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THE SERPHOID AND CHALCIDOID PARASITES OF THE HESSIAN FLY

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CONTENTS

	Page
Introduction	2
General history	2
Host relationship	3
Superfamily Serphoidea	4
Family Platygasteridae	4
Platygaster hiemalis Forbes	4
Platygaster zosine Walker	10
Platygaster herrickii Packard	14
Platygaster error Fitch	18
Trichacis remulus (Walker)	22
Superfamily Chalcidoidea	25
Family Callimomidae	25
Ditropinotus aureoviridis Crawford	25
Pseuderimerus mayetiolae Gahan	30
Pseuderimerus femoratus, new species	32
Pseuderimerus semiflavus, new species	33
Family Eurytomidae	33
Eurytoma phoebus Girault	33
Eurytoma atripes, new species	36
Decatoma amsterdamensis Girault	38
Family Eupelmidae	41
Eupelmus allynii French	41
Eupelmus atropurpureus Dalman	46
Eupelmus karschii Lindeman	51
Eupelmella vesicularis (Retzius)	52
Calosota metallica Gahan	58
Family Encyrtidae	60
Cheiloneurus elegans (Dalman)	60
Family Pteromalidae	65
Amblymerus mayetiolae (Gahan)	65
Polyscelis modestus Gahan	67
Meraporus crassicornis Kurdjumov	70
Superfamily Chalcidoidea—Continued.	
Family Pteromalidae—Continued.	Page
Arthrolytus maculipennis (Walker)	71
Eupteromalus fulvipes (Forbes)	75
Eupteromalus americanus, new species	82
Eupteromalus micropterus (Lindeman)	86
Merisus destructor (Say)	89
Merisus febriculosus Girault	95
Merisus mordellistenae Crawford	99
Merisus cognatus, new species	102
Merisoporus chalcidiphagus (Walsh and Riley)	104
Callitula bicolor Spinola	109
Bubekia fallax, new species	114
Halticoptera aenea (Walker)	116
Family Aphelinidae	121
Tumidiscapus flavus Girault	121
Centrodora speciosissima (Girault)	124
Family Eulophidae	128
Horismenus texanus (Girault)	128
Pleurotropis benefica Gahan	131
Pleurotropis metallicus (Nees)	133
Tetrastichus carinatus Forbes	138
Tetrastichus productus Riley	143
Tetrastichus ainsliei Gahan	144
Other species recorded in literature as parasitizing the hessian fly	145
Coelopisthia forbesii (Dalla Torre)	145
Hoplogryon kansasensis Gahan	146
Lygocerus triticum (Taylor)	146
Synaldis incisa Gahan	146
Unpublished records that are considered doubtful	146

[1] The preliminary work was greatly facilitated by an incompleted manuscript written by the late P. R. Myers shortly before his death in 1925. Myers had devoted many years to the study of hessian-fly parasites and had brought together bibliographies and descriptions of 29 different species, together with a number of illustrations. His manuscript was not in form for publication, however, and although consulted freely in the preparation of the present paper, the entire subject matter has been rewritten and rearranged, even the bibliographic references being greatly augmented and brought up to the end of the year 1932. The descriptions, synonymy, and review of literature, as well as the remarks on hosts, life histories, distribution, etc., are all by the present writer. The illustrations accumulated by Myers have been utilized, but in many instances these have been revised, and a number of other drawings made under the writer's supervision have been added. It is deeply to be regretted that Myers was unable to complete his paper, and the writer is pleased to acknowledge the help that it has been in connection with the preparation of this publication. To all the many field workers of the Division of Cereal and Forage Insects of the Bureau of Entomology and to others whose notes on biology, distribution, hosts, and life histories have been freely consulted or who have furnished a large part of the thousands of specimens studied, sincere thanks are accorded. The whole-hearted cooperation of C. C. Hill, of the Carlisle (Pa.) laboratory, in this respect deserves special mention. The numerous illustrations were drawn by E. H. Hart, formerly artist of the Division of Cereal and Forage Insects; Mrs. Eleanor A. Carlin, artist of the Division of Identification and Classification of Insects; and W. R. Walton, senior entomologist of the Division of Cereal and Forage Insects.

INTRODUCTION

The hessian fly, *Phytophaga destructor* (Say), has long been known as the major pest of the wheat plant in the United States, and it is similarly injurious to this crop in Europe as well as in various other parts of the world. First discovered in North America more than 165 years ago, it has spread from the original point of discovery in the neighborhood of New York City over most of the wheat-growing region of the United States and Canada and for many years has been the object of almost constant investigation.

Because of the important influence which they exercise in its control, the hymenopterous parasites of this pest early became a matter of interest to entomologists and have become increasingly so as the years have gone by. Because of aroused interest in natural-control methods, the past 2 or 3 decades have witnessed extensive and intensive studies on the biology of various hymenopterous parasites of injurious insects. Workers on the hessian fly have been active in this field, their investigations resulting in the uncovering of numerous heretofore unknown parasites attacking the fly and in the accumulation of much information regarding those already known. More than 130 authors and upward of 200 separate articles involving seven different languages make up the present literature dealing with parasites of this one host. This mass of literature, scattered through many different journals, bulletins, etc., and involving much synonymy and many changes in names, taken in conjunction with the natural difficulties involved in the identification of these minute insects, has made it extremely difficult for one engaged in a study of the parasites of the fly either to determine their identities or to know what has been written about any particular species. A pressing demand has arisen for a coordinated discussion of information now available regarding the exact identities, synonymy, distribution, etc., of the various species attacking this fly.

The object of this publication is to bring together, in so far as possible, in the case of each species attacking the fly, a complete bibliography and review of the literature, a description that will make it possible to recognize the species, a list of its synonyms, and a short outline of what is known regarding its hosts, life history, and distribution.

GENERAL HISTORY

The first record of a hymenopterous parasite of the hessian fly was made by Thomas Say in 1817, when he named and described the species now known as *Merisus destructor* (Say), giving a short account of its oviposition and development. Another early investigator, E. C. Herrick, in 1842 recorded the rearing of five species from the fly. One of these he identified as the species described by Say, but the others were left unnamed. Herrick gave the first account of a parasite ovipositing in the egg of its host and developing upon the larva. The species is now believed to have been *Platygaster hiemalis* Forbes, which did not receive a name until over 40 years after Herrick's observations were published. As will be shown elsewhere, this interesting observation by Herrick was discredited by many subsequent writers but is now known to have been entirely accurate.

Among other early American writers who concerned themselves with the subject of hessian-fly parasites, either by describing species or recording observations on their habits and abundance, were Asa Fitch, Thaddeus W. Harris, C. V. Riley, S. A. Forbes, G. H. French, Benjamin D. Walsh, A. J. Cook, A. S. Packard, H. Osborn, L. O. Howard, and F. M. Webster. Of these, Forbes and Riley probably made the most important contributions, each having published descriptions of several species and recorded important facts regarding their habits and distribution In Europe, Fred Enock, Eleanor A. Ormerod, and Karl E. Lindeman made important contributions to the same subject. The studies by workers in the Bureau of Entomology and by certain investigators in France and Russia since 1890 have added greatly to our knowledge of these parasites. Outstanding contributions have been made in North America by W. H. Ashmead, P. R. Myers, R. W. Leiby, C. M. Packard, C. C. Hill, W. R. McConnell, W. J. Phillips, and E. G. Kelly; and in Europe Paul Marchal's biological studies and the taxonomic work by N. Kurdjumov are especially important in this connection. Other workers, too numerous to mention, have either published information of greater or less importance or furnished such information to be published by others.

Of the 41 species treated herein, 5 are serphoids belonging to the family platygasteridae while the others are all chalcidoids, of which 3 belong to the family Eurytomidae, 4 to the Callimomidae, 15 to the Pteromalidae, 5 to the Eupelmidae, 1 to the Encyrtidae, 2 to the Aphelinidae, and 6 to the Eulophidae. Thirty-five species are known to parasitize the fly in America, 17 attack it in Europe, and 11 species are common to both continents.

The disparity between the number of species attacking the fly in North America and of those known to attack it in Europe is believed to be due more to the fact that the parasites of this host have been more thoroughly investigated in this country than abroad than to any actual difference in the amount of parasitization. It is suspected that several of the more important parasites in North America which are at present not known to occur in Europe will eventually be found there. Of the 6 European species which have not yet been found in North America, only 1, *Trichasis remulus* (Walker), seems to be of much importance, if one may judge by the rather meager records available. Not enough is known of the other five species—*Meraporus crassicornis* Kurdjumov, *Arthrolytus maculipennis* (Walker), *Eupteromalus micropterus* Lindeman, *Eupelmus atropurpureus* Dalman, and *E. karschii* Lindeman—to warrant any positive statement regarding their effectiveness as parasites of the fly.

HOST RELATIONSHIP

It is interesting to note the host associations of the various parasites. Of the 5 species of Platygasteridae parasitic upon the hessian fly, 4 species seem to be confined, very largely at least, to that host, although 3 of these apparently do occasionally attack other closely related dipterous insects that infest wheat or other grass and grain plants. The fifth species is believed to be primarily a parasite of the wheat midge, *Contarinia tritici* (Kirby), but at times attacks the fly. The various species of Chalcidoidea in general seem

to be less selective in the matter of hosts. Several are quite polyphagic, the 3 species of Eupelmidae being especially so. *Eupelmella vesicularis* (Retzius) is recorded from no less than 68 different hosts ranging through several orders of insects and embracing species having a wide range of food habits. *Eupelmus allynii* (French) is recorded from 29 widely different hosts, and *E. atropurpureus* Dalman from 16. Among other surprising records, both *Eupelmus allynii* and *Eupelmella vesicularis* are said to breed successfully upon the eggs of *Oecanthus*.

Aside from the eupelmids, most of the chalcidoids seem to be guided by the character of the plant and the location of possible hosts in it, rather than by taxonomic relationship of the species attacked. Many of the species having as their preferred hosts one or more of the jointworms that live in the stems of grains and grasses attack the hessian fly occasionally; and, conversely, many of the species which normally attack the hessian fly will at times develop on the jointworms. Likewise, parasites of such wheat-infesting insects as *Oscinella frit* (Linnaeus), *Meromyza americana* Fitch, *Mayetiola avenae* Marchal, *Contarinia tritici* (Kirby), *Cephus cinctus* Norton, *C. pygmaeus* Linneaus, and *Trachelus tabidus* Fabricius are at times reared from the fly.

Among the most interesting of these host records are those of two species of Aphelinidae attacking the fly. As is well known, the vast majority of the species of this large family are parasitic upon scale insects. However, the species of the genera *Centrodora* and *Tumidiscapus*, to which these fly parasites belong, are known to be commonly, if not normally, parasitic upon eggs of Orthoptera, such as *Xiphidium* and *Orchelimum*, which insert their eggs in stems of grasses and other plants. The occurrence of these aphelinids as parasites of the fly, therefore, is probably attributable to the same instinct that seems to guide the oviposition of many of the other chalcidoids—that of thrusting their eggs into any insect body which happens to be suitably located in the type of plant which they habitually frequent.

Contrary to the usual belief, none of the species involved in the complex of hessian-fly parasites is strictly a secondary parasite, although many, if not all, of the chalcidoid species under certain circumstances will attack and successfully develop at the expense of other parasites, in some instances even devouring those of their own kind. *Tetrastichus carinatus* Forbes was long supposed to be strictly a secondary parasite, but it is now known to develop as a primary parasite in the great majority of cases. The platygasterids rarely, if ever, develop as secondary parasites.

Superfamily SERPHOIDEA

Family PLATYGASTERIDAE

PLATYGASTER HIEMALIS Forbes

(Fig. 1)

Platygaster sp. Herrick, Amer. Jour. Sci. and Arts 41: 157, 1841; Fitch, N.Y. State Agr. Soc. Trans. 6: 334, 356, 1846; The hessian fly (private publication), p. 43, 1847; N.Y. State Ent. Rpt. 7; 829, 1862; Harris, Insects, injurious to vegetation, p. 587, 1862 (also 1890 ed.); Fitch, Cult. and Country Gent. 28; 354, 1866; Packard, Rpt. U.S. Ent. Comm., Bul. 4: 20, 1880, and U.S. Ent. Comm. Rpt. 3: 219, 1883; Riley, U.S. Natl. Mus. Proc. (1885) 8: 420, 1886.

Platygaster herrickii Fitch, Cult. and Country Gent. 28: 354, 1866 (without description, not *herrickii* Packard); Enock, Ent. Soc. London, Trans. 1888: proc., p. xxiii.

Platygaster minutus Lindeman (not *minutus* Zetterstedt), Bul. Soc. Imp. Nat. Moscou (2) 1: 188, 1887; Ormerod, Entomologist 20: 317, 1887; Riley, U.S. Dept.Agr., Div. Ent., Insect Life 1: 132, 1888; Enock, Ent. Soc. London, Trans. 1891: 342, 343; Miller, New Zeal. Jour. Agr. 19: 205, 1919; Znamenski, Poltava Agr. Expt. Sta., Ent. Dept. Bul. 2: 1923 (abstract in Rev. Appl. Ent. (A) 12: 291 (1924).

Platygaster hiemalis Forbes, Psyche 5: 39, 1888; Riley, U.S.Dept.Agr., Div. Ent., Insect Life 1: 323, 1889; Hill, Ent. Soc. Wash. Proc. 24: 109, 1922; Leiby and Hill, Jour. Agr. Research 25: 337, 1923; Parks, Jour. Econ. Ent. 16: 303–304, 1923; Fouts, U.S. Natl. Mus. Proc. 63 (art. 15): 84, 1924; Hill. Jour. Agr. Research 32: 261, 1926: Leiby, Ann. Ent. Soc. Amer. 19: 294, 1926; Kieffer, Das Tierreich, v. 48, p. 747, 1926; Hill and Smith, Jour. Agr. Research 38: 153, 1928; Blunck, Ztschr. Angew. Ent. 18: 585, 1931.

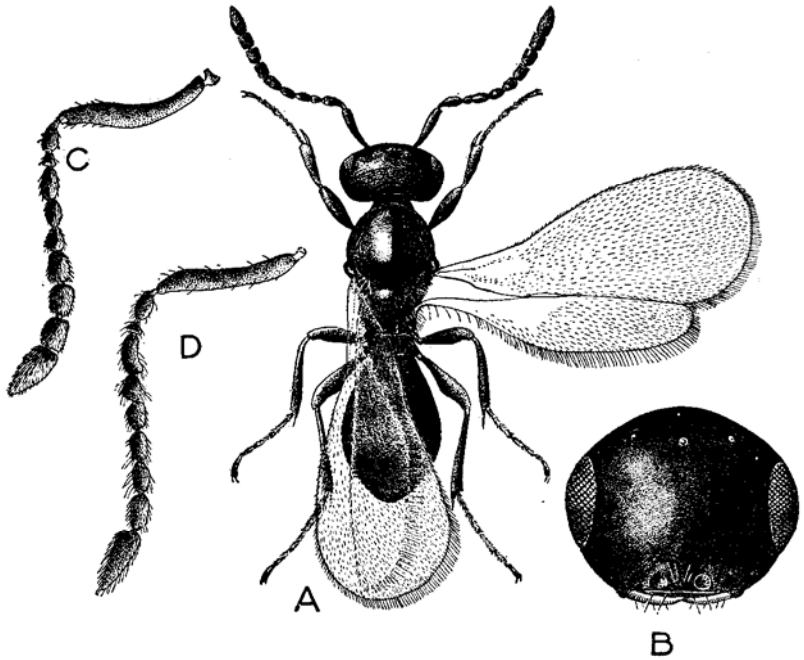


FIGURE 1.—*Platygaster hiemalis* Forbes: *A*, Adult female; *B*, head of female; *C*, antenna of female; *D*, antenna of male. *A*, × 48.

Polygnotus hiemalis Riley, U.S.Dept.Agr., Div. Ent., Insect Life 4: 126, 1891; Ashmead, U.S. Natl. Mus. Bul. 45: 301, 311, 1893; Marchal, Ann. Soc. Ent. France 66: 81, 1897; Osborn, U.S.Dept.Agr., Div. Ent. Bul. (n.s.) 16: 28, 35, 1898; Dalla Torre, Catalogus hymenopterorum . . ., v. 5, 478, 1898; Lugger, Minn. Agr. Expt. Sta. Bul. 64: 556, 1899; Fletcher, Canada Dept. Agr. Rpt. Ent. and Bot. (1899), p. 169, 1900; Webster and Newell, U.S.Dept.Agr., Div. Ent. Bul. (n.s.) 31: 85, 1902; Gossard and Houser, Ohio Agr. Expt. Sta. Bul. 177: 31, 1906; Tucker, Kans. Farmer 44 (15): 404, 1906; Webster, U.S.Dept.Agr., Bur. Ent. Circ. 70: 12, 1906; Bruner and Swenk, Nebr. Agr. Expt. Sta. Bul. 96: 17, 1907; Webster, U.S.Dept.Agr. Bul. (n.s.) 67: 95, 1907; U.S.Dept.Agr. Yearbook 1907: 244, 1908; Viereck, *in* Smith, Insects of New Jersey . . ., p. 652, 1910; Howard and Fiske, U.S.Dept.Agr., Bur. Ent. Bul. 91: 21, 1911; Headlee and Parker, Kans. Agr. Expt. Sta. Bul. 188: 110, 1913; Kelly, Jour. Econ. Ent. 7: 297, 1914; Webster, U.S.Dept.Agr. Farmers' Bul. 640: 14, 1915; Viereck, Conn. State Geol. and Nat. Hist. Survey Bul. 22; 537, 1916; Myers, U.S. Natl. Mus.

Proc. 53: 256, 1917; Walton, U.S.Dept.Agr. Farmers' Bul. 1083: 12, 1920; McColloch, Kans. Agr. Expt. Sta. Tech. Bul. 11: 70, 71, 1923.

Platygaster minutula Dalla Torre, Catalogus hymenopterorum . . ., v. 5, p. 474, 1898 (for *minutus* Lindeman, not Zetterstedt); Kieffer, Das Tierreich, v. 48, p. 828, 1926; Yaroslavtzev and Novinenko, Kharkov Regional Agr. Expt. Sta., Ent. Otd. no. 7, 1927 (abstract in Rev. Appl. Ent. (A) 16: 177, 1928); Meyer, Rpt. Appl. Ent. Leningrad 4: 241, 1929.

Polygnotus minutus Pospjelov, Illus. Ztschr. Ent. 5: 261, figs. 1 and 2, 1900; Spassky, Ann. Don Polyt. Inst. Novotcherkassk 5 (1): pt. 2, 1916 (abstract in Rev. Appl. Ent. (A) 5: 29, 1917).

Polygnotus sp. Ainslie, Ent. Soc. Wash. Proc. 10: 14, 1908; Pettit, Mich. Agr. Expt. Sta. Bul. 258: 72, 1910.

Polygnotus minutulus Blunck, Ztschr. Angew. Ent. 18: 585, 1931.

DESCRIPTION

Platygaster hiemalis may be distinguished at once from *P. herrickii* Packard and *P. error* Fitch by its lack of distinct parapsidal grooves. In having these grooves very poorly developed or almost absent it agrees with *P. zosine*, but it differs from that species in that the front of the head below the ocelli is mostly smooth and shining, the front wings are barely twice as long as the abdomen and perfectly hyaline, and the scutellum is distinctly broader than long, without marginal carinae. It also superficially resembles *Trichacis remulus* but is separated at once by the absence of any tuft of hairs on the scutellum, by the poorly developed parapsidal grooves, and by antennal characters.

Female.—Length 0.75 to 1.3 mm. Head as viewed from above twice as broad as long; occiput weakly margined; behind the vertex finely transversely rugulose; head viewed from in front a little broader than high; ocelli in a low triangle, the lateral ocelli about as far from the eye margins as from the front ocellus; vertex nearly smooth but usually with faint reticulate sculpture around the ocelli; upper part of frons usually perfectly smooth, the lower half usually with very weak, more or less oblique aciculations; eyes oval, more than twice as long as the malar space; whole head bare except for a few hairs on mandibles and around the mouth. Antennae 10-jointed, inserted at the clypeus; scape extending a little above the vertex, about as long as the 5 following joints; pedicel about as long as the 2 following joints; first and second flagellar joints unequal, the first shorter and more slender than the second but longer than broad; the second usually a little less than twice but sometimes twice as long as broad; the third about as long and nearly or quite as broad as the second, broadest near the middle; the fourth a little longer than the third, narrow at base but much broader at apex; the fifth, sixth, and seventh subequal, each about as long as the fourth but usually a little thicker and not broader at apex than at base; apical joint ovate, about one and one half times as long as the preceding joint; flagellar joints (under high magnification) with a few hairs, those hairs at the lower apical angle of each joint somewhat coarser than elsewhere and pale; last 5 joints forming the club. Thorax ovoid, highly convex above; prothorax very finely and weakly reticulated; mesoscutum nearly smooth but with some faint reticulations anteriorly; parapsidal grooves absent or very faintly indicated posteriorly; scutellum convex, broader than long, immargined, smooth or nearly so, its sides covered with whitish pile; the transverse groove separating scutellum from mesoscutum deep and broad but partially interrupted in the middle; mesopleura smooth, polished, bare; metapleura evenly clothed with white pile; propodeum short, with a groove medially which is bordered on each side by a carina, pilose except in the groove. Wings veinless; fore wing about twice as long as the abdomen; discal ciliation not uniform, a triangular area corresponding to the basal cell practically bare; marginal cilia very short; hind wing nearly bare at base, ciliated beyond the hooklets. Legs normal. Abdomen a little longer than thorax and about as broad as thorax, subovate; first tergite more than twice as broad as long and longitudinally striated; second tergite bare, comprising about two thirds of the total length of abdomen, mostly smooth and polished but with an elongated

fovea on each side at base and with the surface within and around these foveae distinctly though not deeply aciculated; tergites beyond the second short, smooth, and each with a few pale hairs.

Color of body usually deep shining black but sometimes brownish black; antennae brownish black, the extreme base of scape narrowly and more or less of the third segment testaceous; legs brownish black, the trochanters, knees, and apices of all tibiae usually very slightly testaceous, all tibiae testaceous with the apical joint dark. Wings hyaline.

Male.—Length 0.75 to 1.3 mm. Fourth joint of the antennae much enlarged, larger than the pedicel and more than twice as long as the small third joint, curved, its dorsal margin convex, its ventral margin concave; fifth to ninth segments subequal. In other respects like the female.

Described from many specimens in the United States National Museum.

REVIEW OF LITERATURE

The name *Platygaster hiemalis* was first proposed by S. A. Forbes in 1888. The record, by E. C. Herrick in 1841, of *Platygaster* sp. attacking the hessian fly in autumn by inserting 4 or 5 eggs in a single egg of the host, and of their emerging as adults from the puparium of the fly, can only apply to *hiemalis* and is the first reference in literature to this species, as was correctly pointed out by C. C. Hill in 1922. Herrick's account of the oviposition and development of this insect was likewise the first record of such a mode of development in any parasitic hymenopteron, a fact that has apparently been generally overlooked or ignored in recent years. A. S. Packard, in his treatise on the hessian fly published in the third report of the United States Entomological Commission, expressed doubt as to Herrick's statement and L. O. Howard, in a footnote attached to the same article (p. 219), also declared that in his opinion the correctness of Herrick's observation was in the highest degree improbable. C. V. Riley in 1885 likewise stated his belief that Herrick's observations were erroneous. Subsequent investigations by others have shown that not only this species but also many others develop in the manner described by Herrick, and to him should go the credit for a discovery which has largely been credited to others.

Herrick's observations were several times reviewed and commented upon by Fitch and also by Harris, and in 1866 Fitch proposed the name *Platygaster herrickii* for the species discussed by Herrick. Unfortunately, however, he did not validate the name by a description of the adult. Subsequently, in 1880, Packard published a description of a parasite of the fly which he identified doubtfully as *P. error* Fitch but stated that if it should prove to be a different species it might be called *Platygaster herrickii.* He supposed this to be the same species as that dealt with by Herrick. Riley pointed out that the insect described by Packard was probably different from *P. error* Fitch and adopted the name *P. herrickii* for it, as Packard had suggested. Packard's species is now well known under the name mentioned and is discussed elsewhere in this paper. Its life history is very different from that of the insect observed by Herrick, all of whose observations agree exactly with the now known life history of *hiemalis* Forbes.

Platygaster minutus Lindeman was described as a parasite of the hessian fly in Russia in 1887. Lindeman stated that he had taken this parasite from puparia of the fly collected at Moscow, in the

Government of Vladimir, and in the Province of the Don Cossacks. In the United States National Museum collection are three specimens labeled "*Platygaster minutus* Lindeman, Russia" which it is believed were sent to Riley or Howard by Lindeman himself and which are probably paratypes of Lindeman's species. These differ in no way from the North American *hiemalis* Forbes. Lindeman gave the length of his species as 0.5 mm, which is somewhat smaller than the smallest specimens of *hiemalis;* but, in view of the fact that the supposed paratypes are fully as large as typical examples of *hiemalis*, it is believed that this measurement was in error. In other respects Lindeman's short description of *minutus*, as also his statement that as many as 11 specimens of the parasite sometimes emerge from the same fly puparium, applies to *hiemalis*, and it appears certain that the two names refer to the same species. The name *minutus* was proposed in 1887, 1 year earlier than *hiemalis*, but the former name had already been used by Zetterstedt in 1838 for a different species, a fact which Lindeman overlooked. Dalla Torre proposed the name *minutula*, in 1898, for *minutus* Lindeman, not Zetterstedt, but this, as well as *minutus* Lindeman, must fall as a synonym of *hiemalis* Forbes.

This species was transferred to the genus *Polygnotus* by Riley, and much of the literature regarding the species treats of it under the name *Polygnotus hiemalis*, but in 1924 Fouts synonymized *Polygnotus* with *Platygaster*, thus restoring the species to its original genus.

European records of this species are apparently not very numerous and, in some instances at least, the species has been confused with *zosine*. There can be little doubt that the references by Enock in 1891 to the presence of *Platygaster minutus* in England refer to *P. hiemalis*. Specimens mounted by Enock and labeled *minutus*, but without indication of locality, are in the United States National Museum collection and differ in no way from typical *hiemalis*. There is also one specimen of this species reared from the hessian fly by O. E. Janson in England in 1887.

Another specimen in the National Museum collection was reared from the hessian fly by F. Cohn, Breslau, Germany. This specimen was sent to Riley by Professor Cohn during the course of their correspondence regarding the fly. It is poorly mounted on a slide, but its characters, so far as they can be ascertained, agree with those of *hiemalis*.

