Komeili); 1 ♀, 1 ♂, Surrey, Richmond Park ex *Eulecanium taxi* on *Taxus baccata*, 8.v.1953 (S. M. Alam); 1 ♀, Surrey, Cobham Communication 19.vi.1970 (Z. Boucek); 1 ♀, Surrey, Dorking White Downs, 18.vii.1970 (Z. Boucek); 19, 18, Surrey, Barnes Common, 8.vii.1995 (J. S. Noyes); FRANCE: 1 ♀, Dept Aisne Oeilley in bomen, 7.vii.1971 (M. Gijswijt); 69, Dépt. Alpes Hte Provence, Reillanne, on *Quercus pubescens*, 21.vii.1978 (M. Gijswijt); 2 ♀, Dépt. Drome, St Auban s/O, on *Salix*, 29.vii.1978 (M. Gijswijt); 1 ♀, Alsace, Hirtzfelden, ex *Parthenolecanium rufulum* on oak, vii.1986 (N. Mills); ANDORRA: 659, 188, Santa Coloma, Trampa Malaise, various dates viii.1992–viii.1993 (J. Pujade); SWITZERLAND: 1 ♀, Wädenswil, ex woolly aphid, v.1937 (R. Menxel); AUSTRIA: 1 ♀, Semmeringgebiet, Reichenau district, 25.v.6.vi.1957 (G. E. J. Nixon); ITALY: 18 ♀, Palma, Campania, ex *Pulvinaria vitis*, 18.vi.1918 (F. Silvestri); 45 ♀, 128, Pignataro Maggiore (CE) ex *Parthenolecanium corni* on *Robinia pseudacacia*, vi.1989 (E. Guerrieri); CZECH REPUBLIC: 199, Bohemia, various localities and dates 23.vi.1943–6.viii.1954 (A. Hoffer); 1 ♀, Bohemia, Hradec Králové, 1946 (Z. Boucek); 29, Bohemia, Hradec Králové, coccid/Ribes, 1946 (Z. Boucek); 31 ♀, Moravia, various localities and dates vii.1938–20.v.1950 (A. Hoffer); 1 ♀, Deblík Stredohorí, 26.vii.1956 (Z. Boucek); SLOVAKIA: 1 ♀, Kovacovske kopce, 7.v.1949 (A. Hoffer); MOLDOVA 1 ♀, Slobodzeja, 5.vii.1961 (Boucek, Talitzky); 1 ♀, Ketsrosi, *Parthenolecanium rufulum*, 7.v.1962 (Talitzky); 29, Ketsrosi, *Parthenolecanium comi*, 7.v.1962 (Talitzky); 29, Strameni, *Sphaerolecanium prunastri*, 14. 15.v.1962 (Talitzky); 12 ♀, 28, Kazul, *Parthenolecanium comi*, 1, 8.viii.1963 (Talitzky) BULGARIA: 7 ♀,

Slancev Brjag, various dates 11–30.vi.1966 (A. Hoffer); GREECE: 19, 1♂, Corfu, Sokaraki, 450 m, 5.ix.1987 (J. S. Noyes); CANARY ISLANDS: 19, Tenerife, Puerto de la Cruz, *Jard. Botanico*, 30.xi.1992 (M. Koponen); AZERBAIJAN 49, Kuba, Teng-Alty, 13.vii.1967 (Z. Boucek) (BMNH, DEZP, FBUB, MKCF, NMP, PBJC).

Comments. *Metaphycus insidiosus* is very similar to *stanleyi*, *lounsburyi* and *swirskii* in the general coloration and structure of the antennae of both sexes. It can be separated from these two species by the brown genae. In *stanleyi* the genae are immaculate and in *lounsburyi* the brown area is restricted to a diagonal stripe. *Metaphycus swirskii* differs in having a much broader scape (see key).

Metaphycus swirskii Annecke & Mynhardt (Figs 86–89)

Metaphycus swirskii Annecke & Mynhardt, 1979: 146.
Holotype ♀, Israel, PPRI, not examined.

Female. Length 0.8–1.0 mm. Head bright orange, face and genae white. Genae with a large blackish mark on lower ½, occiput black; antenna (Fig. 86) with scape mostly black but with upper margin and a small apical area yellowish, basal ½ of pedicel, F1–F4 (latter somewhat paler) and clava (save apex) blackish, remaining parts yellowish; pronotum white with a brown spot on each side, mesoscutum, axillae and scutellum orange, tegulae with basal ½ white, apex brown; metanotum and propodeum black, pleurae and ventral parts of thorax white; legs yellowish, all knees and tarsal tips brownish, fore tibiae almost uniformly infuscate, mid tibiae each with 2 dark rings, hind tibiae each with one dark basal ring and a very faint median one; forewing uniformly faintly infuscate, venation brown; gaster dorsally black, ventrally white.