Two other specimens of *hiemalis* in the collection were reared from the fly by T. Cheviroff, Leningrad (St. Petersburg), Russia. No literature reference to these specimens is known to the writer.

In 1900 W. Pospjelov published a paper on the parasites of the hessian fly in Russia, in which he redescribed *Polygnotus minutus* and figured the antenna together with a cluster of cocoons. These figures seem to agree with those of *hiemalis*, as does also the description, but the latter might also apply to many other species of *Platygaster*. Pospjelov's statements that the larvae accomplish their development during the summer, pupate in the fall, and emerge as flies in the spring, after overwintering in the cocoons, seem to agree more closely with the known facts in the development of *zosine* than with those of *hiemalis*. It is not impossible that both species were

involved in this instance, but in the absence of specimens the facts given by Pospjelov are too meager to warrant a definite conclusion. All specimens from Russia seen by the writer have been *hiemalis*, but there appears to be no good reason why *zosine* should not occur there also.

The studies, in France by Paul Marchal, of polyembryonic development in what he supposed to be *Polygnotus minutus* in reality deal with *Platygaster zosine*, as will be shown in the discussion of the latter species.

In a recent paper Hans Blunck states that specimens reared by him from *Mayetiola phalaris* in Pomerania were identified by Ch. Ferriere, of the British Museum, as being probably *Platygaster hiemalis* Forbes, and that others from the same rearing were sent to L. Bïro, of Budapest, who identified them as *Polygnotus minutulus* Dalla Torre. According to Blunck the material identified by Bïro was later seen by Ferriere and found to be the same species as that which he had called *Platygaster hiemalis*. As already pointed out, these two names refer to the same species, and although the present writer has seen none of Blunck's material, it is highly probable that the identification as *P. hiemalis* is correct.

The many references to *hiemalis* in American literature were satisfactorily reviewed in a paper by Hill in 1922. In some instances the species may have been confused with *zosine*, but for the most part the records since the Forbes description have probably been based on correct identifications. Many of the references add only new distribution records. Webster has given some account of attempts at introduction of the species from one part of the country into another, and various authors have made more or less important contributions to a knowledge of its life history, but it was not until the careful work done at the Carlisle (Pa.) laboratory of the Bureau of Entomology was published in a series of papers by Hill and Leiby between 1922 and 1926 that the life history and importance of the species in America was understood. This information is well summarized in the paper by Hill in 1926.

HOSTS AND LIFE HISTORY

Platygaster hiemalis has long been known as a primary, internal, gregarious parasite of the hessian fly and only recently has been recorded by Hans Blunck as a primary parasite of *Mayetiola phalaris* Barnes.

It is said to deposit from 1 to 8 eggs in a single egg of its host. Development may be either monembryonic or by process of twinning and always takes place in the body cavity of the host larva instead of in the mid intestine as in the case of *P. zosine*. When full grown the larvae form individual cocoons closely crowded together within the host puparium, and as many as 23 parasites have been known to emerge from a single puparium.

This species attacks the fly in the autumn. Oviposition takes place in eggs of the overwintering generation of the fly, but the embryonic development is retarded and development of the larva does not take place until midsummer of the following year. The parasites pupate in late July and early August and by the first of September are ready to emerge as adults. According to Hill (1926) its seasonal history

may be greatly modified by climatic conditions, as illustrated by the fact that in the spring-wheat area of northern New York many adults emerge in the spring and are thus enabled to take advantage of the principal egg-laying period of the host in that region. In Oregon *hiemalis* is said by L. P. Rockwood, in correspondence, to have two generations per year, the first in the late spring and the other in the fall.

DISTRIBUTION

This species, as has already been shown, occurs in Europe as well as in North America, and it is also said to occur in New Zealand. In North America it is probably generally distributed throughout the wheat-growing region of the United States and Canada, with the possible exception of California. According to Webster (1907), an attempt was made to introduce it into California, but it has never been recovered in any of the extensive collections of fly material since made in that State. Definite records of its occurrence have been obtained from practically all the other wheat-growing States of the United States, and also from Ontario and Manitoba in Canada.

Its distribution in Europe is less definitely known. Specimens from England, from Breslau in Germany, and from the vicinities of Moscow and Leningrad in Russia have been seen by the writer. If statements by Lindeman, Spassky, and other Russian writers are correct, the species also occurs in the Province of the Don Cossacks in southern Russia. Blunck records it from Pomerania in Prussia. These few records indicate as wide a distribution for the species in Europe as in North America, although there are not enough records to warrant the definite assumption that the distribution is as general there as in America.

The species is recorded as a parasite of the fly in New Zealand by David Miller and, together with *Pleurotropis epigonus*, is credited by him with controlling the fly.

IMPORTANCE

Platygaster hiemalis is believed to be the most efficient parasite of the hessian fly in North America, and it no doubt plays an important role in the control of the pest in certain parts of Europe also. In North America it is practically the only parasite that attacks the fall generation of the fly. Hill (1926) states that in the Middle Atlantic States over a period of 9 years an average of 28 percent of the flies of the fall generation were parasitized by it. It is also said to be a very efficient enemy of the fly in the Pacific Northwest.

PLATYGASTER ZOSINE WALKER

(Fig. 2)

Platygaster zosine Walker, Ent. Mag. 3: 266, 1836; Myers, U.S. Natl. Mus. Proc. 53: 255, 1917; Kieffer, Das Tierreich, v. 48, p. 817, 1926.

Polygnotus zozini Marchal, Ann. Soc. Ent. France 66: 93, 1897; Ashmead, Psyche 8: 137, 1897.

Polygnotus minutus Marchal (not *minutus* Lindeman), Ann. Soc. Ent. France, 66: 91, 1897; Ashmead, Psyche 8: 138, 1897; Howard, Science (n.s.) 7: 248, 1898; Marchal, Bul. Soc. Ent. France 1903: 90; Marchal, Compt. Rend. Soc. Biol. [Paris] 56: 468, 1904; Howard, Science (n.s.) 24: 814, 1906; Marchal, Notice sur la travaux scientifiques, p. 47, 1912.

Platygaster longicaudatus Kieffer, Ann. Soc. Sci. Bruxelles 30: 131, figs. 11 and 12, 1906; Kieffer, Das Tierreich, v. 48, p. 826, fig. 334, 1926.

Platygaster brevicaudatus Kieffer, Ann. Soc. Sci. Bruxelles 30: 133, fig. 13, 1906.

Polygnotus sp. Ainslie, Ent. Soc. Wash. Proc. 10: 14, 1908.

Polygnotus hiemalis Howard and Fiske (not *hiemalis* Forbes), U.S.Dept.Agr., Bur. Ent. Bul. 91: 21, 1911.

Polygnotus vernalis Myers, U.S. Natl. Mus. Proc. 53: 256, 1917; Kieffer, Das Tierreich, v. 48, 756, 1926.

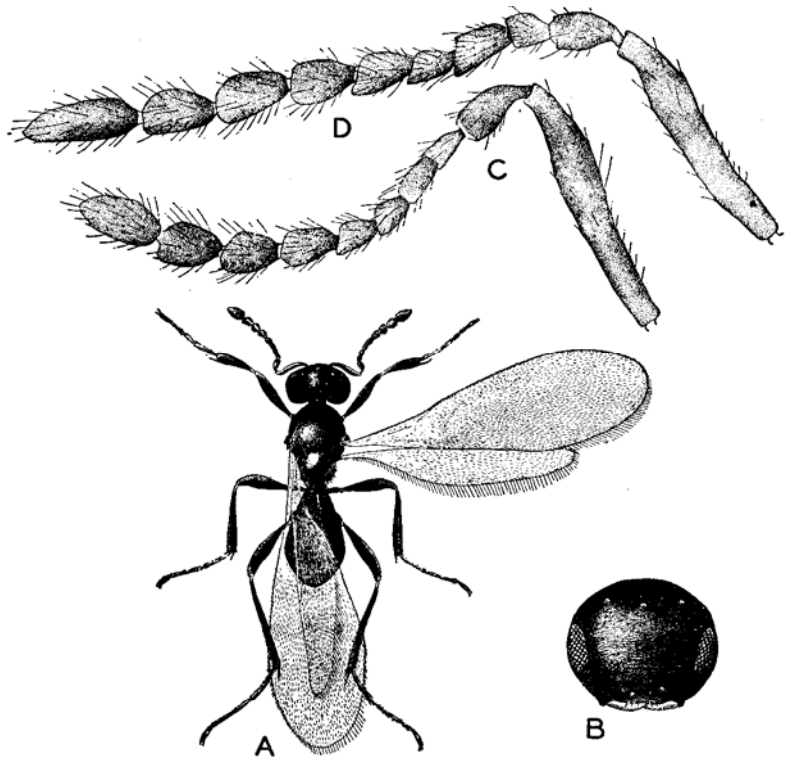


FIGURE 2.—*Platygaster zosine* Walker: *A*, Adult female; *B*, head of female; *C*, antenna of female; *D*, antenna of male. *A*, × 35.

Platygaster vernalis Hill, Ent. Soc. Wash. Proc. 24: [109], 1922; Hill, Jour. Agr. Research 25: 31, 1923; Fouts, U.S. Natl. Mus. Proc. 63: 70, 1924; Leiby and Hill, Jour. Agr. Research 28: 829, 1925; Leiby, Ann. Ent. Soc. Amer. 19: 295, 1926; Hill, Jour. Agr. Research 32: 266, 1926; Kieffer, Das Tierreich, 1. 48, p. 756, 1926; Hill and Smith, Jour. Agr. Research 36: 153, 1928; Hill and Smith, Penn. Dept. Agr. Bul. 12 (12): 10, 1929.

DESCRIPTION

Platygaster zosine can be distinguished from other *Platygasters* parasitic on the hessian fly by the distinctly transversely reticulated occiput, vertex, and frons; by the more or less distinct lateral margination of the scutellum; and by the long wings, which are about three times as long as the abdomen, and slightly fuscous.

Female.—Length 0.7 to 0.9 mm. Head about as wide as the thorax at tegulae, not, or scarcely, twice as broad as long; occiput, vertex, frons, and temples with fine reticulate sculpture which on the vertex and frons usually has the

appearance of fine transverse rugulae; head apparently bare except for a few hairs on clypeus and mandibles; antennae 10-jointed; scape extending above the vertex, about as long as the following 6 antennal joints combined, reticulately sculptured; pedicel two to two and one half times as long as thick, as long as the 2 following joints of the flagellum or slightly shorter; first and second flagellar joints subequal in length and very slender, cylindrical, closely joined; third and fourth flagellar joints very slightly thicker than the preceding joints, distinctly separated, subequal, shorter than the other joints, usually a little longer than broad, and more or less subtriangular in profile; club 4-jointed, the joints well separated, nearly pedicellate, each longer than broad, much thicker than the preceding joints, the apical joint somewhat longer but rarely thicker than the other club joints; whole flagellum sparsely clothed with rather short hairs. Thorax ovoid, about as broad at tegulae as thick dorsoventrally; pronotum weakly reticulated, shining, bare; mesoscutum bare, weakly reticulated, and shining, the reticulation frequently appearing as longitudinal lines; parapsidal grooves absent; scutellum shining, sparsely hairy, convex, about as broad as long, more or less distinctly carinately margined laterally at base but not at apex, the groove separating it from mesoscutum deep and broadest laterally; propodeum short, medially with two longitudinal carinae which diverge posteriorly, the area between the carinae smooth and bare, laterad of the carinae with moderately dense white pile; mesopleura bare and mostly smooth, but with some longitudinal rugulae beneath the wings; metapleura covered with dense whitish pile. Abdomen approximately as long as the thorax, ovate; first tergite much broader at apex than long down the middle, with a smooth bare knob at base, otherwise covered with pile; second tergite comprising two thirds or more of the total length of abdomen, its extreme base weakly sculptured and covered with white pile, elsewhere smooth and bare, with the two basal sulci rather broad and short; tergites beyond the second short, smooth, and nearly bare; ovipositor concealed. Legs rather long and slender, the tarsi all distinctly longer than their tibiae. Fore wings unusually long, equal to about three times the length of abdomen, nearly uniformly ciliated from base to apex, the marginal cilia equal to approximately one sixth the wing width; hind wings also long and rather narrow. Color shining black; mandibles, trochanters, and tarsi usually dark reddish; antennal flagellum black with a somewhat reddish cast; wings with a distinct fuscous cast.

Male.—Length 0.7 to 0.9 mm. Antenna a little longer and more hairy than in the female, the pedicel not so long as first and second flagellar joints; the first flagellar joint distinctly shorter than the second, which is nearly as long as the pedicel and usually thicker than either the preceding or the following joint; third and fourth flagellar joints not equal, the fourth distinctly the longer; fifth, sixth, and seventh flagellar joints subequal, and each usually fully twice as long as thick; apical joint longest of the flagellar joints, about four times as long as thick, and usually a little narrower than the preceding joint; abdomen more broadly rounded than in the female. Otherwise like the female.

REVIEW OF LITERATURE

Francis Walker described *Platygaster zosine* in 1836 from a male specimen taken near London, England. Walker's description, although short and incomplete, agrees in every particular with that of the insect described above and includes the most striking characters which differentiate it from related forms, viz the transversely rugulose frons, the inconspicuous parapsidal grooves, and the infuscated fore wings.

In 1897 Paul Marchal recorded *Polygnotus zosine* and *P. minutus* Lindeman as parasites of *Phytophaga destructor* in France. The identifications were made for Marchal by Ashmead, who, during the same year, published the results of his study of the material. Marchal gave an account of the development of the so-called *P. minutus*, and in 1903 and again in 1904 he further discussed the same subject, showing clearly the polyembryonic nature of its development. Of

P. zosine he simply stated that specimens emerged in March from a fly puparium which had been isolated the previous August. Specimens of the supposed *P. minutus* from France were sent by Marchal to J. J. Kieffer, who in 1906 stated that they were not *minutus* of Lindeman and proceeded to describe two species from the material, one of which he called *Platygaster longicaudatus* and the other *P. brevicaudatus*. Kieffer subsequently, in 1926, synonymized the last-named species with *longicaudatus*.

The present writer has examined not only the material in the United States National Museum collection retained by Ashmead from Marchal's original sending but also all of that material still in existence which Ashmead returned to Marchal, these last-mentioned specimens having been obtained from Dr. Marchal through L. O. Howard before his retirement from the Bureau of Entomology. These comprise the actual specimens upon which the Ashmead and Marchal papers were based. Also it should be noted that the types of *longicaudatus* Kieffer and *brevicaudatus* Kieffer, while not included in the material examined by the present writer, nevertheless were actually a part of the same lot of specimens reared by Marchal and named by Ashmead.

Careful study of this material has failed to disclose any difference between the specimens identified by Ashmead as *P. minutus* and those identified as *P. zosine*. Furthermore, it is quite certain that the true *minutus* of Lindeman was not represented in Marchal's rearings. As has been shown elsewhere, the true *minutus* is identical with *P. hiemalis* Forbes, a species quite distinct from the one at present under consideration. Kieffer recognized that Marchal's specimens were not *minutus* Lindeman, and he considered them to represent a species different also from *zosine* Walker. While he proposed the new name *longicaudatus* for *minutus* Ashmead and Marchal, not Lindeman, he at the same time repeated the record of *zosine* as a parasite of *Phytophaga destructor* and *Mayetiola avenae*. It appears certain, however, that Kieffer saw none of the Marchal material which had been identified as *zosine* by Ashmead, and it is almost equally certain that *zosine* was unknown to him by specimens, since his description of the species is simply a free translation of Walker's original description. His failure to recognize his species *longicaudatus* as the same as *zosine* was no doubt due to a misunderstanding of Walker's description.

Myers recognized that his species *vernalis*, described from America in 1917, was identical with the specimens from France misidentified as *minutus* by Ashmead and also that it might prove to be identical with *zosine*, but because of the incompleteness of Walker's description he did not consider it safe to identify it as *zosine*. Myers apparently was unaware of Kieffer's description of *longicaudatus*.

The writer has compared the specimens from France with types of *vernalis* Myers and cannot distinguish them in any way. The biology of the European form as worked out by Marchal seems to correspond with that of *vernalis*, as Hill has stated in his account of the development of *P. hiemalis*, published in 1926. It therefore appears certain that these two forms are the same and the species should be known as *Platygaster zosine* Walker.

HOSTS AND LIFE HISTORY

Platygaster zosine is a primary, internal, gregarious parasite of the hessian fly in North America and in Europe. It is also recorded as a parasite in Europe of (*Cecidomyia*) *Mayetiola avenae* Marchal. The egg of the parasite is laid in the egg of its host and development of the germ is polyembryonic. The larvae develop in the mid intestine of the host larvae and when fully grown pupate in individual sacs or cells closely grouped together within the dead body of the host larva or pupa. Adults emerge early in the spring and attack the eggs of the spring generation of the fly. The larvae develop rapidly, pupate in late July, according to Hill, and reach the adult stage early in August. The adults normally do not emerge at this time, however, but remain in their pupal cells during the fall and winter and emerge the following spring. The species is said to be capable of reproducing parthenogenetically.

DISTRIBUTION

In Europe *Platygaster zosine* is known only from London in England and from the Department of Loir-et-Cher in France. In all probability its distribution is much wider than these few records indicate. In North America it is generally distributed throughout the winter-wheat-growing region from New York to Missouri and south at least to Staunton, Va. The writer has seen no specimens from points west of Missouri.

IMPORTANCE

This species is probably the most important parasite of the spring generation of the fly in North America. In the Middle Atlantic States it is said by Hill to destroy an average of 23.89 percent of this generation of the fly each year. In Europe very little seems to be known of its effectiveness.

PLATYGASTER HERRICKII Packard

(Fig. 3)

Platygaster herrickii Packard, Rpt. U.S. Ent. Comm., Bul. 4: 21, 1880, and U.S. Ent. Comm. Rpt. 3: 220, 1883; Riley, U.S. Natl. Mus. Proc. (1885) 8: 420, 1886; Packard, Amer. Nat. 19: 1104, 1885; Riley, Amer. Assoc. Adv. Sci. Proc. 34: 333, 1886; Ashmead, Canad. Ent. 19: 132, 1887; Cresson, Synopsis of the families and genera of the Hymenoptera of America, north of Mexico . . ., p. 250, 1887; Lindeman, Bul. Soc. Imp. Nat. Moscou (2) 1: 178, 192, 1887; Forbes, Psyche 5: 40, 1888; Enock, Ent. Soc. London, Trans. 1888, proc. xxiii; Riley, U.S.Dept.Agr., Div. Ent., Insect Life 4: 125, 1891; Ashmead, U.S. Natl. Mus. Bul. 45: 324, 1893; Howard, U.S.Dept.Agr., Div. Ent., Insect Life 7: 415, 1895; Marchal, Ann. Soc. Ent. France 66: 81, 1897; Kulagin, Ztschr. Wiss. Zool. 63: 196-232, 1898; Osborn, U.S.Dept.Agr. Div. Ent. Bul. (n. s.) 16: 28, 41, 35, fig. 6, 1898; Dalla Torre, Catalogus hymenopterorum . . ., v. 5, 473, 1898; Felt, N.Y. State Ent. Rpt. 17 (Mus. Bul. 53): 721, 1902; Stedman, Missouri State Bd. Agr. Rpt. 34: 83, 1902; Webster, U.S.Dept.Agr., Bur. Ent. Circ. 70: 12, 13, fig. 13, 1906; Webster, U.S. Dept. Agr. Yearbook 1905: 634, 1906; Gossard and Houser, Ohio Agr. Expt. Sta. Bul. 177: 31, 33, 1906; Marchal, Arch. Zool, Expt. et Gen. (4) 4: 490, 1906; Webster, U.S.Dept.Agr., Bur. Ent. Bul. 67: 96, 1907; Bruner and Swenk, Nebr. Agr. Expt. Sta. Bul. 96: 16, fig. 3, 1907; Viereck, *in* Smith, Insects of New Jersey . . ., p. 2, 652, 1910; Felt, N.Y. State Ent. Rpt. 28 (Mus. Bul. 165): 40, 1913; Headlee and Parker, Kans. Agr. Expt. Sta. Bul. 188: 110, 1913; Webster, U.S. Dept. Agr. Farmers' Bul. 640: 16, 19, 1915; Fyles, Ontario Ent. Soc. Rpt. 40: 56, 1916; Viereck, Conn. State. Geol. and Nat. Hist. Survey Bul. 22: 540, 1916;

Hill, Ent. Soc. Wash. Proc. 24: 110, 1922; McColloch, Kans. Agr. Expt. Sta. Tech. Bul. 11: 63, 72, 1923; Fouts, U.S. Natl. Mus. Proc. 63 (art. 15): 26, 47, 1924; Hill and Smith, Jour. Agr. Research 36: 151, 1928.

Platygaster error (?) Packard, Rpt. U.S. Ent. Comm., Bul. 4: 20, 1880; U.S. Ent. Comm. Rpt. 3: 219, 1883.

DESCRIPTION

Platygaster herrickii is distinguished from *hiemalis* and *zosine* by its distinct and complete parapsidal grooves as well as by its larger size and different sculpture. It differs from *P. error* by having the temples less receding, the head and thorax finely reticulately sculptured instead of polished, and the scutellum more convex.

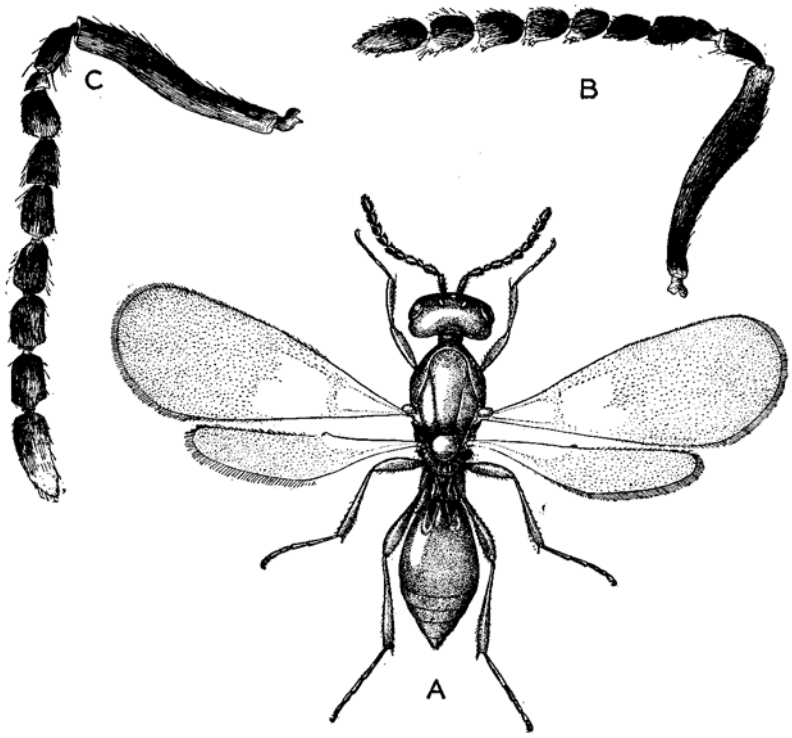


FIGURE 3.—*Platygaster herrickii* Packard: *A*, Adult female; *B*, antenna of female; *C*, antenna of male. *A*, × 25.

Female.—Length 1.5 to 2.2 mm. Head viewed from above transverse, about twice as broad as long, as broad as the thorax; temples nearly as broad as the eyes, not receding from the eye margins but broadly rounded; occiput not concave, delicately margined; head in front view a little broader than high, subcircular; malar space short, not equal to more than one fourth the eye height; ocelli in a very obtuse triangle, the lateral ocellus about twice its own diameter from the eye margin; head finely reticulately sculptured, this sculpture strongest on vertex and temples; upper part of frons usually weakly sculptured and shining, the lower part with distinct transverse rugulae; cheeks, mandibles, and the oral region with sparse hairs, rest of the head bare or practically so. Antennae 10-jointed, inserted at the clypeus; scape extending distinctly above the vertex; pedicel about as long as the two following joints, two and one half times as long as broad; flagellum not twice as long as scape and not distinctly clavate; first flagellar joint small, pyriform, usually about as long as

wide but frequently longer than wide; second flagellar joint distinctly thicker and longer than the first and usually a little longer than the following joint, about twice as long as thick; third to penultimate joints as thick as the second, the third sometimes a little smaller than the others; apical joint ovate, as long as or somewhat longer than the second flagellar joint; flagellar joints clothed with short hairs, the apical five joints (under high magnification) each with what appears to be a short pale spine or spur near its ventral apical angle. Thorax ovoid, moderately convex above; sides of prothorax and the neck above smooth and polished, the dorsolateral portions finely granular; mesoscutum longer than broad, with distinct and complete parapsidal grooves, the median lobe distinctly finely reticulate-punctate and dull, the lateral lobes usually more shining; scutellum nearly circular in outline, roundly convex, immargined, reticulate-punctate and dull like the median lobe of mesoscutum, and sparsely hairy; propodeum with a narrow median longitudinal groove which is margined laterally by very distinct carinae, the surface of propodeum except in the groove densely pilose; mesopleura polished and bare; metapleura densely hairy. Hind coxae rather hairy beneath and at base above. Fore wings approximately twice as long as abdomen, veinless, the marginal cilia very short, discal cilia on a little less than basal half of wing sparse and irregular, on rest of wing uniform. Abdomen about as long as head and thorax and as broad as thorax; first tergite about twice as broad as long, with two distinct and parallel longitudinal carinae near the middle, the surface between the carinae bare and smooth, outside the carinae densely hairy; second tergite comprising more than half the total length of abdomen, smooth and mostly bare, with two large smooth foveae at base which are somewhat hairy within, the foveae margined on the inner side by weak carinae and separated by a distance about equal to the width of a fovea; tergites beyond the second smooth and each with a transverse row of short hairs; basal sternite densely hairy.

General color deep black; pubescence grayish; wings hyaline; antennae black or brownish black, the extreme base of scape narrowly, pedicel at apex and base of first flagellar joint usually testaceous; mandibles reddish testaceous; front legs except their coxae fuscotestaceous, usually darker on the dorsal side of femora and tibiae; middle and hind legs varying from black through piceous to fuscotestaceous.

Male.—Length 1.5 to 2 mm. Antennal pedicel about twice as long as thick; first flagellar joint much broader at apex than at base, with a short pedicel at base, urn-shaped, about as long as broad at apex, the apex about as broad as the pedicel; second flagellar joint much thicker and a little shorter than the pedicel, a little longer than broad; third joint of flagellum as long as the second but usually very slightly narrower; fourth to seventh flagellar joints each subequal in length and width to the third; apical joint conical and 2½ to 3 times as long as thick, a little narrower than the preceding joint; whole antennae clothed with pale, short hairs. Abdomen about as long as the thorax, the apex more rounded than in the female.

Redescribed from many specimens in the United States National Museum.

REVIEW OF LITERATURE

As pointed out in the discussion of *Platygaster hiemalis* Forbes, the name *Platygaster herrickii* was first proposed by Asa Fitch in 1866 for the *Platygaster* sp. recorded by Herrick in 1841 and which is now known to have been *hiemalis*. Fitch published no description of the species, however, and hence the name was not validated. In 1877 A. J. Cook recorded observations he had made in Michigan on a parasite of the fly which deposited 1, 2, or 3 eggs in the egg of its host and pupated in the fly puparium. A specimen was sent by Cook to A. S. Packard, who in 1880 published a description of the species which he doubtfully identified as *P. error* Fitch, at the same time suggesting that in case this identification proved to be wrong it be called *Platygaster herrickii*. Packard considered it probable that he was describing the species studied by Herrick, but his description applies to a species now known to have a different life history from

that outlined by Herrick. It is probable that Cook's observation regarding oviposition involved more than one species, since the statement that more than one egg is deposited in a single host egg is applicable to *hiemalis* but not to the species which was sent Packard and which was described by him. In 1885 Riley figured the species and, being convinced that it was different from *error*, adopted for it the name Packard had suggested. Forbes (1888) mentioned it in pointing out the characters distinguishing it from *hiemalis*.

In his monograph of the proctotrypids in 1893, Ashmead redescribed *herrickii* and synoymized with it *Aneurynchus aneurus* Provancher. This synonymy was based by Ashmead upon examination of a male specimen sent to him by W. H. Harrington and labeled "type." This specimen is in the National Museum collection and it is *herrickii*, but it cannot be the Provancher type because the species was described from a female, no mention being made of a male, and also because it does not agree with the description. It certainly is not the species described by Provancher, which is said to have the antennae 13-jointed and inserted on a transverse prominence on the middle of the head, the thorax polished and shining, and the legs honey-yellow. None of these characteristics agrees with *P. herrickii*, and the Provancher species is therefore dropped from the synonymy. Provancher's species probably belongs in the Diapriidae, but only examination of the type will permit it to be placed generically.

Platygaster herrickii has received mention by numerous authors since Ashmead, very few of whom have contributed any new information other than records of distribution and abundance.

HOSTS AND LIFE HISTORY

Platygaster herrickii is a primary, internal, solitary parasite of *Phytophaga destructor* and so far as known has been reared from no other host. Adults appear in early spring (February, March, and April are indicated by the labels on specimens in the National Museum collection) and attack the spring generation of the fly by laying a single egg in the egg or in the very young larva of the host. The parasite larva does not destroy its host until after the latter has formed its puparium. It then devours the contents of the puparium and forms its cocoon within the empty shell. Complete details of the development of this species are not known.

DISTRIBUTION

Platygaster herrickii occurs generally throughout most of the wheat-growing region of the United States from the Atlantic to the Pacific, and from New York to North Carolina. So far as is known to the writer, it has not been recorded from California. The single male specimen already mentioned as having been sent by Harrington to Ashmead under the name *Aneurynchus aneurus*, and probably collected somewhere in Ontario, is the only Canadian material of the species seen. Specimens from Niagara, N.Y., and Battle Creek, Mich., however, indicate the possibility that the species may be more common in eastern Canada than the records imply.

The species was doubtfully recorded from England by Ormerod in 1887 and by Enock in 1888. These records have been copied by

several subsequent writers, but so far as known they have never been verified. Kulagin (1898) identified *P. herrickii* as a parasite of an *Agromyza* in Russia, basing the identification upon a larva. That this record was almost certainly an error was pointed out by Marchal in 1906. Marchal gave it as his opinion that the larva figured by Kulagin was probably a chalcidoid instead of a *Platygaster*. The writer has seen no specimens of *P. herrickii* from Europe. There appears to be no reason why it should not occur there, but if it does its presence has not yet been proved.

IMPORTANCE

Although generally distributed, this species is probably not so important a parasite of the hessian fly as either *P. hiemalis* or *P. zosine*. According to Hill and Smith, it was responsible for an average of only 0.08 percent parasitization over a period of 10 years in Maryland, Virginia, and Pennsylvania. They state that it is more prolific farther south. In Oregon, according to an unpublished statement by L. P. Rockwood, the species was responsible for a 15 percent parasitization of the spring generation of the fly in 1930.

PLATYGASTER ERROR Fitch

(Fig. 4)

Platygaster error Fitch, N.Y. State Agr. Soc. Trans. (1860) 1861: 818, pl. i, fig. 4 (reprinted in Insects of New York, Rpt. 6: 76, 1865); Packard, Rpt. U.S. Ent. Comm., Bul. 4: 21, 1880, and U.S.Ent.Comm.Rpt. 3: 219, 1883; Forbes, Ill. State Ent. Rpt. 14: 44, 1885; Ashmead, Canad. Ent. 19: 132, 1887; Cresson, Synopsis of the families and genera of the Hymenoptera of America, north of Mexico . . . p. 250, 1887; Smith, Insects of New Jersey . . ., p. 42, 1890; Fouts, U.S. Natl. Mus. Proc. 63 (art. 15): 27, 60, 1924.

Anopedias error Riley, U.S.Dept.Agr., Div. Ent., Insect Life 4: 125, 1891; Ashmead, U.S. Natl. Mus. Bul. 45: 291, 1893; Dalla Torre, Catalogus hymenopterorum . . ., v. 5, p. 482, 1898; Smith, Insects of New Jersey . . ., p. 546, 1900; p. 652, 1910; Viereck, Conn. State Geol. and Nat. Hist. Survey Bul. 22: 533, 1916; Britton, Conn. State Geol. and Nat. Hist. Survey Bul. 31: 326, 1920: Kieffer, Das Tierreich, v. 48, p. 703, 1926.

DESCRIPTION

In size and general appearance *Platygaster error* resembles *P. hiemalis*, but it may be distinguished from that species by the distinct parapsidal grooves, the more triangular and less convex scutellum, the shallower groove between scutellum and mesoscutum, the more receding temples, and the differently shaped abdomen of the female. It differs from *P. zosine* by the same characters as from *hiemalis*, and in addition by the much smoother head. From *herrickii* it differs in the smaller size and less convex scutellum and also in the lack of distinct sculpture on the mesoscutum.

Female.—Length 1.20 to 1.30 mm. Head transverse, about as wide as the thorax, distinctly narrowing behind the eyes, the temples receding; head behind the vertex weakly shagreened, elsewhere mostly smooth and polished; ocelli in a low triangle, the lateral ones a little more than their own diameter from the eye margin; head viewed from in front very slightly broader than long; malar space short, not more than one fourth as long as the eye; a few hairs on mandibles and around the oral region, the rest of head practically bare. Antennae inserted at the clypeus, 10-jointed, covered with short pubescence; scape subfusiform, about equal in length to the 5 following joints; pedicel more than twice as long as thick, distinctly a little shorter than the 2 following joints

combined; first and second flagellar joints unequal; first narrower than the pedicel and longer than broad, about half as long as pedicel; second about two thirds as long as pedicel and about twice as long as broad; third about equal in width and length to second; fourth very slightly shorter than third and equal to it in width; fifth and sixth joints subequal, each very slightly longer than the second and slightly thicker than the fourth; seventh flagellar joint thicker than the preceding and about one and one third times as long as broad; apical joint ovate, about twice as long as broad and distinctly the longest of the

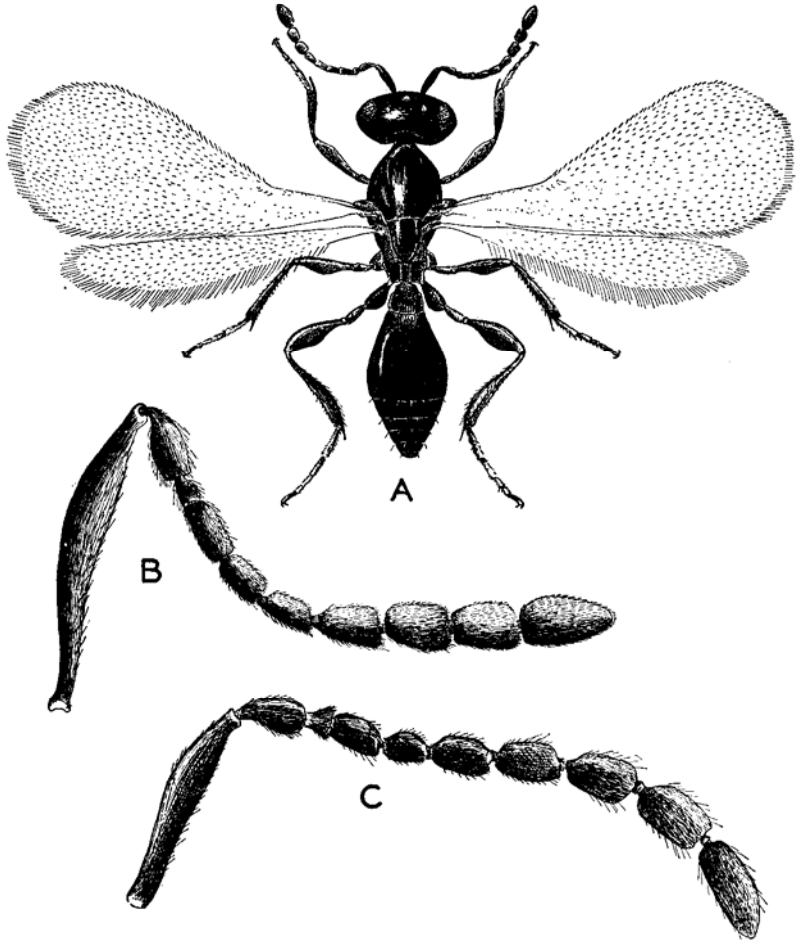


FIGURE 4.—*Platygaster error* Fitch: *A*, Adult female; *B*, antenna of female; *C*, antenna of male. **A**, × 40.

flagellar joints. Thorax ovoid, a little higher than broad, mostly smooth and shining; pronotum polished, with very weak shagreening along the posterior margin in front of the mesoscutum; mesoscutum faintly shagreened, the parapsidal grooves complete and distinct but not deeply impressed, nearly parallel; scutellum triangular, about as broad as long, not convex, smooth, and sparsely hairy; transverse groove between scutellum and mesoscutum very delicately impressed; mesopleura perfectly smooth and bare; metapleura also nearly smooth but thickly covered with pale hairs; propodeum short, hairy, with a narrow median groove between two parallel longitudinal carinae, the groove bare. Wings veinless, the fore wing about one and two thirds times as long as

the abdomen; marginal cilia short, discal cilia sparse and weak on basal one third of wing, the weakly ciliated area produced medially to near middle of wing; hind wing practically bare from base to hooklets, moderately ciliated beyond hooklets; marginal cilia longest on posterior margin of wing between base and hooklets, where they are longer than half the greatest width of wing. Legs normal. Abdomen about as long as head and thorax and as broad as thorax, distinctly dorsoventrally compressed behind the middle; first tergite bare except for a few hairs laterally, approximately as long as broad, longitudinally striated and with a distinct transverse depression near middle and a transverse ridge near base; second tergite bare, about as long as all the following combined, a little longer than broad, longitudinally striated medially at base for approximately one third of its length, remainder of its surface smooth and polished; tergites beyond the second smooth and polished and each with a transverse row of very weak hairs; basal sternite more or less distinctly hairy.

Color deep shining black; mandibles testaceous; antennae brownish black, with the radicle yellow; legs variable, usually dark brownish testaceous, but sometimes nearly black with the trochanters and tarsi reddish; wings hyaline.

Male.—Length 1.15 mm. Antennae a little longer and more slender than in the female, with the second flagellar joint obviously thicker than the first and a little larger than the third; joints 4, 5, 6, 7, and 8 of flagellum separated by a short but distinct pedicel; eighth joint about three times as long as thick; abdomen not longer than thorax, rounded at apex and not flattened apically. Otherwise like the female.

REVIEW OF LITERATURE

Platygaster error was described and figured by Fitch in 1861 from specimens taken in association with the wheat midge, *Contarinia tritici* (Kirby), in New York State. Although occurring with the midge on wheat, the species was not known by Fitch to be a parasite of that insect. In fact, in a postscript to his original remarks on the species he expressed the belief that it was parasitic in the eggs of a hemipteron, this opinion being based on some fragments which had been removed from an egg and which Fitch identified as *P. error*. The report of the entomologist of the United States Department of Agriculture for 1880 records *P. error* as a parasite of the clover seed midge, *Dasyneura leguminicola* Lintner, in New York.[2] In 1880 and again in 1883 Packard doubtfully identified as *P. error* a parasite of the hessian fly, but this parasite is now known to have been *P. herrickii*, as has been pointed out in the discussion of that species. In these same articles Packard also mentioned Fitch's observations on the true *error*. In the course of a discussion of *P. herrickii* as a parasite of the hessian fly, Riley in 1885 [3] repeated Fitch's record that *error* was parasitic in the eggs of a hemipterous insect, and this article was briefly reviewed by Packard in 1885 [4] and by Riley in 1886.[5] In 1891 the species was transferred to the genus *Anopedias* by Riley and recorded as having been reared from (*Diplosis*) *Contarinia tritici* at La Fayette, Ind., this being the first definite record of it from the wheat midge. Ashmead redescribed the species in his monograph of the family Proctotrypidae in 1893, placing it in the genus *Anopedias*. He based his description upon specimens reared from the wheat midge by Webster at La Fayette, Ind., stated that Fitch's identification of *error* as a parasite in hemipterous eggs was certainly erroneous, and expressed the belief that the fragments studied by Fitch were undoubtedly those of some

[2] Comstock, U.S. Dept. Agr. Rpt. Ent. 1879: 196, 1880.
[3] Riley, U.S. Natl. Mus. Proc. (1885) 8: 420, 1886.
[4] Packard, Amer. Nat. 19: 1104, 1885.
[5] Riley, Amer. Assoc. Adv. Sci. Proc. (1885) 34: 333, 1886.

Telenomus. In 1906 Webster [6] republished the Comstock record of *P. error* from the clover seed midge in New York, and in 1916 Viereck recorded the species from Connecticut, naming both the wheat midge and the clover seed midge as hosts but failing to indicate from which, if either, of these hosts the Connecticut specimens were reared. In a revision of the North American Platygasterinae published in 1924, Fouts redescribed the Fitch type and returned the species to the genus *Platygaster*. Comstock's early record of *P. error* from the clover seed midge was again cited by Wehrle [7] in an extensive treatise on that midge in New York State published in 1929; but notwithstanding the fact that Wehrle's investigations covered a period of several years and included observations on the parasites, he failed to rear *P. error*, but did rear two other species of Platygasteridae, viz *Platygaster leguminicolae* Fouts and *Inostemma leguminicola* Fouts.

Ashmead was undoubtedly correct in assuming that the record by Fitch of this species as a parasite of hemipterous eggs was a mistake and that the parasite in question was a *Telenomus*. Fragments of a *Telenomus* could easily have been mistaken by Fitch for a *Platygaster*, and it is now well known that no *Platygaster* develops as a true egg parasite.

It is likewise almost certain that the record by Comstock of *P. error* from the clover seed midge is another case of misidentification. The species has not been recorded from this host since that time, and this notwithstanding that Wehrle's above-cited investigations were carried on in the same general locality as that from which the Comstock record originated. It seems altogether likely that the species involved in the Comstock record was *Platygaster leguminicolae* Fouts, a species very similar to *error* in many respects, and one that easily might have been confused with it.

HOSTS AND LIFE HISTORY

Little is known of the life history of this species. Two specimens are in the National Museum collection which were reared from puparia of the wheat midge collected at New Castle, Pa., by P. R. Myers, emergence having occurred April 22, 1924. In the same collection is a single broken specimen reared by Myers, January 19, 1915, at Hagerstown, Md., from a puparium of the hessian fly.

According to unpublished notes by Myers and R. M. Fouts, the species occurred abundantly on the green heads of wheat at Mount Holly Springs, Pa., in 1920 and 1921 at about the time the grains were filling, and numerous specimens were obtained by sweeping. These observations agree with those made by Fitch in New York 60 years earlier, when he found numerous individuals on the wheat heads late in June and in July. Several of the specimens swept by Myers and Fouts have been examined by the writer, and they are undoubtedly *P. error*.

The date of appearance of the *Platygasters* in the field seems to coincide rather closely with the date of egg laying by its host, and it therefore appears likely that the egg of the parasite is deposited

[6] Webster, U.S.Dept.Agr.. Bur. Ent. Circ. 69 : 5, 1906.
[7] Wehrle, N.Y. (Cornell) Agr. Expt. Sta. Bul. 481 : 29, 1929.

either in the egg of the host or in the very young larva. It also seems probable, although data are too scanty for a definite conclusion, that the species is single brooded, eggs being deposited in late spring or early summer, and the adult emerging the following spring from the puparium of the fly.

DISTRIBUTION

Not many records of this species are available, but it appears certain that it is widely distributed. Fitch recorded it from New York; Webster reared it at La Fayette, Ind.; Ashmead recorded it from Washington, D.C., and Arlington, Va.; and Viereck recorded it from West Haven, Conn. Besides the types and one of Webster's specimens, there are in the National Museum collection 1 specimen from Chambersburg, Pa., collected by C. N. Ainslie; 1 from Hagerstown, Md., reared by P. R. Myers; 2 from New Castle, Pa., reared by Myers; and 7 from Mount Holly Springs, Pa., swept by Myers and Fouts. It is not unlikely that the parasite occurs throughout the range of the wheat midge.

IMPORTANCE

This species is normally parasitic upon the wheat midge and is probably an important factor in the control of that insect. As a parasite of the hessian fly it is of no importance. Only a single specimen has been reared from that host at the Carlisle, Pa., laboratory of the Bureau of Entomology, where an extensive study has been made of the parasites of the fly in the Middle Atlantic States during the last 20 years. The species is included in this bulletin because of that record and in order that it may be differentiated from the other *Platygasters* attacking the hessian fly, with which it might be confused because of its association with the wheat plant.

TRICHACIS REMULUS (Walker)

(Fig. 5)

Platygaster remulus Walker, Ent. Mag. 3: 239, 1836.

Trichacis remulus Foerster, Hymenopterologische Studien, Heft 2, p. 115, 1856; Ashmead, Psyche 8: 138, 1897; Marchal, Compt. Rend. Soc. Biol. [Paris] 49: 59–60, 1897; Ann. Soc. Ent. France 66: 84, 1897; Howard, Science (n.s.) 7: 247, 1898; Osborn, U.S.Dept.Agr., Div. Ent. Bul. (n.s.) 16: 29, 1898; Pospjelov, Illus. Ztschr. Ent. 5: 262, fig. 3, 1900; Marchal, Arch. Zool. Expt. et Gen. (4) 4: 548, pls. 19 and 20, 1906; Kieffer, Ann. Soc. Sci. Bruxelles 30: 135, fig. 14, 1906; Marchal, Notice sur travaux scientifiques, p. 47, figs. 19 and 23, 1912; Znamenski, Poltava Agr. Expt. Sta., Ent. Dept. Bul. 2: 1923 (abstract in Rev. Appl. Ent. (A) 12: 291, 1924); Kieffer, Das Tierreich, v. 48, p. 712, 1926; Meyer, Rpt. Appl. Ent. Leningrad 4: 241, 1929; Blunck, Ztschr. Angew. Ent. 18: 585, 1931.

DESCRIPTION

Trichacis remulus more closely resembles *Platygaster herrickii* than it does any of the other hessian-fly parasites, but it may be distinguished at once from that species, as well as from all the others, by the very distinct tuft of short gray hairs near the apex of the scutellum.

Female.—Length 1.4 to 1.9 mm. Head viewed from above transverse, about twice as broad as long, scarcely narrowed behind the eyes, the temples nearly or quite as wide as the eyes and broadly rounded, the occiput not concave; ocelli in a low triangle, the lateral ones more than twice their own diameter from the eye margin; viewed from the front the head is slightly broader than high, the

malar space one third to one fourth the length of eye. The occiput is granularly opaque with a few very delicate transverse striae just behind the vertex and clothed with short hairs; vertex finely reticulately punctate, subopaque and bare; frons bare, above smooth and shining except along the eye margins where it is weakly sculptured, below the middle finely reticulated and with some weak transverse rugae just above the antennae; cheeks smooth; mandibles and clypeus with a few long hairs. Antennae approximately half as long as the body, 10-jointed, distinctly clavate, the club 5-jointed; scape about as long as the five following joints; pedicel two and one half times as long as broad; first and second flagellar joints subequal and each about as long as pedicel, cylindrical and more slender than the pedicel; third flagellar joint about half as long as the preceding joint, obliquely truncate at apex above; fourth flagellar joint subequal in length to the third but distinctly thicker, thickest at apex and a little longer than broad; fifth flagellar joint shaped like the fourth but a little longer and much thicker; sixth and seventh subequal in length and thickness to the

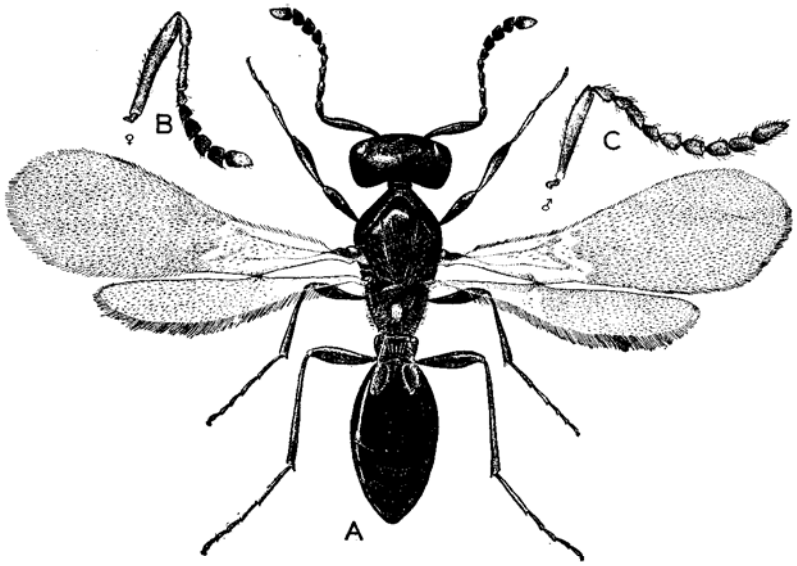


FIGURE 5.—*Trichacis remulus* (Walker): *A*, Adult female; *B*, antenna of female; *C*, antenna of male. *A*, × 30.

fifth but the apex not much narrower than the base, each very nearly as broad as long; apical joint a little narrower than the preceding joint, ovoid, and a little less than twice as long as broad; the apical four joints each with a short thick spur or spine near its ventral apical angle. Prothorax evenly clothed with pale pubescence, and with very fine granular sculpture except immediately behind the head where it is smooth; mesoscutum also evenly pubescent, very faintly sculptured anteriorly, but smooth and shining posteriorly, the parapsidal grooves distinct and complete; scutellum triangular, about as long as broad, subconvex, smooth, pubescent over its whole surface and with a short protuberance near apex which is densely covered with short erect hairs, the protuberance concealed and having the appearance of a tuft of yellow hairs; mesopleura smooth, bare; mesosternum smooth but pubescent; metapleura and propodeum strongly pubescent, the propodeum with two very distinct longitudinal carinae medially, the groove between the carinae deep and bare. Fore wing veinless or with only a trace of subcosta; not twice as long as the abdomen, evenly ciliated at base as well as on disk, marginal cilia short; posterior wing without discal cilia basad of the hooklets, the longest marginal cilia, which are on the posterior margin near base of wing, longer than the breadth of wing opposite their bases, but not equal to the width of wing beyond the hooklets. Legs rather hairy. Abdomen about as long as head and thorax, more than twice as long as broad, as broad as the thorax; first tergite about as broad as long

or a little broader than long, longitudinally striated, with a slight transverse prominence at base, and clothed with long hairs; second tergite a little longer than the following tergites combined, polished, the two basal foveae short and smooth and pilose at the bottom, the rest of tergite bare; tergites beyond the second subequal, smooth, and each with a transverse row of hairs; first sternite hairy, the second bare, following sternites with a transverse row of hairs.

Color black, more or less shining; antennae brownish black, the flagellum frequently brownish testaceous; mandibles reddish; legs brownish black, the front tibiae and more or less of their femora usually reddish; pubescence grayish except the tuft of hairs on scutellum which is yellow; wings very slightly fuscous.

Male.—Length 1.5 to 1.9 mm. Antennae not distinctly clavate, the flagellar joints all of approximately the same thickness; scape subequal to the five following joints together; pedicel about twice as long as broad; first flagellar joint shorter than pedicel, about one and one half times as long as broad at apex, its apex as broad as apex of pedicel but its base much narrower; second flagellar joint longer than the first joint and a little longer than pedicel, cylindrical with its apex obliquely truncate; third flagellar joint a little longer than broad, subtriangular, distinctly shorter than second; fourth to seventh joints subequal, nearly cylindrical, and about one and one half times as long as broad; apical joint conic-ovate and approximately twice as long as the preceding joint. Abdomen a little broader than the thorax, broadly rounded at apex, the second tergite usually with a few very weak and short striae at base. Otherwise like the female.

Described from 10 specimens reared from *Phytophaga destructor* in France by P. Marchal and 4 specimens reared from the same host insect by T. Cheviroff, Leningrad (St. Petersburg).

REVIEW OF LITERATURE

This species was described under the name *Platygaster remulus* by Walker in 1836 from specimens collected on grass near London, England. In 1856 it was transferred by Foerster to his genus *Trichacis* along with two other species. In 1897 Ashmead identified as *T. remulus* specimens which had been reared by Marchal from the hessian fly in France and during the same year Marchal published a very interesting account of the postembryological development of the species. Marchal's paper was reviewed by Howard the following year, and this review was quoted by Osborn. The species was redescribed and figured in 1900 by Pospjelov, who recorded it as a parasite of the fly in Russia. In 1906 Marchal recorded further detailed studies on its embryology, and in the same year Kieffer redescribed it from specimens transmitted to him by Marchal. It was recorded as a parasite of the fly in Poltava, Russia, by Znamenski in 1923, and in 1929 Meyer again mentioned its occurrence in Russia. Kieffer included it in his monograph of the family Scelionidae in 1926, and in giving its distribution mentioned only England and France. Hans Blunck in 1931 recorded the species as a parasite of *Mayetiola phalaris* Barnes in Pomerania.