Head about 3.3× as broad as frontovertex, in side view about 1.5× as long as deep; ocelli forming an acute angle of clearly less than 60°; antenna (Fig. 86) with scape strongly expanded, less than 2X as long as broad, F5–F6 larger than preceding segments and with linear sensilla, clava slightly truncate at apex. Relative measurements: HW 37, FV 11, POL 4, OOL 2, OCL 2, EL 23, EW 18, MS 10, SL 14, SW 8.

Mesoscutum about 2X as broad as long, notaular lines incomplete clearly not reaching halfway; scutellum nearly ½ longer than mesoscutum, about as long as broad; forewing about 2.4× as long as broad, venation and setation as in Fig. 87. Relative measurements: FWL 96, FWW 40, HWL 60, HWW 14.

Gaster with ovipositor shorter than mid tibia and not exerted. Relative measurements: OL 25, GL 7 (MT 30).

Male. Length 0.5–0.70 mm. Very similar to female except for antenna (Fig. 88) and genitalia; torulus (Fig. 89) with few pores along lower margin plus many scattered pores in a large well defined area along the inner margin.

Variation. Very little in the available material.

Hosts. *Metaphycus swirskii* has been noted as a parasitoid of *Coccus capparidis*, *C. hesperidum*, *C. viridis* complex, *Protospulvinaria* sp., *P. pyriformis*, *Saissetia* sp., *S. coffeae*, *S. oleae* and *S. somereni* (Homoptera: Coccidae).

Distribution. Italy, Greece, Israel and Kenya.

Material examined. Paratypes, ISRAEL: 2♀, 2♂, Bet Dagan, ex *Saissetia oleae* laboratory stock, vi.1976 (D. Blumberg) (BMNH). Non-types, ITALY: 6♀, 6♂, Portici (NA), ex *Coccus hesperidum* on *Citrus* sp., II.iv.1981 (G. Viggiani); KENYA 2♀, Taita Hills, Mlange, ex green scale on coffee, 14.v.1985 (CIE A17534); 1♀, Mchana, ex star scale on coffee, x.1984 (A 17534); 1♀, Kiambu Dist., Mchana Est., assoc. with *Zcerya pattersoni* on coffee, 28.x.1985 (CIE A17679) (BMNH, DEZP).

Comments. *Metaphycus swirskii* is very similar to both *M. stanleyi* Compere and *M. insidiosus* (Mercet) in general coloration and structure of the antennae. As stated by Annecke & Mynhardt (1979), *swirskii* can be separated from *stanleyi* on the basis of the colour of the genae, scape and wings. In *swirskii* the genae are partly dark brown, the scape is almost completely black and the wings are infuscate, whereas in *stanleyi* the genae are white, the scape is white apically and the wings are hyaline. Both sexes of *M. swirskii* can be separated from those of *insidiosus* by the more flattened expanded scape which is less than twice as long as broad in *swirskii* and not less than 2.5 times as long as broad in *insidiosus* (see also key couplet 29). Males of the two species can be separated by the arrangement of the pores around the torulus. In *swirskii* there is a well defined area containing many scattered pores along the inner margin of each torulus (Fig. 89), whereas in *insidiosus* there are only a few pores alongside the inner, upper margin (see Fig. 85).

Metaphycus garmon sp.n. (Figs 90, 91)

Female. Length 0.8 mm. Head bright orange, lower ½ paler and tending to whitish; antennal scape yellowish, with a brown stripe dorsally in middle (Fig. 90), basal ½ of pedicel and F1–F4 (this latter somewhat paler) brownish, clava save paler apex blackish, remaining parts yellowish; dorsal parts of thorax (save pronotum) orange; pronotum, tegulae, sides and venter of thorax white; forewing (Fig. 91) infuscate in basal ½ and with a large, darker, circular area beneath stigmal vein which almost reaches posterior wing margin; legs yellowish, immaculate; gaster orange, ventrally paler.

Head 4× as broad as frontovertex; ocelli forming an acute angle of clearly less than 60°; antenna (Fig. 90) with scape a little more than 5X as long as broad, F5–F6 abruptly larger than preceding segments, with linear sensilla, clava with apex slightly truncate. Relative measurements (holotype): HW 28, FV 7, POL 3, OOL 1, OCL 3, EL 18, EW 16, MS 8, SL 21, SW 4.

Mesoscutum about 1.5× as broad as long, notaular lines almost complete, clearly reaching halfway; scutellum hardly