One specimen of the series from which the foregoing description was drawn is without much doubt a part of the material upon which Ashmead based his determination of the species for Marchal. The other nine specimens from France were reared by Marchal at Blois, France, in March 1903. These were not seen by Ashmead but were identified by Marchal himself, and were sent to L. O. Howard in 1921 and by him turned over to the present writer. They undoubtedly constitute a part, at least, of the material upon which Marchal's later biological notes on the species were based. Nothing is known of the history of the Russian specimens.

HOSTS AND LIFE HISTORY

Trichacis remulus is a primary, solitary, internal parasite of the hessian fly. It is also said to attack *Mayetiola avenae* Marchal in France and *M. phalaris* Barnes in Pomerania, Germany.

According to Marchal, who has written extensively on the post-embryonic development of this species, oviposition takes place in May and June in the Department of Vendée, France. While he has not observed the act of oviposition, he has always found the larva of the *Platygaster* in the very young larva of the host soon after its emergence from the egg, and he therefore concludes that the parasite egg is deposited either in the egg of the host or else in the host larva just after it emerges. The first-stage parasite larva is always located in the nervous system of the host. Although Marchal observed as many as four first-stage larvae of the parasite in a single host larva, he never found more than one second-stage larva per host. He observed three larval stages. The parasite pupates in the puparium of its host.

There is probably a single generation of the parasite per year and emergence takes place in the early spring.

DISTRIBUTION

This species has never been found in North America and, in view of the extensive investigations of parasites of the hessian fly that have been carried on in this country, it is safe to say that it does not occur here. In Europe it appears from the records to be a common and widely distributed species. It has been recorded from England, France, Germany, and from several of the governments of Russia. It probably occurs throughout the European range of its host.

IMPORTANCE

No data are available upon which to base an estimate of the importance of the species in the control of the hessian fly. The fact that it usually has been reared wherever the parasites of the fly have been studied in Europe indicates that it is a more or less constant factor, but it is probably of less importance than several of the other parasites.

Superfamily CHALCIDOIDEA

Family CALLIMOMIDAE

DITROPINOTUS AUREOVIRIDIS Crawford

(Fig. 6)

Ditropinotus aureoviridis Crawford, Jour. N.Y. Ent. Soc. 15: 178, 1907; Webster, U.S. Dept. Agr. Yearbook 1907: 255, fig. 20, 1908; Bur. Ent. Circ. (rev.) 66: 4, 1908; Houser, Ohio Agr. Expt. Sta. Bul. 226: 196, 1911; Phillips, Jour. Econ. Ent. 10: 145, 1917; U.S. Dept. Agr. Farmers' Bul. 1006: 13, 1918; Lochhead, Class book of economic entomology . . ., p. 354, 1919; Gahan, Ent. Soc. Wash. Proc. 22: 236, 1920; Pettit and McDaniel, Mich. State Bd. Agr. Rpt. (1918/19) 58: 275, fig., 1920; Phillips and Poos, Jour. Agr. Research 21: 408, figs. 2 and 3, 1921; U.S. Dept. Agr. Farmers' Bul. 1323: 8, 1923; Parker, Ann. Soc. Ent. France 93: 282, 1924; Phillips, Jour. Agr. Research 34: 751, 1927; Leonard, N.Y. (Cornell) Agr. Expt. Sta. Mem. 101: 975, 1928; Hill and Smith, Jour. Agr. Research 36: 153, 1928; Larrimer, Jour. Econ. Ent. 24: 653, 1931.

Ditropinotus flavicoxus Gahan, Ent. Soc. Wash. Proc. 14: 5, 1912.

DESCRIPTION

Ditropinotus aureoviridis is more closely related to the species of *Pseuderimerus* than to other parasites of the hessian fly, but the females may be distinguished from species of that genus by the

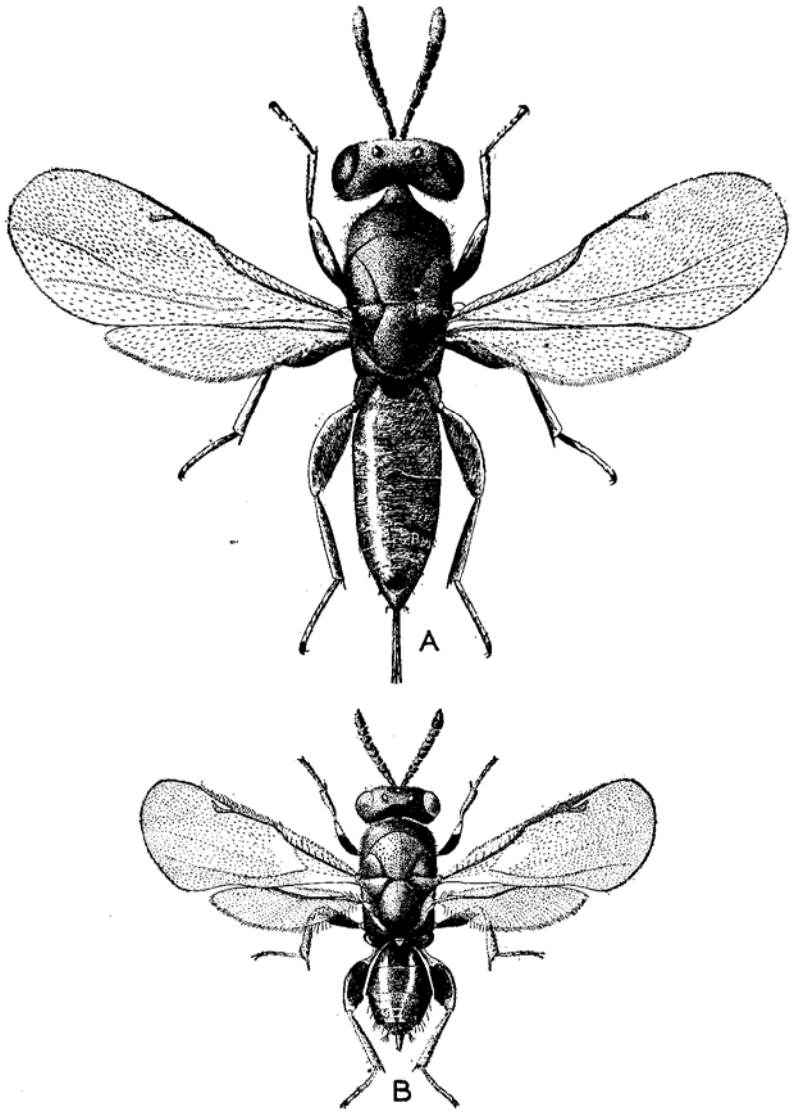


FIGURE 6.—*Ditropinotus aureoviridis* Crawford: *A*, Adult female, × 20; *B*, adult male, × 17.

distinctly 7-jointed funicle, the presence of two longitudinal carinae on the propodeum, the presence of weak serrations on the ventral margin of hind femur apically, the distinctly bicalcarate hind tibia, the longer ovipisitor, the much larger size, and the wholly yellowish

abdomen. These characters will also serve to distinguish the female from other parasites of the fly. The most striking characters for recognition of the males are the distinctly thickened funicle and the apically serrate ventral margin of hind femur.

Female.—Length 1.7 to 3.25 mm. Head transverse, a little wider than the thorax, over two and one half times as broad as thick antero-posteriorly at the middle, moderately concave behind, temples strongly receding, about one fourth as broad as the eyes, rounded into the occiput; occiput immargined; ocelli in a low triangle, the postocellar line about twice the length of ocellocular, the latter equal to about one and one half times the diameter of an ocellus; antennal scrobe rather shallow, its lateral edges not sharp; eyes moderately large, slightly divergent anteriorly, distinctly ovate, and covered with a distinct short pile; viewed from in front, the head subtriangular, narrowing below the eyes; malar space shorter than half the eye height; face with a median ridge which terminates between the antennae; clypeal margin straight or only very slightly convex; mandibles both tridentate, the teeth all acute or subacute; maxillary palpi 4-jointed, the apical joint as long as the other three combined, slender, terminating in a long, slender, slightly curved seta which is about half as long as the segment and with several additional shorter setae on the apical half of the inner surface and about four on the outer surface; labial palpi 3-jointed, short, the apical joint 2½ to 3 times as long as thick, with several setae apically. Antennae 13-jointed, weakly clavate, inserted below middle of head or very slightly above lower extremities of eyes; scape attaining very nearly the level of front ocellus, subcylindrical, slightly curved; pedicel about twice as broad as long; one distinct ring joint which is about three times as broad as long; funicle 7-jointed, cylindrical, slightly thicker at apex than at base, the joints subequal and subquadrate, or slightly transverse, loosely joined, the first joint frequently somewhat narrower than the following; club 3-jointed, compact, very slightly thicker than funicle, about as long as the three preceding funicle joints combined, elongate-ovate, the sutures not very distinct; funicle and club covered with short hairs, and each provided with numerous elongate sensoria. Whole head closely and finely punctate and clothed with conspicuous pale hairs. Thorax sculptured like the head and similarly pubescent, a little less than twice as long as broad; pronotum moderately large, transverse; mesonotum broader than long (30:20); parapsidal grooves sharply impressed, complete and strongly curved anteriorly; scutellum slightly shorter than mesoscutum, sculptured like mesoscutum, finely margined apically; axillae broadly separated and sculptured like scutellum; propodeum short, distinctly but more weakly sculptured than scutellum, with two longitudinal carinae near middle, the area between carinae nearly smooth; prosternum, mesosternum, mesepisternum, and metapleurum not so strongly sculptured as mesoscutum; mesepimeron mostly smooth. Hind coxae rather large, much larger than the anterior pair, compressed into a sharp edge dorsally on apical half at least, and reticulate punctate on outer face; posterior femora a little swollen, with a few very weak serrations on ventral margins before apices; hind tibiae bicalcarate, the outer spur about half as long as the inner one. Wings well developed; anterior wing usually extending a little beyond apex of abdomen, usually a little more than two and one half times as long as broad, variable; marginal vein not quite half as long as submarginal, about two and one half times stigmal; postmarginal vein two thirds to three fourths the length of marginal; angle between stigmal and postmarginal vein narrow; basal and median veins more or less defined by rows of hairs, the basal cell with a few discal cilia; costal cell with very short cilia on ventral surface; hind wing nearly uniformly ciliated. Abdomen elongate-ovate, a little longer than head and thorax, weakly reticulated dorsally, the first to third tergites emarginate medially, first tergite constituting a little less than one third the total length of abdomen; ovipositor exserted one third to one half the length of abdomen.

Color of head and dorsum of thorax green with a strong aeneous cast; eyes reddish; mandibles yellow, with the teeth brown; palpi pale; antennal scape mostly aeneous brown with the base pale or mostly pale with only the apex above brownish; flagellum dark brown or blackish with the club mostly pale orange yellow; pleura and sterna varying from almost entirely yellowish to entirely metallic green; propodeum usually dark medially and anteriorly with the posterior and lateral portions tending to yellowish; legs pale yellow, the hind coxae varying from mostly metallic green to entirely pale yellow; wings

hyaline, venation yellow; abdomen entirely yellowish, sometimes with an admixture of brownish on the sides; ovipositor sheaths blackish.

Male.—Length 1.9 to 2.25 mm. Antennae with the flagellar joints thick, all of nearly the same width, or successively increasing very slightly in thickness, and all distinctly broader than long; pedicel short, not twice as broad as long; funicle and club joints densely clothed with short hairs; club not or scarcely thicker than funicle. The propodeal carinae very indistinct or lacking, the propodeum nearly smooth medially; abdomen shorter than thorax, short ovate, with moderately strong sculpture dorsally. Head, thorax, abdomen, coxae, and femora bright metallic green; tegulae, trochanters, apices of all femora, and tibiae and tarsi pale yellowish; antennal scape dark metallic, flagellum including club black. Otherwise like female.

Described from about 85 specimens in the National Museum collection inclusive of the type series of *aureoviridis* Crawford and *flavicoxus* Gahan. Eleven of these specimens, according to the labeling, were reared from the hessian fly at Jackson, Mo., by E. G. Kelly. Other specimens reared from the same host in Pennsylvania have been identified by the writer and returned to the Carlisle, Pa., laboratory of the Bureau of Entomology.

REVIEW OF LITERATURE

Ditropinotus aureoviridis was first described by Crawford in 1907 from a series of specimens reared by W. J. Phillips from the wheat jointworm, the host material having been collected at Hudson, Mich., and Richmond, Ind. In the Department of Agriculture Yearbook for 1907, F. M. Webster figured the female and expressed the opinion that this parasite probably had been responsible for the disappearance of the wheat jointworm in Ohio, Michigan, and Indiana during that season. In a bulletin of the Bureau of Entomology appearing in 1908, he again referred to it as a common and efficient parasite of that pest. In 1911 J. S. Houser gave a short account of the species, including some observations on its life history as a parasite of *Harmolita tritici* in Ohio. Phillips mentioned it in connection with the same host in 1917, and again in 1918, when he gave a figure of the female. The species was listed by Lochhead in his textbook of economic entomology published in 1919 as one of several parasites of the wheat jointworm, and in 1920 Pettit and McDaniel, treating of the jointworm in Michigan, figured the female of *D. aureoviridis*, which they found to be the commonest parasite. A detailed account of the life history of this parasite, accompanied by figures of egg, larva, pupa, and both sexes of the adult, was published by Phillips and Poos in 1921, and the same authors again mentioned the species in a Farmers' Bulletin published in 1923. A thesis on the postembryonic forms of chalcid flies by Parker in 1924 included comments on the larva of *D. aureoviridis*, these remarks being based upon the work of Phillips and Poos. Phillips in 1927 recorded the species as a parasite of *Eurytoma parva* Phillips, and the following year it was for the first time recorded as attacking the hessian fly by Hill and Smith. It was listed by Leonard in 1928 in his memoir on the insects of New York and again briefly referred to by Larrimer in 1931 in the course of some remarks about the effect of the previous season's drought upon the jointworm and other insects.

Ditropinotus flavicoxus, described by the present writer in 1912, was designated by him a synonym of *aureoviridis* in 1920. The types of *flavicoxus* were collected in a storeroom containing meal and other

grain products which were infested by various insects common to such products, and it was originally believed probable that the *Ditropinotus* had issued from some one of these stored-product insects. Later acquisition of what appear to be typical specimens of *flavicoxus* from the wheat jointworm, accompanied by equally typical specimens of *aureoviridis*, and the presence of distinct intergrades, convinced the writer that the two were the same species; and in view of the fact that the species has never been definitely reared from any stored-product insect, it is now deemed likely that the specimens upon which the name *flavicoxus* was based actually issued from some host other than the insects infesting stored products. It is probable that the grain room in question contained straw or chaff which may have harbored either jointworms or hessian flies which were the source of the *Ditropinotus*.

HOSTS AND LIFE HISTORY

In their paper dealing with the life history of *D. aureoviridis*, Phillips and Poos stated that this parasite had been reared from field-collected *Harmolita tritici* (Fitch), *H. vaginicola* (Doane), *H. grandis* (Riley), *H. atlantica* Phillips and Emery, and *H. secalis* Fitch, and that they had induced it to breed in the laboratory upon *H. elymicola* Phillips and Emery. They also stated that it sometimes played the role of a secondary parasite through *Homoporus chalcidiphagus* Ashmead and *Eurytoma* spp. As already indicated, Phillips (1927) also recorded *Eurytoma parva* Phillips as a host of this species, and Hill and Smith (1928) recorded it as attacking *Phytophaga destructor*. Its preferred host is, without much doubt, the wheat jointworm, as Phillips and Poos have stated.

The species is a primary, solitary, external parasite upon the larva of *Harmolita* within its cell and develops in the same manner within the puparium of the hessian fly. According to Phillips and Poos, there are two complete generations and sometimes a partial third generation per season upon the jointworm, in the latitude of Virginia, the first appearing early in June and the second early in July. They state that normally no males occur in the first generation and that females seem greatly to outnumber males in succeeding generations. Males are not rare, however, the National Museum collection containing at least 18 males as compared with about 70 females.

The egg is deposited in the cell of *Harmolita* or in the puparium of the hessian fly external to the host larva. Five larval instars were observed and described by Phillips and Poos. The winter is passed as a full-grown larva.

DISTRIBUTION

This parasite probably occurs throughout most of the wheat-growing region of the United States. Specimens have been identified from the following States: New York, Pennsylvania, Maryland, District of Columbia, Virginia, North Carolina, Alabama, Tennessee, Kentucky, Ohio, Indiana, Michigan, Illinois, Missouri, Kansas, and Oregon. No specimens have been seen from Canada, but it is not unlikely that the species occurs there, since it is common in the Great Lakes region of the United States. It is apparently not present in California.

IMPORTANCE

Although *Ditropinotus aureoviridis* is said by Phillips to be one of the most important parasites of the wheat jointworm, it cannot be ranked as of much importance as a parasite of the hessian fly. Hill and Smith record an average annual parasitization by it of approximately 1 percent of the spring generation of the fly in Virginia, Maryland, and Pennsylvania. In only 2 out of the 10 years covered by their investigations did it appear at all as a parasite of the fly in the region covered.

PSEUDERIMERUS MAYETIOLAE Gahan

(Fig. 7)

Pseuderimerus mayetiolae Gahan, U.S. Natl. Mus. Proc. 55: 125, fig. 2, 1920; Packard, U.S. Dept. Agr. Tech. Bul. 81: 14, 1928.

DESCRIPTION

Pseuderimerus mayetiolae is more closely related to *Ditropinotus aureoviridis* Crawford than to any of the other parasites of the hessian fly, but it is readily distinguished from that species by its more slender and differently shaped funicle joints, the shorter ovipositor sheaths, the single spur on the hind tibiae, the nonserrated lower margin of hind femora, the much finer and shallower sculpture, and its distinctly different coloration.

Female.—Length 1.5 to 2 mm. Head viewed from above transverse, a little over twice as broad as thick antero-posteriorly, finely and nearly uniformly reticulate-punctate; ocellocular line equal to a little more than half the postocellar line, a little longer than the diameter of an ocellus; temples receding, about equal to half the width of eyes; occiput slightly concave; antennal scrobe moderately deep, extending to the front ocellus, its lateral margins rounded; malar space equal to a little more than one fourth the eye height; eyes ovate, distinctly pilose; both mandibles 3-toothed, the inner tooth short and broadly rounded at apex; labial palpi 3-jointed, short, the apical joint not quite twice as long as broad; maxillary palpi 4-jointed, the first 3 joints short and subequal, the apical joint as long as the other 3 combined. Antennae inserted below the middle of head, about on a line with the lower extremities of the eyes, 13-jointed, clavate; scape slender, cylindrical; pedicel rather slender, nearly as long as 5 following joints combined; third joint a true ring joint, the fourth and fifth antennal joints very slightly broader than the ring and no longer; sixth, seventh, and eighth each broader than long and successively increasing slightly in both length and breadth; ninth and tenth joints subequal, subquadrate, and a little broader than the preceding joints; club 3-jointed, distinctly broader than the funicle, about equal in length to the 4 preceding funicle joints, the apical joint terminating in a very short process. Thorax sculptured like the head; prothorax conical, broader than long, mesoscutum broader than long, the parapsidal grooves complete and distinct; scutellum nearly as long as mesoscutum, and nearly flat, with a delicate marginal carina apically; axillae broadly separated; propodeum short, without lateral folds or spiracular sulci and without a distinct median carina, its sculpture like that of mesoscutum but usually a little stronger. Anterior and posterior femora somewhat enlarged, the latter not serrated beneath; hind tibiae straight, with a single short apical spur. Wings fully developed, reaching to the apex of abdomen, a little more than twice as long as broad (25:55), bare basally, finely ciliated from base of marginal vein to apex of wing except that anteriorly the bare area is extended beneath the marginal vein; stigmal and postmarginal veins subequal, the marginal about twice as long as postmarginal. Abdomen about as long as head and thorax, slightly conic-ovate, finely reticulately sculptured, slightly flattened dorsally, the first two or three tergites weakly emarginate medially at apex; ovipositor exserted approximately one fourth the length of abdomen. Head and thorax very dark aeneous, or black

with a faint aeneous cast; abdomen black with a slight metallic cast in some lights; antennae black, the apex of club usually brownish; legs, except coxae, reddish yellow; wings hyaline, with a faint brownish stain beneath marginal vein, the venation brownish testaceous; ovipositor sheaths black.

Male.—Length 1.5 mm. Like the female except as follows: Posterior orbits a little broader and less receding, eyes and ocelli smaller, ocellocular line and

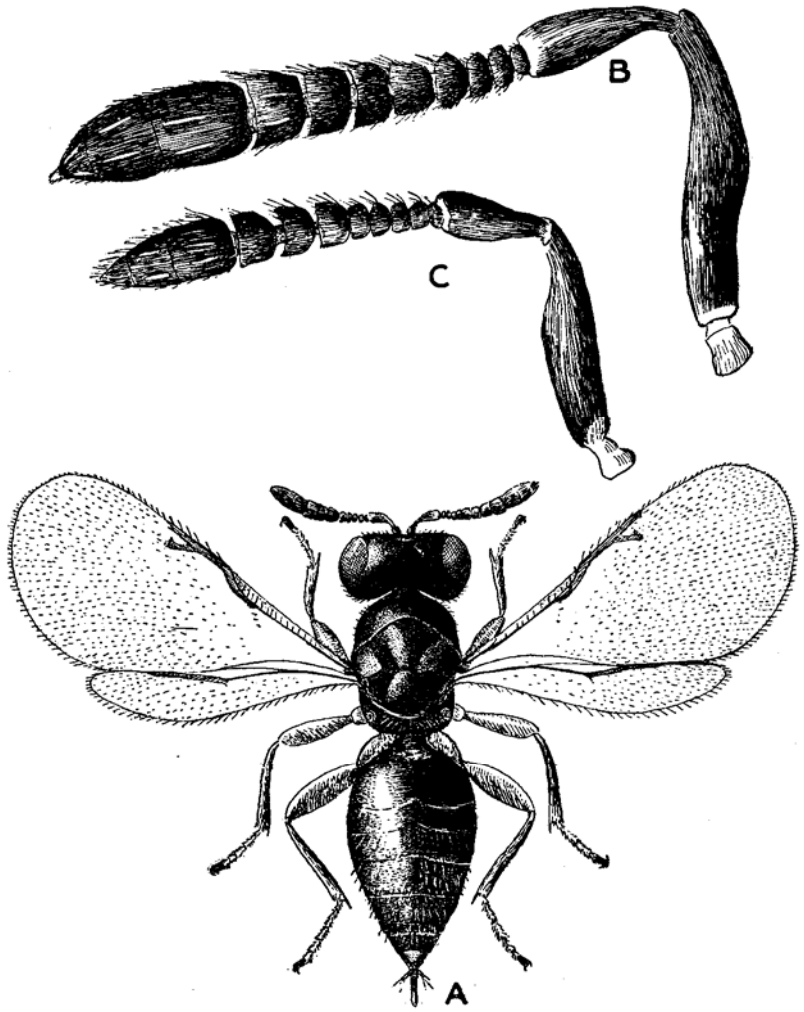


FIGURE 7.—*Pseuderimerus mayetiolae* Gahan: *A*, Adult female; *B*, antenna of female; *C*, antenna of male. *A*, × 32.

postocellar lines nearly equal, the latter four or five times as long as the diameter of an ocellus; the antennae a little shorter, with funicle joints smaller than in the female but of about the same relative proportions, the apical club joint a little more distinctly set off from the preceding by a groove; abdomen elliptical, largely yellowish above and below with the margins black; apices of coxae usually yellowish like the rest of legs.

Described from 111 specimens in the National Museum collection inclusive of the type series, all of which were reared from the hessian fly.

REVIEW OF LITERATURE

Specimens reared by C. M. Packard from puparia of the hessian fly at Altamont, Calif., in 1917, formed the basis for the description by the writer, in 1919, of *Pseuderimerus mayetiolae*. Both the genus and the species were found to be new to science. Subsequently Packard reared many additional specimens of the species. In 1928 he published a bulletin dealing with the host insect in California, in which he made brief reference to this and other parasites.

HOSTS AND LIFE HISTORY

So far as known this species has been reared from *Phytophaga destructor* only. Since it is not known to occur in other parts of the world, it may be assumed to be a native of the Pacific coast region, and as such it must have had some other host before the advent of the hessian fly into that region. Doubtless it will eventually be found to attack some native insect enemy of a native grass.

It is believed to be a solitary, primary parasite feeding externally upon the larva or pupa within the puparium and emerging as an adult from the fly puparium.

DISTRIBUTION

The only specimens of this species thus far seen have come from the following localities in California: Altamont, Birds Landing, Concord, Rio Vista, Benicia, Vallejo, Tres Pinos, and Cordelia. It apparently does not occur in Oregon or Washington.

IMPORTANCE

According to Packard, *Pseuderimerus mayetiolae* is by far the most important parasite of the hessian fly in California, being more widely distributed throughout the fly-infested area in that State and generally more numerous than any of the other parasites.

PSEUDERIMERUS FEMORATUS, new species

Pseuderimerus femoratus is very similar to *P. mayetiolae* but differs especially by having a longer ovipositor, a less strongly sculptured propodeum, and all the femora concolorous with the thorax. The following description should serve to distinguish it from *mayetiolae*.

Female.—Length 1.8 mm. Scutellum a little shorter than mesoscutum, apparently a little more convex and appearing distinctly a little longer than broad; propodeum weakly reticulated, shining, nearly smooth, distinctly less strongly sculptured than in *mayetiolae*, without trace of median carina or lateral folds; anterior and posterior femora very slightly thickened; first and second tergites weakly emarginate apically; third and following apparently without emargination; ovipositor exserted fully one third the length of abdomen. Reticulate sculpture of mesoscutum and scutellum similar to that of *mayetiolae* but apparently not quite so strong. Color nearly black with a distinct tinge of greenish on head and thorax, not at all bronzy; wings completely hyaline; venation brown; all coxae and the femora, except at apices, concolorous with thorax; trochanters, apices of femora, all tibiae, and all tarsi yellow, the apical joint of hind tarsus blackish. In all other respects agreeing with the description of *mayetiolae*.

Male.—Unknown.

Type locality.—Altamont, Calif.

Type.—Catalog no. 44836, U.S. National Museum.

Described from a single female specimen reared May 18, 1917, from *Phytophaga destructor* by C. M. Packard, and recorded in the Bureau of Entomology under Webster no. 13346, Martinez no. 1750.

The species is known only from the unique female which forms the type, and nothing is known of its life history or distribution.

PSEUDERIMERUS SEMIFLAVUS, new species

Pseuderimerus semiflavus is very similar structurally to *P. femoratus* but quite different in color. It differs from *mayetiolae* in the smoother propodeum and more convex scutellum as well as markedly in color.

Female.—Length 2 mm. Mesoscutum a little longer than scutellum; scutellum not flat but convex; propodeum nearly smooth, weakly reticulated, the sculpture distinctly weaker than that of scutellum; front femur a little, the posterior pair hardly at all, thickened; first to third tergites apparently weakly emarginate medially; ovipositor exserted about one third the length of abdomen. Head black with a slight aeneous cast, a little more distinctly aeneous on frons and face than above; scape and pedicel black, flagellum brownish black, apex of club paler; thorax purplish black; coxae concolorous with thorax; front femora black, except at apices; all trochanters, apical third of front femora, median and posterior femora entirely, all tibiae, and all tarsi pale yellowish; tarsal claws blackish; wings entirely hyaline; venation pale yellowish; abdomen pale yellow, the lateral margins of tergites 1 to 4 narrowly and a broad median stripe on venter black; ovipositor sheaths black. Otherwise agreeing with the foregoing description of *P. mayetiolae*. Mandibles not seen.

Male.—Unknown.

Type locality.—Birds Landing, Calif.

Type.—Catalog no. 44837, U.S. National Museum.

Described from a single female specimen said to have been dissected from a puparium of *Phytophaga destructor* August 7, 1919, by M. C. Lane and recorded under Webster no. 13346, Berkeley no. 191142.

No other specimens of this form have been seen and nothing can be said of its life history or its habits except that they are probably similar to those of *P. mayetiolae*.

Family EURYTOMIDAE

EURYTOMA PHOEBUS Girault

(Fig. 8)

Eurytoma phoebus Girault, U.S. Natl. Mus. Proc. 58: 204, 1921; Hill and Smith, Jour. Agr. Research 36: 153, 1928.

DESCRIPTION

Eurytoma phoebus Girault may be distinguished from all other known Hessian fly parasites except the new species which follows by the umbilicately punctate head and thorax, the subquadrate pronotum, and the channeled propodeum. From the new species it differs mainly by having the legs, except coxae, mostly dark reddish testaceous instead of mostly black.

Female.—Length 2 to 3 mm. Head and dorsum of thorax with large, close, umbilicate punctures and clothed with fine silvery hairs; head transverse, about twice as broad as thick antero-posteriorly, a little broader than thorax; ocelli in a low triangle, the ocellocular line very slightly longer than the diameter of an ocellus; eyes short oval, nearly round, bare; malar space only a little shorter than the eye height; antennal scrobe deep, a little narrower than the space between it and the eye margin, its sides perpendicular; face with a smooth

median ridge running from near base of antenna to clypeus; clypeus smooth, depressed at apical middle. Antennae inserted near middle of head, nearly on a line with lower extremities of eyes, 11-jointed, weakly clavate; scape subcylindrical, narrowed a little apically, extending a little above front ocellus; pedicel not twice as long as thick, distinctly shorter than first funicle joint; the single ring joint small and transverse; first funicle joint about two

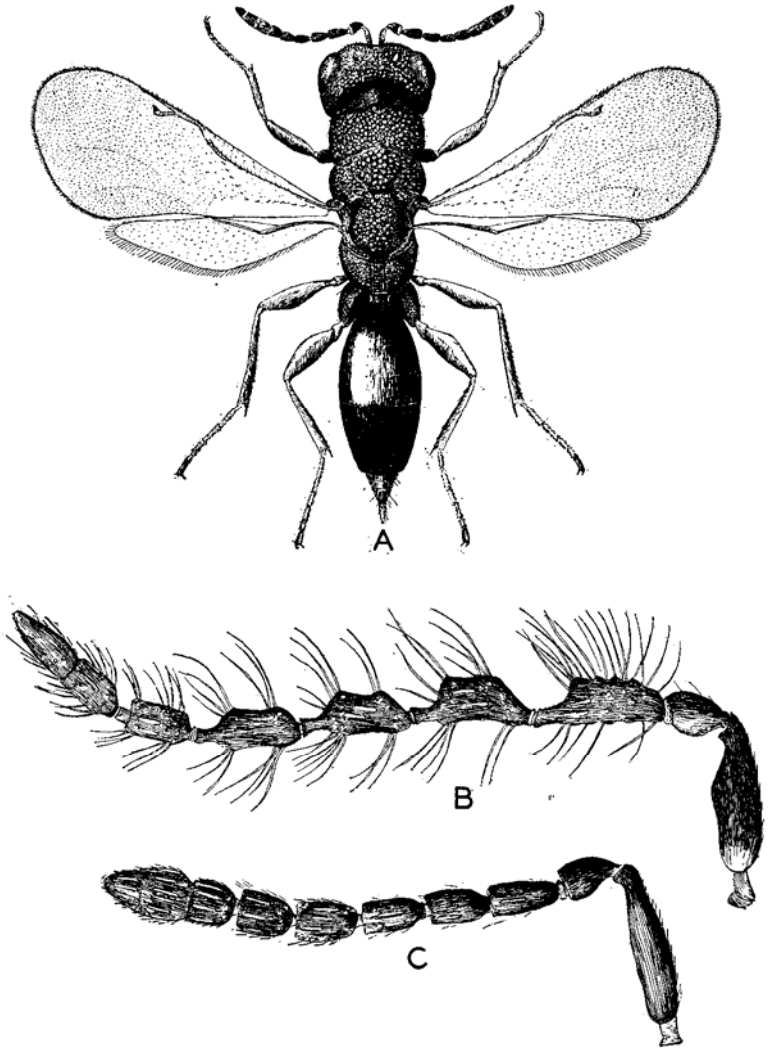


FIGURE 8.—*Eurytoma phoebus* Girault: *A*, Adult female; *B*, antenna of male; *C*, antenna of female. *A*, × 23.

and one half times as long as thick, longer than any of the other funicle joints, a little narrower at base than at apex; second and third joints subequal and each very slightly shorter than first; fourth a little shorter than third and a little longer than fifth, which is about one and one half times as long as thick; club distinctly 3-jointed, longer than two preceding funicle joints combined, the first joint as broad as long and almost as distinctly set off as the funicle joints, second and third joints each subequal in length to the first and

closely joined; funicle and club clothed with moderately long hairs and with some elongate sensoria which are most numerous on the club joints. Pronotum large, not twice as broad as long, subquadrate, with a short neck anteriorly; mesoscutum about as long as pronotum without the neck, about twice as broad as long; parapsidal grooves complete; scutellum convex, a little longer than mesoscutum and with exactly similar sculpture; axillae broadly separated and sculptured like scutellum; propodeum strongly declivous, rugosely punctate, longitudinally depressed medially and with a narrow, indistinctly margined and weakly foveolated median longitudinal groove at the bottom of the depression; metapleura sculptured like propodeum; mesopleura more finely punctate with the mesepimeron more or less longitudinally aciculated above. Hind coxae finely and closely punctate; hind tibiae with two spurs. Wings well developed; fore wings extending to apex of abdomen, only a little more than twice as long as broad; costal cell ciliated on the ventral side, the cilia densest near the anterior margin; basal cell distinctly outlined by rows of hairs representing the obsolete median and basal veins, the disk of this cell with a few scattered but conspicuous hairs; the area behind the median vein bare and another area just distad of the basal vein nearly bare; rest of the wing evenly ciliated; marginal cilia very short; marginal vein one third as long as submarginal, one and one third times postmarginal; stigmal vein about half as long as marginal; submarginal vein with many erect bristles, about 14 to 17 in number. Abdomen about as long as thorax, ovate, somewhat compressed from the sides, shortly petiolate; petiole rugose, much broader than long, attached at the lower margin of abdomen; first to third tergites (not counting petiole) bare, polished dorsally, the second and third weakly reticulated laterally, the first mostly declivous, second and third subequal, the third attaining about the middle of abdomen; fourth tergite dorsally about as long as second and third together, practically smooth and bare, laterally longer and more or less distinctly reticulated; tergites beyond the fourth short, finely reticulated and hairy dorsally as well as laterally; apices of ovipositor sheaths shortly exserted. Color dull black; scape, except apically above, ring joint, mandibles, and all legs except their coxae, reddish testaceous; wings hyaline, venation testaceous; apices of ovipositor sheaths yellowish; vestiture of body mostly silvery white in some lights.

Male.—Length 1.6 to 2.3 mm. Antennae 10-jointed, longer than in female; scape slightly thickened, thickest a little beyond middle; pedicel longer than broad; one small ring joint; funicle 5-jointed, the joints each abruptly narrowed at apex into a distinct neck to which the following joint is attached; first funicle joint the longest, 2½ to 3 times the length of pedicel, the thickened portion clothed with long hairs which do not appear to be arranged in whorls; second to fifth funicle joints successively decreasing a little in length, each with two distinct whorls of long hairs, the fifth joint about two thirds as long as the first; club about equal to scape in length, no thicker than the funicle, consisting of two distinct joints which are not separated by a peduncle, each joint clothed with hairs which are slightly shorter than those on funicle joints; funicle joints each with about four elongate sensoria, the club joints apparently with six each. Abdomen shorter than thorax; petiole long, extending a little beyond the apices of hind coxae, finely punctate; segments beyond petiole smooth; first tergite (not counting petiole) mostly declivous; second only about half as long as third, which is the longest tergite; fourth less than one third the length of third; following tergites retracted into the fourth. Other characters, including color, as in the female except that the scape is mostly black and the median and the hind femora are more or less blackish with their bases and apices testaceous.

Described from 12 specimens (9 females and 3 males) including the types. The 2 female specimens, which constitute the type series of this species, are considerably larger than any of the other specimens here considered to belong to it, but in other respects they seem to agree perfectly.

REVIEW OF LITERATURE

Eurytoma phoebus was described by Girault from two female specimens reared by C. N. Ainslie. The only other mention of the species in literature appears to be one by Hill and Smith, who in-

cluded it, without comment, in a tabular arrangement of collection data showing the relative values of the various parasites on the spring generation of the hessian fly in the region of Pennsylvania, Maryland, and Virginia.

HOSTS AND LIFE HISTORY

This species is probably normally parasitic upon jointworms infesting wild grasses. The type specimens, according to the original notes by C. N. Ainslie, were reared from galls on *Elymus canadensis*, and a species of *Harmolita* is said to have been reared from the same material. One specimen in the National Museum collection is said to have been reared from a gall of *Harmolita tritici* (Fitch) by T. R. Chamberlin, another is said by the same collector to have been reared from *Elymus*, while two others were reared by E. G. Kelly from *Harmolita* galls on *Elymus*. The following specimens have been reared from puparia of the hessian fly: 2 males by P. R. Myers at Carlisle, Pa., 1 female by C. C. Hill and H. D. Smith at Palmyra, Pa., 2 females by S. E. Keen at Forest Grove, Oreg., and 1 male by M. M. Reeher at Molalla, Oreg.

Myer's manuscript states that examination of the hessian-fly puparia from which this species emerged indicated that it developed as a primary, external, solitary parasite of the fly larvae. Nothing further can be said of its biology.

DISTRIBUTION

Eurytoma phoebus appears to be widely distributed, specimens having been taken at Carlisle and Palmyra, Pa.; Elk Point, S.Dak.; Wellington, Kans.; and Forest Grove and Molalla, Oreg.

IMPORTANCE

This species is of no importance as a parasite of the hessian fly, only six specimens having been reared from the many thousands of fly puparia collected in connection with the extensive investigations of fly parasites by the Bureau of Entomology in recent years.

EURYTOMA ATRIPES, new species

Eurytoma atripes differs structurally from the preceding species, *E. phoebus*, only by having the antennae shorter, the first funicle joint in the female being very little longer than the pedicel, and none of the funicle joints more than one and one half times as long as thick. Typical specimens may be separated from *phoebus* at once, however, by the differently colored legs, which in *phoebus* are all testaceous except the coxae, while in this supposedly new form they are mostly black. The new species is also extremely similar to *E. bolteri* var. *parva* Phillips, from which it can be separated only by its smaller size and the shorter funicle joints.

Female.—Length 1.6 to 2.5 mm. Agrees with the description of *E. phoebus* except in the following particulars: First funicle joint about one and one half times as long as broad, only a little longer than the pedicel; second, third, and fourth funicle joints subequal, each very slightly longer than broad and only a little shorter than the first joint; fifth funicle joint about as broad as long; club similar to that of *phoebus* but with the basal joint a little less distinctly separated from the other two. Propodeum similar to that of *phoebus*, but

with the median impression apparently not quite so deep and the central groove usually not margined laterally. Color dull black; scape as well as rest of antenna black, occasionally a little testaceous at base, the ring joint usually pale; mandibles brownish testaceous; all coxae, all femora except apically, and usually all tibiae blackish, the trochanters, knees, apices of all tibiae narrowly, and all tarsi testaceous, anterior femora and tibiae sometimes mostly testaceous; wings hyaline, venation brownish testaceous; ovipositor sheaths usually blackish; vestiture as in *phoebus*, but apparently a little less conspicuous.

Male.—Length 1.25 to 1.8 mm. Similar to the male of *phoebus* in every way, except that the legs are darker as in the female and the funicle joints appear to have the peduncles slightly longer, the thickened portions of the joints being not much longer than the peduncles in some specimens.

Type locality.—Carlisle, Pa.

Type.—Catalog no. 44838, U.S. National Museum.

Described from 26 specimens as follows: Type female reared at Carlisle, Pa., from hessian-fly puparium, August 5, 1917, by P. R. Myers; allotype reared from the same host February 1, 1920, at Muncy, Pa., by Myers; 1 female paratype reared at Carlisle, Pa., by Myers, July 31, 1917; 1 male paratype reared at Montoursville, Pa., by Myers, July 28, 1915; 1 female, Jersey Shore, Pa., reared August 3, 1932, by J. S. Pinckney; 1 female reared June 14, 1916, at Williamsport, Md., by Myers; 1 male, Albion, N.Y., reared by W. R. McConnell, September 20, 1918; 1 female, Hardin County, Ohio, reared by W. H. Larrimer; 1 female, Knoxville, Tenn., reared by G. G. Ainslie; 4 males and 4 females, Vancouver, Wash., reared by G. I. Reeves and M. W. Reeves in August 1911; 1 male, Kelso, Wash., reared April 30, 1920, by M. M. Reeher; 1 female reared in September 1923, 1 female reared May 22, 1 male in June, and 1 male in July 1924 at Forest Grove, Oreg., by S. E. Keen; 1 female, Forest Grove, Oreg., August 25, 1926, reared by M. M. Reeher; 1 female reared from wheat stubble at Forest Grove, Oreg., by Reeher, september 15, 1919; 1 male swept from wheat at Hagerstown, Md., by W. R. McConnell; and 1 male swept from wheat at Pine Grove Furnace, Pa., May 28, 1923, by Myers. All the above-mentioned specimens, excepting the last three, were from the hessian fly. One other female paratype was reared by C. N. Ainslie at Bottineau, N.Dak., August 23, 1923, from *Cephus cinctus* Nort.

Although treated here as a new species, it must be admitted that this parasite cannot be separated very satisfactorily either from *Eurytoma phoebus* Girault or from the so-called *E. bolteri* var. *parva* Phillips. The antennal differences mentioned are very slight and may possibly be merely the concomitant of small and poorly developed individuals. The color of the legs is known to be variable, but specimens at hand do not show a variation wide enough to bridge the gap between typical *phoebus* and typical specimens of *atripes*. On the other hand, the leg color of *atripes* is extremely similar to that of *parva*, and if the differences in the antennae will not hold, then it will be practically impossible to distinguish the present form from *parva* except by its smaller size. According to Phillips [8] the normal mode of development for *parva* is for its young larva to attack and consume the young larva of *Harmolita tritici* in its cell and then to complete its development in the *Harmolita* cell by feeding upon the plant sap. Specimens of *atripes* are said to emerge from puparia of the hessian fly, and it is therefore certain

[8] Phillips, Jour. Agr. Research 34: 743–758, 1927.

that their development differs from that normal for *parva*. In the fly puparium they could have no opportunity to feed on plant sap and hence must develop entirely as animal feeders. Experiments by Phillips, however, indicated that *parva* might be able under some circumstances to develop entirely as a plant feeder, while in another experiment a second-instar larva of *E. parva* which had already consumed a young larva of *Harmolita* and had begun to feed on plant sap is said to have been transferred to a full-grown larva of *H. tritici*, on which it was reared to maturity. If it is true that the larva of *E. parva* is capable of adapting itself to a wholly phytophagous, wholly entomophagous, or a partly phytophagous and partly entomophagous development, then it is possible that the parasites of the fly here described as *atripes* are merely individuals of *parva* which have been somewhat reduced in size and otherwise slightly modified by the circumstance of their development on the limited amount of food represented by a single fly larva. In the absence of complete proof that *E. parva* is capable of such wide adaptability in its mode of development, and in view of the apparent though slight differences which do exist, it is deemed better for the present to treat this parasite of the hessian fly as different from *parva*.

HOSTS AND LIFE HISTORY

As already indicated, 22 specimens of *E. atripes* have been reared from *Phytophaga destructor* and 1 from *Cephus cinctus*. It is doubtful, however, if either of these insects is the normal host, and it is believed likely that future studies will reveal it to attack some other grass-infesting species.

Little can be said of its life history other than that it emerges from the fly puparium as an adult. Manuscript notes by Myers show that the examinations made by him of puparia from which this *Eurytoma* emerged indicated that the parasite in every instance had developed as a primary, solitary parasite feeding externally upon the fly larva within its puparium.

DISTRIBUTION

As will be seen by reference to the type material, this species has been taken in the Pacific Coast States of Washington and Oregon, in the northern Central State of North Dakota, and in the Eastern States of New York, Pennsylvania, Maryland, Tennessee, and Ohio. These records indicate a probable distribution over most of the wheat-growing region of North America.

IMPORTANCE

The fact that so few specimens of this species have been obtained during the many years that the fly has been studied demonstrates that it is of little importance as a parasite of the hessian fly.

DECATOMA AMSTERDAMENSIS Girault

(Fig. 9)

Decatoma amsterdamensis Girault, Descriptiones stellarum novarum, p. 10, 1917; Leonard, N.Y. (Cornell) Agr. Expt. Sta. Mem. 101: 976, 1928; Balduf, U.S. Natl. Mus. Proc. 79 (art. 28): 20, pl. 1, fig. 4, 1932.

DESCRIPTION

Decatoma amsterdamensis differs from other parasites of the hessian fly in having a short and much thickened marginal vein. It is more closely related to the species of *Eurytoma* than to any of the other parasites, but it is distinguishable at once by the thickened marginal vein which is enveloped in a narrow fuscous cloud, and also by the mostly yellow color of the body. It should be rather easily recognized from the accompanying figure.

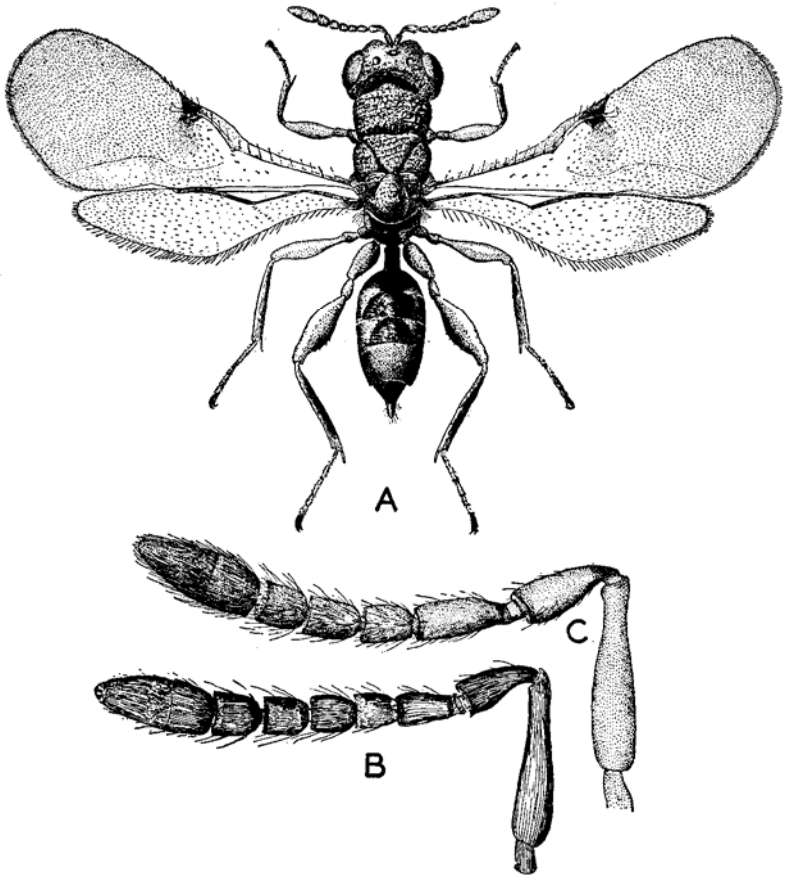


FIGURE 9.—*Decatoma amsterdamensis* Girault: *A*, Adult female; *B*, antenna of female; *C*, antenna of male. *A*, × 25.

Female.—Length 2 to 2.5 mm. Head about twice as broad as long, a little broader than thorax, rugulosely sculptured, the face below antennae medially nearly smooth; eyes nearly circular, bare; ocelli in a low triangle; postocellar line nearly twice the ocellocular, the latter a little longer than the diameter of an ocellus; antennal scrobe deep, smooth within, broader below than above, its greatest width about equal to the distance between it and the eye margin; malar space only a little shorter than the eye height, malar furrow distinct and complete; mandibles each with three teeth, the inner tooth very short; maxillary palpi 4-jointed, the apical joint nearly as long as the other three combined. Antennae 11-jointed, moderately clavate; scape attaining the level of front ocellus, clavate, thickest at base and tapering gradually to apex;

pedicel about twice as long as thick; one strongly transverse ring joint; funicle 5-jointed, the joints sucessively increasing slightly in thickness, the first joint a little less than twice as long as thick, shorter than pedicel; second to fifth joints each very slightly longer than broad; club compact, 3-jointed, the joints not distinctly separated, the separation between joints 2 and 3 being especially vague. Thorax finely rugulosely sculptured, the sculpture on prescutum and to some extent on pronotum and scutellum taking the form of sparse irregularly transverse rugae; pronotum large, subquadrate, about twice as broad as long; mesoscutum shorter than pronotum, parapsidal grooves complete; scutellum equal to prescutum; axillae separated; propodeum with a narrow, shallow, foveolated, median depression, the surface of propodeum outside of the groove finely rugulose; pleura with fine, punctate sculpture. Legs with all the femora slightly thickened; basal joint of hind tarsi scarcely longer than apical joint; hind tibia with a row of stiff spines or bristles along its posterior margin. Wings normal, extending well beyond apex of abdomen, a little less than two and one half times as long as broad, bare behind the submarginal vein except for a few (from 4 to 8) erect stiff hairs marking the obsolete median and basal veins; costal cell with fine cilia on its ventral surface, bare above; marginal cilia short; marginal vein very short and thick, less than one fourth as long as submarginal, wider distally than at base; postmarginal vein very short, subobsolete; stigmal vein approximately half as long as marginal. Abdomen about as long as thorax, ovate, distinctly compressed from the sides, and strongly petiolate; petiole nearly as long as hind coxae, slender, rugulose; body of abdomen smooth or nearly so, the fourth tergite (not counting the petiole) slightly the longest, fifth tergite short, the following tergites concealed; ovipositor not exserted. Color reddish yellow; a spot on occiput and an adjacent area on neck of pronotum, a spot at each anterior lateral angle of mesoscutum (these spots sometimes united to form a transverse band across the anterior margin of mesoscutum), sutures at lower margin of axillae, transverse band at base of propodeum connecting with a median longitudinal stripe, prosternum, mesosternum, metasternum, abdominal petiole, and usually a large triangular spot on each of the first three abdominal tergites, black; antenna and legs concolorous with the body, the hind tibia sometimes stained with fuscous on its outer side; wings hyaline with a narrow transverse band of fuscous embracing the marginal vein and extending about two thirds of the distance across the wing.

Male.—Length 2 mm. Similar to the female except that the funicle is 4-jointed; the first funicle joint as long as the pedicel and a little more than twice as long as thick, second funicle joint about twice as long as broad, third and fourth each a little longer than broad, club composed of three subequal and closely united joints; abdominal petiole a little longer than hind coxae, the abdominal tergites beyond the third (not counting petiole) retracted. Color as in the female except that the scutellum usually has a large black spot apically.

Redescribed from the type specimens.

REVIEW OF LITERATURE

Decatoma amsterdamensis was originally described, together with a number of other species of Chalcidoidea, in a small pamphlet privately published and distributed by A. A. Girault in 1917, the types having been reared in 1914 and 1915 by W. J. Phillips at Penn Yan and Auburn, N.Y. The species was included by Leonard in his list of the insects of New York in 1928, and Balduf included a redescription of it in his revision of the tribe Decatomini published in 1932.

HOSTS AND LIFE HISTORY

This species is probably normally parasitic upon the species of jointworms. In the original description Girault stated that the types were reared in connection with *Harmolita* (=*Isosoma*) at Penn Yan, N.Y., by W. J. Phillips. Balduf gave the additional information that three specimens in the National Museum collection were para-

sites of *Harmolita hordei* (Harris). The types of *Decatoma amsterdamensis* bear the same note number (Webster no. 9355) and other data as do the types of *Harmolita atlantica* Phillips and Emery and were undoubtedly reared in conjunction with that jointworm from stems of *Agropyron*. There is no reason to doubt that they were parasites of *H. atlantica*.

A single specimen of *D. amsterdamensis* was reared March 16, 1919, from an isolated puparium of *Phytophaga destructor* collected by W. R. McConnell and C. R. Crosby on the university farm at Ithaca, N.Y.

Nothing is known of the life history of the species.

DISTRIBUTION

Up to the present time the species is not known to have been taken except in New York State. The source of the three specimens mentioned by Balduf as having parasitized *Harmolita hordei*, however, is unknown. In New York State it is said to have been taken in Penn Yan, Auburn, Geneva, and Ithaca.

IMPORTANCE

Since but one specimen has been reared from the hessian fly, the species is evidently of no importance as a parasite of that pest.

Family EUPELMIDAE

EUPELMUS ALLYNII (French)

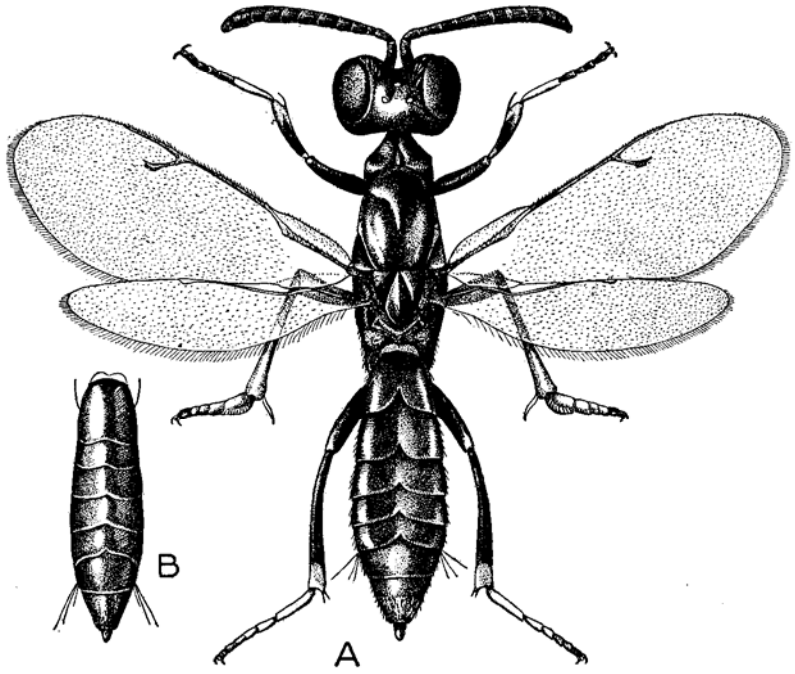
(Fig. 10)

Pteromalus sp. Harris, Insects injurious to vegetation, p. 556, 1862 (also Flint ed., 1863).

Isosoma allynii French, Prairie Farmer 52: 518, 1881; French, Canad. Ent. 14: 9, 1882.

Eupelmus allynii Riley, Amer. Nat. 16: 247, 1882; Riley, Rural New Yorker 41 (1675): 151, 1882; French, Canad. Ent. 14: 48, 1882; Prairie Farmer 53: 74, 1882; Riley, Sci. Amer. Sup. 13: 5382, 1882; French, Ill. State Ent. Rpt. 11: 81, 1882; Forbes, Ill. State Ent. Rpt. 13: 34, 1884; 14: 36, 37, 44, 49, pl. 1, fig. 6, 1885; French, Canad. Ent. 16: 123, 1884; Packard, Amer. Nat. 19: 1104, 1885; Riley, U.S. Natl. Mus. Proc. (1885) 8: 418, pl. 23, figs. 3 and 4, 1886; Amer. Assoc. Adv. Sci. Proc. 34: 333, 1886; Cresson, Synopsis of the families and genera of the Hymenoptera of America, north of Mexico . . . , p. 238, 1887; Lindeman, Bul. Soc. Imp. Natl. Moscou (2) 1: 178, 187, 192, 1887; Smith, Insects of New Jersey . . . , p. 39, 1890; Webster, U.S.Dept.Agr., Div. Ent., Insect Life 5: 90, 1892; 6: 151, 1893; Marchal, Ann. Soc. Ent. France 66: 81, 1897; Osborn, U.S. Dept. Agr. Bul. (n.s.) 16: 28, 34, 1898; Dalla Torre, Catalogus hymenopterorum . . . , v. 5, p. 273, 1898; Fletcher, Canada Dept. Agr. Rpt. Ent. and Bot. (1899), p. 169, 1890; Lugger, Minn. Agr. Expt. Sta. Bul. 64: 556, 1899; Ashmead, *in* Smith, Insects of New Jersey . . . . p. 557, 1900; Stedman, Missouri State Bd. Agr. Rpt. 34: 96, 1902; Webster, U.S.Dept.Agr., Div. Ent. Bul. 42: 22, 33, 1903; Ent. Soc. Wash. Proc. 7: 115, 1905; Burgess, U.S.Dept.Agr., Bur. Ent. Bul. 60: 71, 1906; Gossard and Houser, Ohio Agr. Expt. Sta. Bul. 177: 31, 1906; Webster, U.S.Dept.Agr., Bur. Ent. Circ. 70: 12, 1906; Bul. (n.s.) 67: 97, 1907; Circ. (rev.) 66: 4, 1908; Webster and Reeves, U.S.Dept.Agr., Bur. Ent. Circ. 106: 8, 9, 1909; Viereck, *in* Smith, Insects of New Jersey . . . , p. 645, 1910; Kelly, Jour. Econ. Ent. 3: 202–204, 1910; Felt, N.Y. State Ent. Rpt. 28: 39, 1913; Headlee and Parker, Kans. Agr. Expt. Sta. Tech. Bul. 188: 110, 1913; Webster, U.S. Dept. Agr. Farmers' Bul. 640: 15, 1915; Packard, Jour. Agr. Research 6: 367, 370–373, 1916; Viereck, Conn. State Geol. and Nat. Hist. Survey Bul. 22: 510, 1916; McConnell, Jour. Econ. Ent. 11: 170, 1918; Walton, U.S. Dept. Agr. Farmers' Bul. 1083: 13, 1920; Gahan, Ent. Soc.

Wash. Proc. 22: 238, 1920; Pettit and McDaniel, Mich. Bd. Agr. Rpt. (1918–19) 58: 275, 1920; Phillips and Poos, Jour. Agr. Research 21: 405, 407, 416, 420, figs. 13–16, 1921; Criddle, Ent. Soc. Ontario Rpt. 52: 19, 1921; McColloch, Kans. Agr. Expt. Sta. Tech. Bul. 11: 63, 69, 1923; Phillips and Poos, U.S.Dept.Agr. Farmers' Bul. 1323: 8, 1923; Criddle, Ontario Ent. Soc. Rpt. 54: 17, 1923;



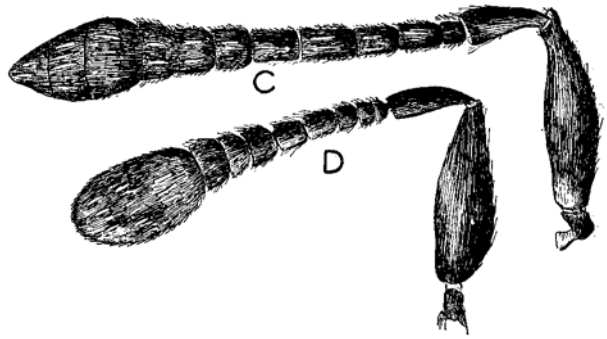


FIGURE 10.—*Eupelmus allynii* French: *A*, Adult female; *B*, abdomen of male; *C*, antenna of female; *D*, antenna of male. *A*, × 25.

Parker, Ann. Soc. Ent. France 93: 286, 1924; Dunnam, Iowa Agr. Expt. Sta. Bul. 220: 66, 1924; Ries, Jour. Agr. Research 32: 293, 1926; Phillips and Poos, Jour. Agr. Research 34: 475, 476, 482, 1927; Phillips, Jour. Agr. Research 34: 751, 1927; Packard, U.S. Dept. Agr. Tech. Bul. 81: 14, 1928; Hill and Smith, Jour. Agr. Research 36: 153, 1928; Salt, Bul. Ent. Research 22: 482, 1931.

DESCRIPTION

The female of *Eupelmus allynii* is similar in general appearance to *Eupelmus atropurpureus* Dalman but is at once distinguishable by the ovipositor, which extends only slightly beyond the apex of abdomen, and by the wings, which are always fully developed. The male is easily recognized by the striking color of its legs, all the femora being pale yellow, the middle and hind tibiae being black except narrowly at apex and the anterior pair usually more or less blackish. May be separated from *Eupelmella vesicularis* (Retzius) by the less strongly exserted ovipositor and the fully developed wings, as well as by the different conformation of the mesonotum. This species differs from *Calosota metallica* Gahan by the much narrower base of the scutellum and the greater concavity of the mesonotum, as well as by the less metallic color and differences in sculpture. From other parasites of the fly it may be distinguished by its long, slender body, as well as by numerous other structural characters.

Female.—Length 1.5 to 3.4 mm. Head as broad as or a little broader than thorax, about twice as broad as thick antero-posteriorly at the middle, very slightly concave behind; ocelli in a nearly equilateral triangle, postocellar line distinctly longer than ocellocular line, the latter about equal to diameter of an ocellus, vertex not broad; eyes large, rather prominent, elliptical, with very short inconspicuous pile; temples about one fourth as broad as the eyes; viewed from in front, the head subtriangular, narrowing below, a little broader than high, the malar space longer than half the eye height; malar groove complete; clypeus not distinctly separated from face, its anterior margin nearly straight; mandibles each with three teeth, the two outer teeth subacute, the inner one rounded and with its margin very weakly serrated; maxillary palpi 4-jointed, short, the first three joints subequal, the apical joint nearly as long as the other three combined; labial palpi 3-jointed; scrobes deep, subtriangular, the antennal fossae separated by a short, rounded, triangular plate. Antennae 13-jointed, long, strongly clavate; scape reaching nearly to the level of front ocellus, slightly expanded, flat on the outer side, subconvex and weakly reticulated on the inner side; pedicel slightly longer than the first two flagellar joints; first funicle joint (really the ring joint) about one half as long as broad; third and fourth subequal in length and a little longer than second; fifth a little longer than broad; sixth subquadrate; seventh and eighth broader than long; funicle moderately slender at base but gradually increasing in thickness toward apex; club more or less obliquely truncate, distinctly thicker than funicle, 3-jointed, the joints subequal in length; each of the funicle and club joints with a single series of elongate sensoria. Frons and most of vertex nearly smooth; occiput, face, cheeks, and temples, except along eye margins, distinctly finely reticulated and sparsely clothed with pale hairs. Thorax about twice as long as broad; prothorax forming a short conical neck; mesonotum about as long as broad, very weakly sculptured and clothed with pale hairs, the parapsidal grooves deeply impressed at anterior angles, and merging into a more or less deep concavity down the middle of the posterior two thirds of mesoscutum; scutellum small, rounded at apex, very narrow at base and weakly sculptured; axillae on nearly the same plane as scutellum and nearly meeting at the middle, the sculpture like that of scutellum; mesopleura large, evenly reticulated; propodeum very short. Wings always fully developed, fore wing extending to or a little beyond the apex of abdomen, nearly three times as long as broad; marginal vein nearly as long as submarginal; stigmal vein about one third as long as marginal; postmarginal vein one half as long as marginal; base of wing, including the costal cell, evenly ciliated like the remainder; marginal cilia very short; hind wing fully three fourths as long and nearly two thirds as wide as fore wing. Legs moderately long; front tibial spur long and curved, the tibia with two or three short black spines at apex on outer side; middle femora flattened dorsoventrally, their tibiae thickened toward apex and with a patch of short black spines at apex on the inner side, their first three tarsal joints swollen and each with a double row of black spines beneath, the tibial spur large and nearly as long as first tarsal joint;

posterior tibia with two apical spurs of which one is short and inconspicuous, their tarsi not thickened. Abdomen about as long as head and thorax, about as broad as thorax, boat shaped or cylindrico-conical, rather strongly reticulately sculptured, the first to fifth tergites emarginate at the middle, the sixth and seventh subequal and each a little longer than the fifth; ovipositor sheaths issuing from before the apex and barely extending beyond the apex. General color black or purplish black, the head above, mesoscutum, propodeum laterally, and usually the base of abdomen, metallic green; antennae brownish black, the scape often slightly metallic; all coxae blackish; fore and posterior legs more or less blackish, with their trochanters, apices of femora narrowly, apices of tibiae broadly, and their tarsi yellow; middle legs mostly yellowish but with their femora and tibiae often more or less dark brown; wings hyaline; abdomen usually metallic at base, black beyond; ovipositor sheaths brownish black with the apices usually paler.

Male.—Length 1.2 to 2 mm. Differs from the female as follows: Distinctly smaller; antennae similar to that of female, but the pedicel about as long as the three following joints, the first flagellar joint a little broader than long, second as broad as long, third about as broad as long, fourth only slightly longer than broad, fifth subquadrate, sixth and seventh broader than long, eighth about twice as broad as long, club shaped as in the female, with three series of elongate sensoria, without dividing sutures and a little longer than the three preceding joints; mesoscutum not depressed down the middle, a little more strongly sculptured than in the female, the parapsidal grooves complete but not sharply impressed posteriorly; scutellum not especially small, sculptured like mesoscutum, as are also the axillae; propodeum short, without distinct grooves or folds, usually with a very weak median carina, and faintly reticulately sculptured; fore wing about two and one half times as long as broad; marginal vein a little shorter than submarginal; stigmal vein nearly half as long as marginal; fore tibiae as in the female; middle femora not flattened, their tibiae without a patch of black spines at apex, the tibial spur long but not thickened, the tarsal joints not thickened and without black spines beneath; abdomen elliptical, usually about as long as thorax, the dorsal segments not emarginate apically. Color bright metallic green or blue-green above, coppery beneath, the abdomen usually blackish above except at base, but with strong coppery tint beneath and on the black dorsal portion; wings hyaline; all coxae concolorous with the pleura; all femora pale yellow; front tibiae yellow, usually with a black stripe on the outer margin; middle and hind tibiae black with a narrow band at apex yellow; all tarsi yellowish at base with the apical three or four segments fuscous or blackish.

More than 300 specimens of this species are in the National Museum collection and have been studied. A part at least of French's original material is included.

REVIEW OF LITERATURE

First mention of this species seems to have been made by T. W. Harris in the 1862 edition of his Insects Injurious to Vegetation, in which he gave a short description of what he called a species of *Pteromalus* which had been reared by Asa Fitch from the jointworm of barley. In 1881 French very briefly described the species, which he named *Isosoma allynii*, and the following year published a more detailed description of it. French's specimens were reared from wheat stems and were believed by him to be true jointworms. French sent specimens to Riley, who recognized the species as a *Eupelmus* and in an article published in 1882 referred the species to its proper genus, at the same time pointing out that it was probably parasitic and not phytophagous. In 1884 French referred to the species as parasitic upon two different species of jointworms, viz *Harmolita hordei* and *H. tritici*, and the following year it was first mentioned by Riley as a parasite of the hessian fly. Figures of both male and female were included in Riley's paper. Forbes figured the female and republished French's description of both sexes in his fourteenth report as entomologist of Illinois in 1885. In 1887 Lindeman men-

tioned the species as a parasite of the fly in North America and compared it with *Eupelmus karschii* Lindeman reared from the same host in Russsia. The next reference of importance was that by Kelly in 1910, in which is given a short account of the life history together with brief descriptions of the egg, larva, and pupa and the fact is recorded that the species occasionally acts as a secondary parasite. In 1916 C. M. Packard published a more detailed account of its biology as a parasite of the hessian fly, giving figures of egg, larva, and pupa; and in 1921 Phillips and Poos gave an excellent account of its development as a parasite of jointworms, including figures of adult, larva, and pupa. Many other writers have mentioned the species, as will be seen by the long list of references cited above, but most of these citations are in the nature of repetitions or reviews of the articles mentioned. A few contain original host records, which will be mentioned in the discussion of the hosts.

HOSTS AND LIFE HISTORY

Eupelmus allynii, like many other species of *Eupelmus*, is decidedly polyphagic. While its hosts are usually species which live in the stems of grasses and grains, it apparently is not confined in its operations to such hosts. It was first recorded as a parasite of the barley and wheat jointworms by Harris and French and it is said by Phillips and Poos to attack no less than 11 species of the genus *Harmolita*, all of which infest the stems of grains and grasses. Phillips and Poos found, also, that it frequently developed as a secondary parasite, using as its victims *Ditropinotus aureoviridis* Crawford, (*Homoporus*) *Merisoporus chalcidiphagus* (Walsh and Riley), and *Eurytoma* sp., primary parasites of the jointworms. Riley's first record of its parasitism of *Phytophaga destructor* has been confirmed by many subsequent authors. Criddle has recorded it from *Cephus cinctus* Norton, the wheat stem sawfly, and also as a secondary parasite on that species through *Microbracon cephi* Gahan. Ries bred it from *Cephus pygmaeus* Linnaeus. Phillips obtained it as a parasite of *Eurytoma parva* Phillips, a species which is said to develop either as a parasite of the jointworms or as a phytophagous species. According to Kelly it sometimes attacks *Merisus febriculosus* Girault, a primary parasite of the hessian fly, and Packard reared it experimentally upon *Merisus destructor* (Say) and *Eupteromalus fulvipes* (Forbes). Dunnam claims to have reared it from the apple leaf trumpet miner (*Tischeria malifoliella* Clemens).

In addition to these published records Myers, in an unpublished manuscript, states that he observed more than 50 instances of its occurrence as a parasite upon *Platygaster* attacking the hessian fly and that in half of these cases the host was identified as *P. zosine* Walker. He also reared it from *Trachelus tabidus* Fabricius and further states that it was reared by C. N. Ainslie from *Meromyza* sp. Still other records taken from specimens in the National Museum collection are as follows: From egg nests of *Melampsalta calliope* Walker, Phillips County, Kans., by R. H. Beamer; from eggs of *Oecanthus* sp., Pittsylvania County, Va., by J. S. Pinckney; from *Mompha eloisella* Clemens, Gretna, Va., by J. S. Pinckney; from *Procystiphora junci* Felt, Centralia, Ill., by W. B. Cartwright; from *Languria mozardi* Latreille, Tempe, Ariz., by V. L. Wildermuth.

From this list of hosts it is apparent that *Eupelmus allynii* is capable of developing under a variety of circumstances. That it may be either a primary or a secondary parasite is established beyond doubt. Just what its true relation to some of these hosts may be, is not definitely known, but in the cases of the hessian fly and the species of *Harmolita* it is almost certainly more often primary than secondary, the degree of secondary parasitization depending largely on the abundance or scarcity of competing species at the time the *Eupelmus* is ovipositing. If the particular host chosen by the *Eupelmus* happens to be already occupied by some other species of parasite, or even by one of its own species, it will develop at the expense of the earlier occupant. There is no evidence, however, to indicate that the *Eupelmus* discriminates between parasitized and unparasitized hosts when ovipositing.

The species is normally a primary, external, solitary parasite of the hessian fly. According to Packard, the egg is deposited in the flaxseed but external to the fly larva or pupa. The parasite feeds externally upon its host and normally passes through five instars. Pupation is accomplished as a naked pupa within the host puparium, emergence taking place through a hole gnawed by the adult. The seasonal history of the species was not worked out by Packard, but according to Phillips and Poos, who studied its biology as a parasite of jointworms, it overwinters as a full-grown larva in the jointworm cells in old wheat stubble, the adults appearing in April and May in the latitude of Virginia, and four generations were reared in the laboratory during one breeding season under conditions as nearly normal as it was possible to keep them.

DISTRIBUTION

This species apparently occurs generally throughout the wheat-growing region of the United States. It also occurs in Canada, having been recorded from Prince Edward Island by Fletcher, and from Manitoba by Criddle, while specimens from Ontario have been seen by the writer. No doubt it is present throughout the entire wheat-growing region of North America, and it may occur in regions where wheat is not grown but where wild grasses infested by jointworms or other hosts are present.

Apparently it does not occur in Europe.

IMPORTANCE

Hill and Smith rank *Eupelmus allynii* as the most important chalcidoid parasite of the fly in the Eastern States, it being outranked only by the serphoids *Platygaster zosine* (syn., *vernalis*) and *P. hiemalis*. Packard found it to rank third in importance in California, while L. P. Rockwood estimates it as ranking fourth among parasites of the fly in Oregon.

EUPELMUS ATROPURPUREUS Dalman

(Fig. 11)

Eupelmus atropurpureus Dalman, Svenska Vetensk.-Akad. Handl. 41: 381, 1820; Nees von Esenbeck, Hymenopterorum ichneumonibus affinium monographiae . . ., v. 2, p. 78, 1834; Ashmead, Psyche 8: 137, 1897; Marchal, Ann. Soc. Ent. France 66: 93, 1897; Dalla Torre, Catalogus hymenopterorum . . .,

v. 5, p. 274, 1898; Rudow, Intern. Ent. Ztschr. 6: 201, 1912; Rimsky-Korsakov, Trudi Bur. Ent. [Russia] 10 (11): 56, 1914; Ruschka, Verhandl. Zool.-Bot. Gesell. Wien (1920) 70: 276, 1921; Chamberlin, Jour. Econ. Ent. 17: 628, 1924; 18: 601, 1925; Meyer, Rpt. Appl. Ent. Leningrad 4: 239, 1929.

Macroneura maculipes Walker, Ent. Mag. 4: 354, 1837, male (female excluded); Blanchard, Histoire naturelle des insectes . . ., v. 3, p. 274, 1840, male

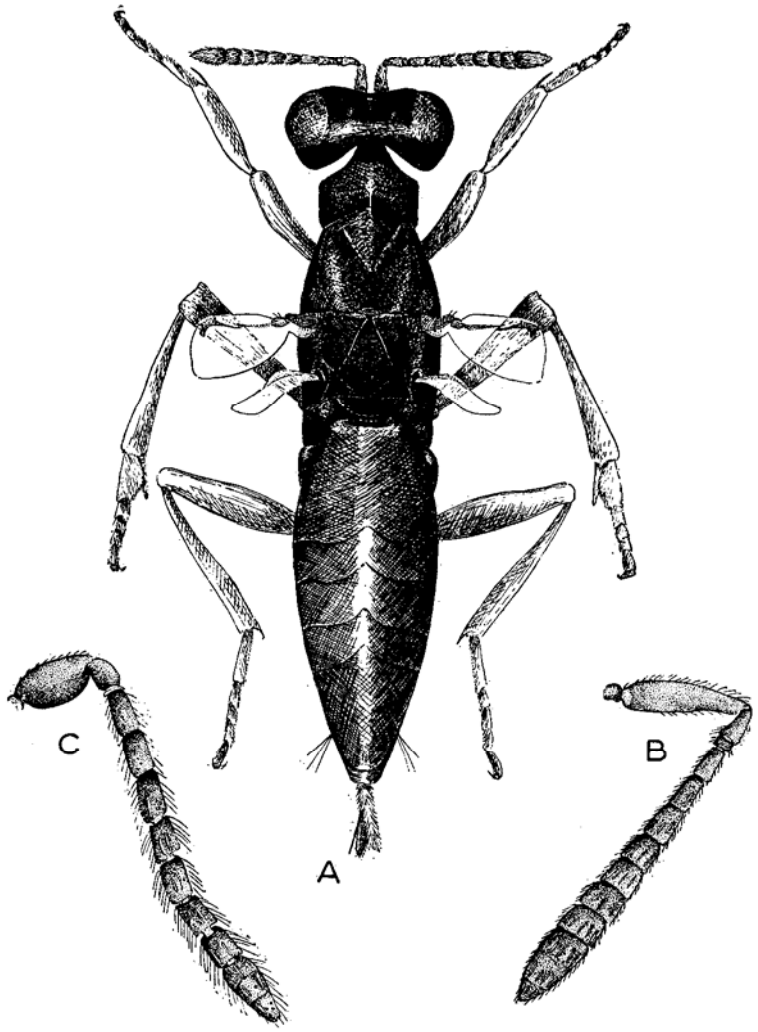


FIGURE 11.—*Eupelmus atropurpureus* Dalman: *A*, Adult female; *B*, antenna of female: *C*, antenna of male. *A*, × 27.

(female excluded); Westwood, An introduction to the modern classification of insects, v. 2, synopsis, p. 72, 1840, male (female excluded).

Urocryptus atropurpureus Blanchard, Histoire naturelle des insectes . . ., v. 3, p. 275, 1840.

Eupelmus atrocoeruleus Thomson, Skandinaviens Hymenoptera, v. 4, p. 106, 1875.

Eupelmus vesicularis Ruschka, Verhandl. Zool.-Bot. Gesell. Wien 70: 301, (1920) 1921, male (female excluded).

DESCRIPTION

Eupelmus atropurpureus is easily distinguishable from *Eupelmella vesicularis* by the conformation of the mesoscutum, which is trilobed, the prescutum being short and triangular, but distinctly set off by the parapsidal grooves which merge at about the anterior one third of mesoscutum, the posterior two thirds of mesoscutum with a broad depression down the middle, the scapulae forming longitudinal ridges which are not acute. It also differs in color, the scape being metallic, the abdomen without a pale band at the base, and the ovipositor sheaths uniformly black.

Female.—Length 2.25 to 4 mm. Head a little wider than thorax, about twice as broad as thick at the middle, the occiput very slightly concave; vertex not broad, precipitous behind but the margin not acute; ocelli in a slightly obtuse triangle, postocellar line nearly twice the ocellocular line, the latter a little longer than the diameter of an ocellus; eyes moderately large, elliptical, sparsely clothed with very short inconspicuous pile; temple about one third as broad as eye; viewed from in front the head a little broader than high, subtriangular; malar space about equal to half the eye height; malar groove very distinct and complete; clypeus smooth, not distinctly separated from face, its anterior margin nearly straight; mandibles 3-toothed, all the teeth subacute; last joint of maxillary palpi a little flattened and slightly expanded; antennal scrobes deep anteriorly, shallow above, subtriangular; frons, upper part of vertex, and temples finely reticulated; face, cheeks, and lower part of frons more strongly rugulose, the face with a low, nearly smooth ridge extending from between antennal fossae to clypeus. Antennae inserted below the eyes, clavate, obliquely truncate at apex; scape slightly thickened, flattened on outer side, rounded and reticulated on inner side; pedicel about twice as long as broad, a little shorter than the two following joints; ring joint not quite so long as broad; second, third, and fourth flagellar joints subequal in length and successively increasing a little in thickness; second a little more, the fourth a little less, than twice as long as thick; fifth a little longer than broad; sixth quadrate; seventh and eighth slightly transverse; club 3-jointed, ovate, about as long as three preceding joints, a little broader than last funicle joint, and slightly flattened or impressed on the ventral side; the whole flagellum covered with short hairs, and each joint, except the ring joint and the first funicle joint, with a single series of elongate sensoria at apex. Thorax fully twice as long as broad; prothorax forming a prominent conical neck; mesoscutum a little longer than broad, weakly reticulated, the prescutum weakly convex, the scapulae forming rounded ridges on each side of the median depression; scutellum and axillae very finely reticulated, the scutellum narrow, rounded at apex, weakly convex, and nearly acute at base; propodeum very short; mesopleura large, shining, with shallow reticulation. Legs as in *allynii* except that the hind tibia apparently has only one spur. Fore wings either well developed or reduced to short truncate stubs which extend only slightly beyond the propodeum; fore wing, in the only winged specimen seen, extending not quite to apex of abdomen, nearly three times as long as broad; marginal vein shorter than submarginal, about twice as long as stigmal, and one and one half times postmarginal vein; base of wing more sparsely ciliated than disk but not bare, the costal cell ciliated; hind wing about four fifths as long and half as wide as fore wing. Abdomen uniformly weakly reticulated, sometimes a little longer and sometimes a little shorter than head and thorax, more or less cylindrico-conical, often slightly compressed, sessile, convex or flattened above; the first four tergites deeply emarginate at apex, the fifth longer than the third and fourth combined, its apical margin triangularly produced and concealing from view nearly all of the sixth and seventh tergites; ovipositor extending beyond apex of abdomen about the length of the first and second joints of hind tarsus combined.

General color purplish black with an aeneous cast, the inner eye margin more or less bluish green; antennae entirely black, the scape and pedicel slightly metallic; tegulae black; wings hyaline; all coxae and femora black; fore and hind tibiae black with broad apical band pale yellow; middle tibiae yellow at base and apex, blackish in the middle; tarsi yellow with the apical 2 or 3 joints blackish; ovipositor sheaths black, without a pale band.

Male.—Length 1.5 to 2 mm. Antennae not clavate, cylindrical, often tapering slightly toward apex; scape about twice as long as broad; pedicel a little longer than broad, ring joint small and transverse; flagellar joints as thick as pedicel, variable in length, the first flagellar joint varying from 1½ to 2½ times as long as broad; other flagellar joints 1½ to 2 times as long as broad; club 3-jointed, not broader than funicle, a little longer than two preceding joints. Mesoscutum weakly convex, not depressed in the middle, the parapsidal grooves complete; scutellum convex, with a little broader base on mesoscutum than in female; propodeum nearly smooth, with a median carina but without lateral folds; wings fully developed, about twice as long as broad, marginal vein not quite twice as long as stigmal, the stigmal vein strongly curved; ciliation of fore wing uniform except for a broad oblique area behind the base of marginal vein. Abdomen elliptical, about as long as thorax, reticulately sculptured, the tergites not emarginate. Color of head and thorax metallic blue-green; abdomen aeneous black, usually metallic green at base; antennae black, the scape slightly metallic; wings hyaline; coxae and femora dark, slightly metallic; trochanters and narrow apices of anterior and median femora yellow; all tibiae pale yellow, the two posterior pairs with a blackish or fuscous band just before apex; tarsi pale at base, blackish at apex.

The foregoing description is based on 15 specimens (8 females and 7 males) reared by Marchal in France from *Phytophaga destructor* and *Mayetiola avenae* Marchal; 4 specimens (2 females and 2 males) from Italy reared by Chamberlin from *Tetrastichus incertus* (Ratzeburg) attacking *Phytonomus posticus* Gyllenhal; 2 females and 3 males reared by M. N. Nikolskaja from alfalfa seed infested with *Bruchophagus funebris* Howard at Poltava, Russia; and 1 female from Russia identified by Ruschka which bears the label "aus Isos. rossicum. Rimsky."

REVIEW OF LITERATURE

Eupelmus atropurpureus was originally described by Dalman in 1820 from specimens collected in Sweden. Nees published a redescription of it in 1834. The male, but not the female, described by Walker in 1837 as *Macroneura maculipes* is believed to be *atropurpureus* instead of *vesicularis*, although it has been treated as a synoym of the latter by Dalla Torre and Ruschka. In 1840 Blanchard transferred *atropurpureus* to *Urocryptus* Westwood. Thomson redescribed it in 1875 under the name *Eupelmus atrocoeruleus*, the spelling of the specific name probably being a lapsus. In 1897 Ashmead and also Marchal recorded it as parasitic upon both *Phytophaga destructor* and *Mayetiola avenae* in France, and the following year Dalla Torre listed it in his Catalogus Hymenopterorum and cited *Bruchus varius* Olivier as its host, apparently on the authority of Goureau. Rudow in 1912 listed six different species of the genus *Orchestes* as attacked by it. Rimsky-Korsakov in 1914 gave an account of its biology and named *Philachyra apterum* (Portchinsky), (*Isosoma*) *Harmolita rossicum* (Rimsky-Korsakov), *H. eremitum* (Portchinsky), *H. inquilinum* (Rimsky-Korsakov), and *Homoporus luniger* (Nees) as hosts. In 1921 Ruschka treated it in a revision of the Eupelminae of Europe, citing *Cleonymus hemipterus* Fonscolombe as a synonym and mentioning the host records by Marchal and also stating that specimens in the Mayr collection received from Rimsky-Korsakov had been reared from (*Isosoma*) *Harmolita rossicum* (Rimsky-Korsakov), *H. noxiale*, and *H. apterum* (Portschinsky). Chamberlin in 1924 and again in 1925 recorded the species as a secondary parasite of *Phytonomus posticus* Gyllenhal, and in 1929

Meyer again listed three of the already-mentioned species of *Harmolita* as hosts.

That Ruschka was correct in synonymizing *Cleonymus hemipterus* with this species is considered extremely doubtful. The description of *hemipterus* by Fonscolombe seems not to agree exactly with *atropurpureus*, especially in the color of the legs. For that reason the Fonscolombe species is omitted from the synonymy.

Some confusion exists regarding the male of *atropurpureus*. The species was originally described from the female only, Thomson being the first to associate a male with the female. Ashmead identified both sexes from material sent to him from France by Marchal. In his revision of the Eupelmidae of Europe and the Mediterranean region, Ruschka gave it as his opinion that the male described by Thomson was not that of *atropurpureus* but belonged to *vesicularis* Retzius. At the same time Ruschka described what he believed to be the true male of *atropurpureus*, this description being based apparently on a single representative of that sex which had been reared in Russia from (*Isosoma*) *Harmolita rossicum*. In the same paper Ruschka, apparently following Dalla Torre, synonymized with *vesicularis* the male (excluding the female) of *Macroneura maculipes* Walker and also declared that the description of *Eupelmus karschii* Lindeman is a characterization of the male of *vesicularis*.

The writer cannot agree with Ruschka in this synonymy. Although *vesicularis* is a common species in North America, hundreds of specimens of it having been reared and its life history studied in detail by Phillips, McConnell, and others, no males have ever been found. McConnell reared it through 5 generations, and Phillips through 6, without producing a male. Hundreds of specimens have also been reared at the gypsy moth laboratory without the appearance of males. Chamberlin's rearing, mentioned above, comprised typical females of *atropurpureus* accompanied by males, but no females of *vesicularis* were present. In the cases of the Marchal and Nikolskaja rearings, females of both species were present, the males in both instances all agreeing with those reared by Chamberlin. The males of the Marchal rearing were associated by Ashmead with the females of *atropurpureus* instead of *vesicularis*, whether on the basis of information furnished by Marchal it is now impossible for the writer to say. The Nikolskaja specimens were sent to the writer by the collector, already identified, with a request for verification of the identifications, and in this case, also, the males had been associated with females of *atropurpureus*, probably on the basis of actual association in the rearing. Because of these facts the writer is convinced that the males herein ascribed to *atropurpureus* are correctly placed in that species. These males appear to agree exactly with the male of Thomson's description of *atropurpureus* and also with the description of the male of *Macroneura maculipes* Walker. Likewise they seem to agree with the description of the male of *vesicularis* given by Ruschka. Ruschka does not indicate either the number or the source of the male specimens from which this description is drawn, and it is therefore impossible to tell on what grounds he based his association of the sexes. He may have had definite information tending to prove that males do exist

and that those which he described were actually those of *vesicularis*, but if so it is not apparent from his remarks. If males of *vesicularis* really exist in Europe, it is difficult to explain why they seem to be absent in North America. In the writer's opinion Ruschka's male of *vesicularis*, Walker's male of *Macroneura maculipes*, and Thomson's male of *atropurpureus* are all *atropurpureus*.

The male described by Ruschka for *atropurpureus* is distinguished by him from the supposed male of *vesicularis* by the fact that the tibiae are all yellow except for a brownish spot on the inner side of the middle pair, while in *vesicularis* males the middle and hind tibiae are broadly black apically. That this difference is probably not specific is demonstrated by the fact that in one of the males reared by Chamberlin there is only a faint infuscation of the tibiae at apex, while in the other the middle and hind tibiae are distinctly blackish apically. The male described as *atropurpureus* by Ruschka is therefore believed to be merely a variant from the typical form.

HOSTS AND LIFE HISTORY

The hosts of *Eupelmus atropurpureus* have already been enumerated in the historical sketch of the species. Like *E. allynii*, it is evidently polyphagous, attacking many different species and at times, at least, acting as a secondary parasite.

DISTRIBUTION

Eupelmus atropurpureus is evidently widely distributed in Europe, having been recorded from Sweden by Dalman, from France by Marchal, from Russia by Rimsky-Korsakov, from Spain, Russia, Germany, and Austria by Ruschka, and from Italy by Chamberlin. It is not known to occur in North America.

EUPELMUS KARSCHII Lindeman

Eupelmus karschii Lindeman, Bul. Soc. Imp. Nat. Moscou (2) 1: 187, 1887; Enock, Entomologist 21: 203, 1888; Riley, U.S.Dept.Agr., Div. Ent., Insect Life 1: 132, 1888; Meyer, Rpt. Appl. Ent. Leningrad 4: 241, 1929.

No specimens of *Eupelmus karschii* have been seen by the writer. It was originally described as a parasite of the hessian fly in Russia and was subsequently identified by Riley among specimens reared from the fly in England, but so far as known no one has again reared it. Ruschka [9] synonymized *karschii* with *Eupelmella vesicularis* (Retzius) apparently on the basis of Lindeman's short description. In the opinion of the writer the description does not apply to *vesicularis*. Lindeman's description contains the statement that the legs are yellow, the femora at apex, the tibiae at apex, and the last tarsal joint black; in the female the fore legs are entirely yellow. This statement clearly indicates that Lindeman had both sexes of this species, a fact that Ruschka apparently overlooked when he stated that Lindeman described the male of *vesicularis* as *Eupelmus karschii* and the female as *Euryscapus saltator*. Since Lindeman placed the female of *vesicularis* (=*Euryscapus saltator*) in a different genus from that in which he placed the female of *karschii*, it is to be presumed

[9] Ruschka, Verhandl. Zool.-Bot. Gesell. Wien 70: 302, 1920.

that his female of *E. karschii* was a different species. The color characters which he gives for the female do not fit the female of *vesicularis*, and this, coupled with the fact that males of *vesicularis* are believed not to exist, makes it impossible to accept *karschii* as a synonym of *vesicularis*.

Lindeman's description of the color of the legs in *karschii*, likewise, does not agree in the case of either sex with *atropurpureus*, and it is therefore believed not to be a synonym of that species. The identity of *karschii* will probably remain in doubt until some one has opportunity to study Lindeman's original specimens, which are probably in the Rural Economy Institute at Moscow, Russia. It may not be a true eupelmine.

EUPELMELLA VESICULARIS (Retzius)

(Fig. 12)

Ichneumon sp. de Geer, Mémoires pour servir a l'histoire des insectes . . . v. 2, pt. 2, p. 909, pl. 31, figs. 12, 22, 1771; Goeze-de Geer, Abhandl. Gesch. Insect. 2 (pt. 2) : 207, pl. 31, fig. 22, 1779.

Ichneumon vesicularis Retzius, Genera et species insectorum . . ., p. 70, 1783; Villers, Caroli linnaei entomologia . . . , v. 3, p. 216, 1789; Olivier, Encyclopédie méthodique, Histoire naturelle insectes, v. 7, p. 205, 1792.

Diplolepis vesicularis Spinola, Insectorum liguriae species novae aut rariores . . . , v. 2, p. 161, 1808.

Eupelmus degeeri Dalman, Svenska Vetensk.-Akad. Handl. 41: 379, 1820; Walker, Ent. Mag. 4: 361, 1837; Entomologist 1841: pl. F, fig. 2; *6*: 249, fig., 1872; Notes on Chalcididae, pt. 5, p. 76, fig., 1872; Dours, Catalogus synonymique des hyménoptères de France, p. 89, 1874; Thomson, Skandinaviens hymenoptera, v. 4, p. 107, 1875; Giraud and Laboulbène, Ann. Soc. Ent. France (5) 7: 420, 1877; Ashmead, Psyche 8: 137, 1897; Marchal, Ann. Soc. Ent. France 66: 83, 1897; Dalla Torre, Catalogus hymenopterorum . . . , v. 5, p. 275, 1898; Rimsky-Korsakov, Trudi Bur. Ent. Russia 10 (11) : 59, pl. 3, fig. 3, 1914; Masi, Ann. Mus. Civ. Stor. Nat. Genova (3) 8: 156, 1919; Fahringer, Ztschr. Wiss. Insektenbiol. 17: 7, 1922; Forsius, Acta Soc. Fauna and Flora Fenn. 49: 68, 1925; Leonardi, Ann. R. Ist. Super. Agr., Portici (3) 1:271–272, 1926; Meyer, Rpt. Appl. Ent. Leningrad 4: 242, 1929; Picard, Bul. Biol. France et Belg. 65: 81, 1931; Del Guercio, Redia 19: 60, 1931.

Eupelmus geeri Nees von Esenbeck, Hymenopterorum ichneumonibus affinium monographiae . . . , v. 2, p. 76, 1834; Foerster, Beiträge für Monographie der Pteromalinen, p. 33, pl., fig. 3, 1841; Ratzeburg, Die Ichneumonen der Forstinsecten . . ., v. 2, p. 151, 1848; v. 3, p. 198, 1852; Reinhard, Stettin. Ent. Ztg. 17: 107, 1856; Goureau, Ann. Soc. Ent. France (4) 6: 170, 1866; Kaltenbach, Die Pflanzenfeinde aus der Klasse der Inseckten, p. 489, 1874; Brischke, Schr. Naturforsch. Gesell. Danzig 5: Heft 2, 179, 181, 199, 1882; Schulz, Spolia hymenopterologica, p. 147, 1906; Rudow, Internatl. Ent. Ztschr. 6: 180, 200, 1912.

Eupelmus albitarsis Costa, Atti R. Accad. Sci. Fis. Mat. Napoli (1883) (2) 1 (2) : 101, 1888; Bul. Soc. Ent. Ital. 15: 338, 1883.

Euryscapus saltator Lindeman, Bul. Sôc. Natl. Moscou (2) 1: 190, 1887.

Mira saltator Dalla Torre, Catalogus hymenopterorum . . . . v. 5, p. 238, 1898.

Eupelminus saltator McConnell, Jour. Econ. Ent. 11: 170, 1918; Pettit and McDaniel, Mich. State Bd. Agr. Ann. Rpt. Sec. (1918/19) 58: 275, 1920; Ries, Jour. Agr. Research 32: 293, 1926; Phillips and Poos, Jour. Agr. Research 34: 473, 1927; Phillips, Jour. Agr. Research 34: 751, 1927; Muesebeck and Dohanian, U.S. Dept. Agr. Bul. 1487: 23, 1927; Hill and Smith, Jour. Agr. Research 36: 153, 1928; Sorenson, Utah Agr. Expt. Sta. Bul. 218: 27, 1930; Salt, Bul. Ent. Research 22: 482, 1931.

Eupelmella degeeri Masi, Ann. Mus. Civ. Stor. Nat. Genova (3) 8: 307, 1919; Lichtenstein, Bul. Soc. Ent. France 1919: 273; Gahan and Fagan, U.S. Natl. Mus. Bul. 124: 60, 1923.

Eupelmus vesicularis Ruschka, Verhandl. Zool.-Bot. Gesell. Wien 70: 238, 240, 241, 301 (1920) 1921; Falcoz, Bul. Soc. Ent. France 1926: 131.

Eupelminus coleopterophagus Girault, Ann. Ent. Soc. Amer. 9: 306, 1916.

Eupelmus coleopterophagus Cockerell, Jour. Econ. Ent. 22: 985, 1929.

DESCRIPTION

Eupelmella vesicularis was first placed by the writer in the genus *Eupelminus*, and in all references to it in American literature that

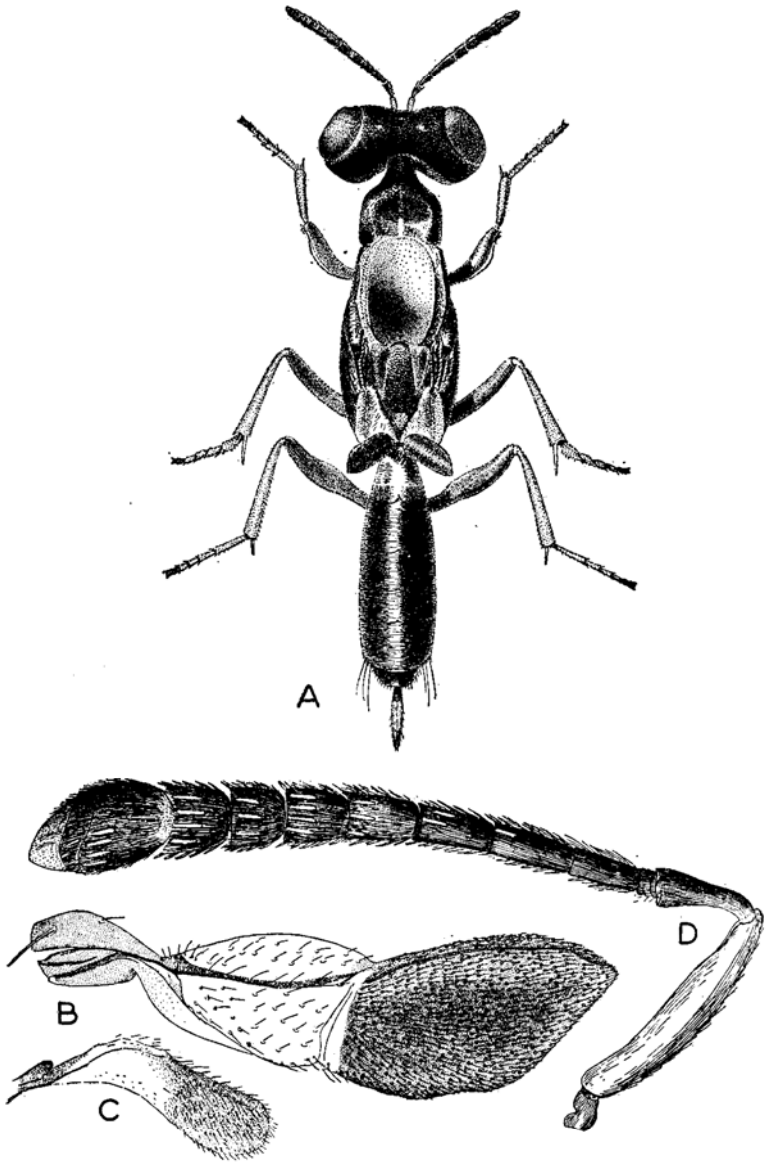


FIGURE 12.—*Eupelmella vesicularis* (Retzius): *A*, Adult female; *B*, fore wing of female; *C*, hind wing of female; *D*, antenna of female. *A*, × 26.

generic name has been used. Recent acquisition of specimens of the type species of *Eupelminus*, *E. excavatus* Dalman, however, has permitted comparison of *vesicularis* with that genotype, with the result

that it now seems advisable to accept the generic name *Eupelmella* which was proposed by Masi especially for *Eupelmus degeeri* Dalman, a species that is believed to be a synonym of *vesicularis*. *Eupelmella* differs from *Eupelminus* by having the axillae not contiguous at base, the scutellum with a narrow base on mesoscutum, the propodeum very short, transversely linear medially, the abdomen completely sessile, with the first to fourth tergites distinctly emarginate at the apical middle, and the ovipositor distinctly exserted. In females of *Eupelminus* the axillae meet for a considerable distance on the median line. The scutellum therefore does not reach the mesoscutum; the propodeum is well developed, the abdomen has a distinct short petiole, the posterior margins of tergites are not emarginate, and the ovipositor does not extend beyond apex of abdomen.

Eupelmella vesicularis may be readily distinguished from all other parasites of the hessian fly by the wings, which are much abbreviated and abruptly bent near the middle, the basal portion hyaline, the apical portion strongly fuscous, nearly acute at apex and usually erect. It also differs from all other hessian-fly parasites in the conformation of the mesoscutum, which forms a broadly elliptical, weakly sculptured, and somewhat hairy, concave plate whose lateral margins are acute, the scapulae very narrow and nearly vertical.

Female.—Length 1.25 to 3.2 mm. Head twice as broad as thick anteroposteriorly at the middle; occiput slightly concave; temples receding, less than half as wide as eyes; ocelli in an obtuse triangle, postocellar line twice the ocellocular line, the latter a little longer than the diameter of an ocellus; eyes elliptical, with sparse short pile; malar space equal to about half the eye height; scrobes triangular, deep anteriorly but fading out above; mandibles each with three acute teeth; labial palpi 3-jointed; maxillary palpi 4-jointed, the apical joint a little thickened and about as long as the three basal joints, which are all subequal; clypeus not separated from the face posteriorly but limited laterally by delicate carinae, its anterior margin straight; surface of head finely reticulate-punctate. Antennae inserted below the eyes, distinctly clavate; scape not thickened and reaching to front ocellus; pedicel slender, more than twice as long as broad; ring joint subquadrate; first funicle joint and ring joint together equal to pedicel; second and third funicle joints subequal and each nearly as long as pedicel; following joints successively shorter, the seventh subquadrate; club 3-jointed, a little shorter than the three preceding funicle joints combined. Prothorax prominent, faintly reticulated, and with a transverse row of fine setae anteriorly near base of cone-shaped neck; mesoscutal plate longer than broad, finely reticulated anteriorly, practically smooth posteriorly and clothed with fine pale hairs; scutellum narrow, weakly convex, and very finely punctate; axillae narrowly separated at base and sculptured about like scutellum; propodeum very short, reduced nearly to a transverse line at the middle; mesopleura large, very finely lineolately sculptured on the disk, with faint reticulation anteriorly and posteriorly. Fore wings extending to apex of first tergite or a little beyond, abruptly bent upward a little before the apex, the elevated portion acute at apex and densely ciliated, submarginal and marginal veins distinct in balsam-mounted specimens, stigmal vein absent. Anterior femora slightly swollen; middle femora a little flattened; middle basitarsus swollen and spined beneath, the other tarsal joints of middle tarsi not much thickened and usually with only two or three spines beneath toward apex; middle tibial spur about as long as basitarsus, the tibia at apex with several short thick spines; hind tibia with a single spur. Abdomen about as long as thorax, convex above, somewhat compressed from the sides, the first tergite smooth, the others weakly sculptured and nearly uniformly clothed with short recumbent hairs; tergites 1 to 4 emarginate at apex; ovipositor exserted approximately one fourth the length of abdomen.

Head metallic green or aeneous; scape pale; pedicel metallic; flagellum brownish black; mesoscutal plate metallic green or brassy; rest of thorax

brownish black to tawny, the prothorax and pleura usually strongly tinged with cupreous; wings hyaline at base, strongly infuscated apically; legs brownish testaceous, the apices of tibiae and the tarsi paler testaceous; abdomen black, with a basal band embracing most of the first tergite pale testaceous; ovipositor dark at base and apex with a broad yellowish band in the middle.

No male of the species has been seen by the writer and, for reasons stated in the discussion of *Eupelmus atropurpureus*, none is believed to exist. Descriptions in the literature purporting to deal with males of *vesicularis* or its synonyms are believed to refer in most instances to *atropurpureus*.

Described from 107 female specimens in the National Museum collection. Included in this series are specimens representative of all the American host records given in the list of hosts. Also included are: 1 broken specimen received from Lindeman bearing his handwritten label "*Euryscapus saltator*" and believed to be a cotype; 1 specimen without locality or host data, identified by Francis Walker as *Eupelmus degeeri;* 1 from Vienna, Austria, identified by G. Mayr as *E. degeeri;* 5 reared by Paul Marchal in France and identified by Ashmead as *E. degeeri;* 2 from Blankenburg, Germany, without further data; 8 reared at Poltava, Russia, by M. Nikolskaja from alfalfa seed infested by *Bruchophagus funebris* and identified by the collector as *Eupelmus vesicularis;* and 1 said to have been extracted from a seed of *Vicia* originating in Turkestan and collected at quarantine in Washington, D.C.

REVIEW OF LITERATURE

De Geer published a description together with a very fair figure of this species as early as 1771, placing it in *Ichneumon;* but the species was not named until 1783, when Retzius published a short description accompanied by a reference to de Geer's figure and called it *Ichneumon vesicularis*. Spinola in 1808 referred the species to *Diplolepis*. In 1820 Dalman again described the species, giving to it the name *Eupelmus degeeri* in honor of de Geer whose original description and figure he cited, and in 1834 this specific name was amended to *geeri* by Nees who gave a description and cited de Geer's, Spinola's, and Dalman's references as synonyms. Walker published a description of it in 1837 and figured the female in 1841, using the name *E. degeeri*. Foerster in 1841 figured what appears to be the female, calling it *geeri*, but accompanied this with a description of a male which may have been of some other species. Ratzeburg mentioned the species, giving short descriptive notes in 1848 and 1852, and in 1872 Walker republished the figure of the female from his previously mentioned paper. In 1883 Costa published a description of *Eupelmus albitarsis* which appears to be a synonym, as Ruschka pointed out in 1921. *Euryscapus saltator* Lindeman was described as a parasite of the hessian fly in Russia in 1887 and was transferred by Dalla Torre in 1898 to the genus *Mira*. Under the name of *Eupelminus saltator* (Lindeman) the species was first recorded from North America, and a good account of its life history given by McConnell in 1918, the present writer having been responsible for the identification and placement of the species in the genus *Eupelminus*. In 1919 Masi erected the new genus *Eupelmella* and named *Eupelmus degeeri* Dalman as the genotype. A revision of the Eupelminae of Europe

by Ruschka, published in 1921, treats the species under the name *Eupelmus vesicularis* (Retzius) and lists as synonyms *Eupelmus degeeri* Dalman, *E. albitarsis* Costa, *Macroneura maculipes* Walker (male, excluding the female), *Eupelmus atrocoeruleus* Thomson (male, excluding the female), *Eupelmus karschii* Lindeman, and *Euryscapus saltator* Lindeman. The biology of the species as a parasite of the jointworm flies in North America was fully treated by Phillips and Poos in 1927 under the name *Eupelminus saltator*.

As stated in the discussion of *Eupelmus atropurpureus* and *Eupelmus karschii*, the writer does not accept in its entirety the synonymy proposed by Ruschka for *vesicularis*. The male of *Eupelmus atrocoeruleus* Thomson and also the male characterized by Ruschka as that of *vesicularis* are believed to be males of *atropurpureus* instead. The description of *Eupelmus karschii* Lindeman does not coincide with *vesicularis*, and the species is therefore removed from the synonymy and treated as unrecognized.

Eupelminus coleopterophagus Girault, described in 1916 from specimens reared in connection with the strawberry weevil (*Anthonomus signatus* Say), and subsequently recorded from galls of *Rhodites rosae* (Linnaeus) by Cockerell, has not been previously synonymized. The types which are in the National Museum collection differ in no way from *E. vesicularis*.

HOSTS AND LIFE HISTORY

This is apparently one of the most polyphagic species of all chalcidoids, its hosts embracing Diptera, Coleoptera, Hymenoptera, Lepidoptera, Homoptera, and Orthoptera. European published records include the following: Diptera, *Phytophaga destructor* (Say), *Mayetiola avenae* (Marchal), *C. potentillae* Wachtl, *C. saliciperda* Dufour, *C. salicina* Giraud, *Lasioptera eryngii* Vallot, *L. rubi* Heeger, *Hormomyia fischeri* Frauenfeld, *Asphondylia dorycnii* F. Löw, *A. melanopus* Kieffer, *Rhabdophaga karschii* Kieffer, *Myopites olivieri* Kieffer, and an unidentified trypetid; Hymenoptera, *Philacyra aptera* (Portschinsky), *Aulax hieracii* (Linnaeus), *A. glechomae* (Linnaeus), *A. scorzonerae* Giraud, *A. salviae* Giraud, *A. scabiosae* (Giraud), *Xestophanes potentillae* (Retzius), *Biorhiza pallida* (Olivier), *Aulacidea macula* Forsius, *Synergus hayeanus* (Ratzeburg), *Andricus sieboldi* Hartig, *Dryophanta flosculi* (Giraud), *D. folii* (Linnaeus), *Neuroterus baccarum* (Linnaeus), *Phanacis centaureae* Foerster, *Rhodites spinosissimae* Giraud, *R. rosae* (Linnaeus), *Cynips kollari* Hartig, and *Lophyrus pini* (Linnaeus); Coleoptera, *Hylesinus fraxini* Panzer, *H. crenatus* Fabricius, *Bruchidius marginellus* (Fabricius), *Brachonyx pineti* (Paykull), *Cassida seladonia* Gyllenhal, *Rhynchites bacchus* (Linnaeus), *Miarus campanulae* (Linnaeus), *Nanophyes lythri* (Fabricius), *N. flavidus* Aubé, and *N. telephi* Bedel; Lepidoptera, *Coleophora giraudi* Ragonot and *C. coronillae* Zeller; Orthoptera, *Oecanthus pellucens* (Scopoli), eggs of; Homoptera, *Aleurodes chelidonii* Latreille? Published American host records include: Diptera, *Phytophaga destructor* (Say); Hymenoptera, *Harmolita hordei* (Harris), *H. maculata* (Howard), *H. tritici* (Fitch), *H. vaginicola* (Doane), *H. albomaculata* (Ashmead), *H. atlantica* Phillips and Poos, *H. elymi* Phillips and Poos, *H. festucae* Phillips and Poos, *H. dactylicola*

Phillips and Poos, *Eurytoma parva* Phillips, *Bruchophagus funebris* (Howard), *Platygaster zosine* Walker, *Apanteles melanoscelus* (Ratzeburg), *Cephus pygmaeus* Linnaeus; Coleoptera, *Anthonomus signatus* Say.

Host records taken from the material in the National Museum collection and believed to be unpublished are: From *Hemadas nubilipennis* (Ashmead) at Cherryfield, Maine; *Aulacidea tumida* (Bassett) at Evanston, Ill., by L. H. Weld; *Cephus cinctus* Norton at Bottineau, N.Dak., by C. N. Ainslie; *Neodiprion banksiana* Rohwer, August 20, 1923, by S. A. Graham, locality not stated; *Bruchus brachialis* Fahraeus, Haddon Heights, N.J., by L. J. Bottimer; *Coleophora pruinella* Clemens, Door County, Wis., by M. H. Doner, and *C. salmani* Heinrich, at Mount Desert Island, Maine, by A. E. Brower. Two specimens are in the collection reared from galls on *Rubus at* Ottawa, Canada.

According to McConnell, the egg is deposited in the puparium of the hessian fly but external to the enclosed host larva, and the parasite larva feeds externally. The contents of the host larva are completely consumed, and the parasite pupates in the fly puparium. The adult emerges through a round hole which it gnaws in the posterior end of the puparium. The egg stage under normal conditions is said to last about 3 days, the larval period 8 to 12 days, and the pupal period about the same length of time. The winter is passed as a mature larva within the host puparium, emergence taking place in late spring. Five complete generations were reared in the laboratory in a single season. Substantially the same average life cycle and mode of development are recorded for the species as a parasite of the jointworms (*Harmolita*) by Phillips and Poos.

The species is normally a primary parasite of the hessian fly and the jointworms, but it may develop also as a secondary in case other parasites are present. Only a single parasite reaches maturity upon one host larva, although several eggs may be deposited in the same host puparium or larval cell.

DISTRIBUTION

In Europe *Eupelmella vesicularis* is evidently very widely distributed. Records indicate its occurrence from the British Isles and western France eastward to Russia and from Sweden in the north to Italy in the south. Throughout this region it seems to be a very common species.

In North America this species is likewise widely distributed. Records of the Bureau of Entomology show its occurrence in the following States: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Virginia, Tennessee, Ohio, Indiana, Michigan, Illinois, Wisconsin, Minnesota, North Dakota, South Dakota, Nebraska, Wyoming, Colorado, and Oregon. Two specimens in the National Museum collection are from Ottawa, Canada, reared from galls on *Rubus*. Apparently the species is not present in California, and to date it has not been recorded from any of the Southern States except Virginia and Tennessee, or from the great wheat-growing sections of Iowa, Missouri, Kansas, and Oklahoma.

IMPORTANCE

This species is probably of slight importance as a parasite of the hessian fly. In investigations extending over a period of 10 years, Hill and Smith found an average parasitization by it in the Eastern States of 0.04 percent. Its polyphagic habits, although tending to insure its survival, tend to reduce its efficiency as a primary parasite of any given species through dissipation of its efforts and to increase the likelihood of its doing more harm than good by attacks upon other beneficial species. Thus, while accomplishing some good as a parasite of the hessian fly, jointworm, wheat stem sawfly, and perhaps other species, this parasite is by no means an unmixed blessing, as shown by Muesebeck and Dohanian who record the rearing of hundreds of specimens of it from cocoons of *Apanteles melanoscelus*, one of the most important parasites introduced to combat the gypsy moth.

CALOSOTA METALLICA Gahan

(Fig. 13)

Calosoter metallicus Gahan, U.S. Natl. Mus. Proc. 61 (art 24) : 16, 1922.
Calosota metallica Packard, U.S. Dept. Agr. Tech. Bul. 81: 14, 1928.

DESCRIPTION

Calosota metallica is related to *Eupelmus allynii*, but it may be distinguished from that species, as well as from other eupelmids attacking the hessian fly, by the scutellum, which is large, strongly convex, and has a broad base on the mesoscutum, and by the axillae, which are small and very widely separated. It also differs by having the mesoscutum only very slightly impressed medially, and by being more uniformly metallic in color.

Female.—Length 2.15 to 3.5 mm. Head transverse, as broad as thorax, about twice as broad as thick at the middle, weakly concave behind, with rather weak reticulate sculpture which is strongest on the frons; ocelli in a slightly obtuse angle; the postocellar line nearly twice as long as ocellocular, the latter no longer than the diameter of an ocellus; scrobes deep, nearly as broad above as below; malar space equal to half the eye height; eyes moderately large, forming a short ellipse, and clothed with very short inconspicuous pile; clypeus not separated from face posteriorly but limited laterally by a very delicate groove, its anterior margin straight or very slightly concave; mandibles each with three acute teeth; labial palpi 3-jointed; maxillary palpi 4-jointed, the apical joint about as long as the three basal joints combined, broadest at the middle, and with a small tubercle or budlike projection at the broadest point. Antennae strongly clavate, rather short; scape cylindrical, not reaching to front ocellus; pedicel a little longer than the ring joint and first funicle joint combined; ring joint subquadrate; funicle rather slender at base, increasing in thickness toward apex and clothed with moderately long hairs; first funicle joint about one and one half times as long as broad; second about twice as long as broad; third and fourth subequal in length to the second but a little broader; fifth subequal in length to first but broader; sixth subquadrate; seventh slightly transverse; club much broader than the funicle joints, 3-jointed, broadly ovate; the first three funicle joints apparently without elongate sensoria, fourth and fifth with 2 sensoria each, sixth and seventh with 4 each, and the club joints with about 12 each, the sensoria on the short ultimate and penultimate joints of the club extending from base to apex of the segment. Prothorax short, conical, far below the level of the mesoscutum; mesoscutum and scutellum strongly sculptured, the former very slightly depressed on its disk, its sculpture consisting of shallow, more or less irregularly shaped areas set off by raised lines, the scutellum with similar sculpture, but with the areas more minute and elongate, giving a more or less longitudinally lineolate appearance; postscutellum distinct, extending to the apex of propodeum; axillae very small and widely separated;

propodeum short, completely divided medially by the postscutellum, nearly smooth dorsally, its lateral aspect faintly sculptured and hairy; mesopleura weakly reticulated, nearly smooth. Wings well developed; the fore wing usually not quite reaching the apex of the abdomen, the costal cell and basal areas ciliated about like the disk of wing; a narrow area along the posterior margin at base of wing comprising the obsolete median and anal cells bare, and an area extending obliquely backward and inward from the union of submarginal and marginal veins also nearly bare; marginal cilia short; stigmal vein slightly shorter than postmarginal, the marginal vein about four times as long as postmarginal; hind wing rather narrow, weakly ciliated at base, more strongly so from the basal spur to apex. Legs normal, the middle tarsi swollen basally but without stout spines beneath; middle tibiae also without conspicuous spines at apex; hind tibia apparently with a single spur. Abdomen usually a little longer than head and thorax, boat shaped, distinctly sculptured all over, the first to

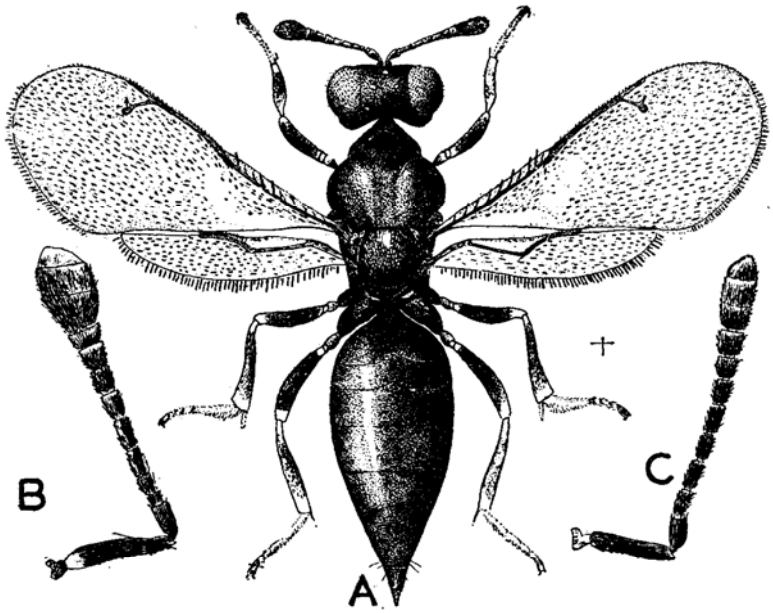


FIGURE 13.—*Calosota metallica* Gahan: A, Adult female; *B*, antenna of female; *C*, antenna of male. *A*, × 24.

fifth tergites more or less emarginate medially at apex, the sixth slightly triangularly produced; ovipositor sheaths usually extending very slightly beyond the apex of abdomen. Antennae shining black; scape more or less metallic; head deep steel blue with the vertex slightly aeneous; thorax above and abdomen entirely metallic green; underside of thorax and all legs bluish green; trochanters, knees, apices of all tibiae and all tarsi, except the apical joint, pale yellow; wings hyaline.

Male.—Antennal pedicel not quite so long as the combined ring joint and first funicle joint; sixth and seventh funicle joints subquadrate or very slightly longer than broad; club a little shorter than the three preceding funicle joints combined, and not so broad as in female; abdomen a little shorter than head and thorax together; posterior margins of none of the tergites emarginate. Otherwise the male is like the female except that the general color is a little more highly metallic.

Redescribed from the type specimens and the following additional material: A male reared by Packard at Tres Pinos, Calif., May 23, 1918, from wheat stems infested by *Phytophaga destructor;* 1 female reared at the same place by the same collector July 28, 1922, from the

puparium of *P. destructor;* 1 female from Birds Landing, Calif., reared by M. C. Lane, August 4, 1919, from wheat containing the hessian fly; 1 female reared by B. G. Thompson September 20, 1920, at Rio Vista, Calif., from *Harmolita grandis* (Riley); 3 females reared by Lane at Concord, Calif., August 4–16, 1919, from *P. destructor;* 1 female reared by T. R. Chamberlin at Molalla, Oreg., July 27, 1927, from *Harmolita tritici* (Fitch); and 1 female reared by G. F. Knowlton in 1930, at Lake Point, Utah, from *Harmolita* sp.

REVIEW OF LITERATURE

This species was originally described in 1922 from specimens reared at San Miguel, Estrella, and Concord, Calif., from wheat stems infested with *Harmolita*, and from *Phytophaga destructor*. The only other mention of it in literature is that by Packard in his bulletin on the hessian fly in California, published in 1928, and it is there merely listed as one of the several species attacking the fly.

HOSTS AND LIFE HISTORY

The only hosts thus far recorded for the species are the hessian fly and the 2 or 3 three species of jointworm flies already mentioned. This list of hosts will probably be increased by future studies, since it is believed to be a species native to the Pacific coast and one which has become associated with insects of the wheat plant only in comparatively recent years.

Little is known of its life history. According to Packard it oviposits in the puparium of the fly during the spring and summer. Judging from the dates of emergence indicated for the specimens examined, which range from May 23 to September 20, there is more than one generation per season and there may be several generations. Emergence is from the puparium.

DISTRIBUTION

So far as is known, this insect is restricted in its distribution to the Pacific coast and Rocky Mountain region. It seems to be widely distributed in California but is at present known from only a single locality in Oregon and one in Utah.

IMPORTANCE

Present information indicates that the species is of very minor importance as a factor in the natural control of the hessian fly.

Family ENCYRTIDAE

CHEILONEURUS ELEGANS (Dalman)

(Fig. 14)

Encyrtus elegans Dalman, Svenska Vetensk.-Akad. Handl. 41: 151, 1820.

Eupelmus (?) *elegans* Dalman, Svenska Vetensk.-Akad. Handl. 41: 384, 1820.

Cheiloneurus elegans Westwood, Phil. Mag. and Jour. Sci. (3) 3: 343, 1833; Nees von Esenbeck, Hymenopterorum ichneumonibus affinium monographiae . . ., v. 2, p. 422, 1834; Westwood, An introduction to the modern classification of insects, v. 2, synopsis, p. 72, 1840; Gahan and Fagan, U.S. Natl. Mus. Bul. 124: 32, 1923; Hill and Smith, Jour. Agr. Research 36: 153, 1928.

Cleonymus elegans Nees von Esenbeck, Hymenopterorum ichneumonibus affinium monographiae . . ., v. 2, p. 88, 1834.

Encyrtus argentifer Walker, Ent. Mag. 4: 444, 1837.
Encyrtus paralia Walker, Ent. Mag. 4: 446, 1837.
Chiloneurus elegans Foerster, Hymenopterologische Studien, Heft 2, p. 50, 1856; Thomson, Skandinaviens Hymenoptera, v. 4, p. 150, 1875; Mayr, Verhandl. Zool.-Bot. Gesell. Wien 25: 746, 1875; Giraud and Laboulbène, Ann. Soc. Ent.

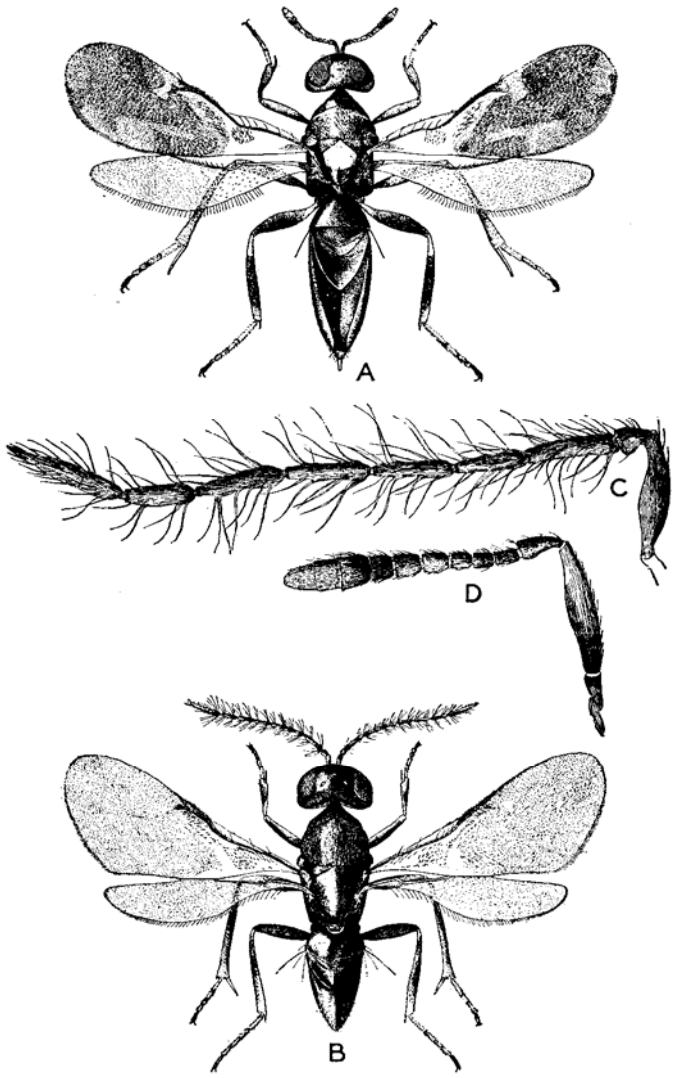


FIGURE 14.—*Cheiloneurus elegans* (Dalman): *A*, Adult female; *B*, adult male; *C*, antenna of male; *D*, antenna of female. *A* and *B*, × 22.

France (5) 7: 420, 1877; Dalla Terre, Catalogus hymenopterorum . . ., v. 5, 241, 1898; Schmiedeknecht, Hymenoptera, Mam. Chalcididae, *in* Wytsman, Genera insectorum, fasc. 97, p. 252, 1909; Feytaud, Bul. Soc. Étude et Vulg. Zool. Agr. 15: 1–16, 1916; Masi, Ann. Mus. Civ. Stor. Nat. Genova (3) 8: 302. 1919; Mercet, Fauna iberica: himenópteros, fam. encírtidos, p. 643, 1921; Ruschka, Verhandl. Zool.-Bot. Gesell. Wien 72: 6, 8, 1923; Ferriere, Actes Soc. Helvét. Sci. Nat. 107: 223, 1926.

DESCRIPTION

Females of *Cheiloneurus elegans* may be distinguished from all other parasites of *Phytophaga destructor* by the distinct tuft of stiff erect black hairs on the mostly yellow scutellum. The males are totally unlike the females but may be recognized by their long slender antennae, on each flagellar joint of which are two whorls of long hairs.

Female.—Length 1.75 to 2.3 mm. Head as broad as thorax, approximately twice as broad as long antero-posteriorly, convexly rounded in front, slightly concave behind; ocelli in a nearly equilateral triangle; lateral ocelli close to the eye margins; fronto-vertex nearly three times as long as broad, its sides nearly parallel; scrobes short, rounded above; eyes broadly oval, sparsely clothed with very short pile; temples very narrow at top of eyes, broadening somewhat below; malar space equal to nearly half the eye height; mandibles each with three acute teeth; labial palpi 3-jointed; maxillary palpi 4-jointed, apical joint as long as the three preceding joints. Viewed from in front the head is subtriangular in outline, as long as broad; fronto-vertex, cheeks, and face laterally with fine shallow reticulation, middle of face and area within scrobes nearly smooth. Antennae 11-jointed, clavate, inserted below the eyes; scape not attaining the front ocellus, fusiform; pedicel about twice as long as thick and about one and one half times the first funicle joint, the latter a little longer than second, which is the shortest joint; third very slightly longer than the second; fourth, fifth, and sixth subequal, each about as long as the first joint but distinctly thicker; club distinctly a little broader than the last funicle joint, and about as long as the three preceding joints, distinctly 3-jointed, not obliquely truncate at apex; the funicle joints all sparsely clothed with hairs but apparently without elongate sensoria; club joints with some elongate sensoria. Prothorax short, conical, weakly sculptured; mesoscutum about twice as broad as long, without grooves, thickly clothed with pale short pubescence, as is also the prothorax posteriorly; scutellum weakly convex, granularly opaque, about as long as mesoscutum with a tuft of erect long hairs at apex; axillae meeting on the median line, opaque; propodeum short, polished, without carinae or folds; pleura weakly sculptured. Wings well developed; for wing evtending beyond apex of abdomen, about three times as long as broad, with a triangular area extending obliquely caudad and proximad from the stigmal vein and more or less of the base of wing bare; marginal vein nearly half as long as submarginal, postmarginal vein shorter than stigmal, the latter about one third the length of marginal; hind wing nearly uniformly ciliated. Middle pair of legs longer than the others, middle tibial spur distinctly longer than first tarsal joint, hind tibiae with one spur. Abdomen nearly as long as head and thorax, as broad as thorax, ovate, depressed above; first tergite comprising about one fourth the length of abdomen, weakly sculptured; second and third tergites short; following tergites longer; ovipositor not exserted. Color of head brownish testaceous; the vertex, temples, and cheeks more or less strongly metallic green; prothorax mostly dark brown, tinged with metallic; mesoscutum entirely metallic green, covered with pale hairs; axillae and scutellum brownish yellow, the scutellum with a broad transverse band of paler yellow basally, with a few black hairs scattered over the apical half in addition to the stiff black pencil; propodeum shining metallic; pleura dark reddish brown with a metallic reflection; abdomen black with metallic reflections; fore wings strongly infuscated, the base for most of the length of submarginal vein hyaline, and usually with a subhyaline spot at extreme apex, another on anterior margin just distad of end of venation, and another on the posterior margin a little distad of the one on anterior margin; hind wing hyaline; all coxae pale yellow; the front legs reddish yellow, middle legs also reddish yellow, but with the femora apically and a band on tibiae a little before the base fuscous; hind femora, except at base, and tibiae, except narrowly at base and apex, usually strongly fuscous; apical joint of all tarsi dark.

Male.—Length 0.8 to 1.5 mm. Very different from the female. Antenna long, slender, threadlike, 9-jointed (or 10-jointed if a very minute and thin ring joint is counted); scape about as long as pedicel and first funicle joint; pedicel about as broad as long; ring joint very thin, strongly transverse, dis-

cernible only when mounted in balsam; funicle 6-jointed, the joints distinctly separated, each 4 to 5 times as long as broad, more or less constricted or narrowed in the middle, the first slightly the longest joint and clothed with long irregularly placed hairs, the second to sixth joints each with similar long hairs but arranged in two rather distinct whorls; club no broader than funicle, nearly twice as long as the last funicle joint, clothed with long hairs which are not arranged in distinct whorls. Fronto-vertex nearly as broad as long, ocellar triangle obtuse, lateral ocelli about their own diameter from eye margin; scutellum without tuft of hairs; propodeum short, shining, and without carinae; marginal vein of fore wing not over one fourth as long as submarginal or over twice as long as stigmal vein; base of wing not bare; abdomen shorter than the thorax. General color dull metallic green; clypeal region and mandibles reddish testaceous, remainder of face green; pleura purplish; propodeum coppery; abdomen purplish black with a strong metallic cast; wings hyaline but with a slight infuscation behind the marginal vein; color of legs as in the female except that median and hind coxae are brownish or blackish, only their apices being pale.

This description is based on the following material: 2 females determined by Gustav Mayr as *Cheiloneurus elegans* and which were obtained from the Naturhistorisches Museum in Vienna through an exchange; 1 male and 1 female from Spain identified by Garcia Mercet; and 36 females and 11 males reared from the hessian fly in North America.

REVIEW OF LITERATURE

Dalman first described this species in 1820, giving it the name *Encyrtus elegans*, but in a second section of the same work he transferred it doubtfully to the genus *Eupelmus*. In 1833 Westwood erected the genus *Cheiloneurus* and cited *Encyrtus elegans* Dalman as the type species. Nees in 1834 placed the species in *Cleonymus* and quoted Dalman's description, but on a subsequent page of the same paper he recognized Westwood's designation of it as the type of *Cheiloneurus*. In 1837 Walker described, in the same paper, *Encyrtus argentifer* and *Encyrtus paralia*, both of which were stated by Mayr in 1875 to be synonyms of *elegans*. Foerster in 1856 changed the original spelling of Westwood's *Cheiloneurus* to *Chiloneurus* and mentioned *Cleonymus elegans* (Nees) as belonging in the genus. In 1875 Thomson briefly described *Cheiloneurus elegans* and Mayr for the first time characterized the male. Two years later Giraud and Laboulbène listed the species as a parasite of *Kermes* on *Laurus cerasus*, this being the first host recorded for it. In 1916 it was cited by Feytaud as a parasite of scale insects infesting the grape in France. Masi recorded it from the island of Giglio in the Mediterranean in 1919, and in 1921 Mercet redescribed the species figuring the venation and antenna in his treatise on the Encyrtidae of Spain. He stated that his specimens were collected on uncultivated grasses. Ruschka included *elegans* in a key to the European species of *Cheiloneurus*, published in 1923, and stated that it was not rare in grasses in Austria from May to September. It was next recorded from *Pulvinaria vitis* Linnaeus in Switzerland by Ferriere in 1926. The first and only published record of its occurrence in North America is that by Hill and Smith, who in 1928 mentioned it as a parasite of the hessian fly in the eastern part of the United States.

It was first discovered in the New World by P. R. Myers and W. R. McConnell, who reared several specimens in 1915 from

hessian-fly puparia collected at Muncy, Danville, Ford City, and State College, Pa., and at Hagerstown, Md. At that time it was tentatively identified by the writer as a probably new species of *Cheiloneurus*. Specimens were subsequently submitted to P. H. Timberlake, an expert on this particular group of Chalcidoidea, who expressed the opinion that they were *C. elegans* Dalman. European specimens of Dalman's species identified by G. Mayr and Garcia Mercet were later obtained by the writer, and Timberlake's identification of the American material was confirmed.

HOSTS AND LIFE HISTORY

If published records are correct, *Cheiloneurus elegans* is parasitic upon not only the hessian fly but also at least two species of scale insects, viz *Kermes* sp. and *Pulvinaria vitis* Linnaeus. The species of *Cheiloneurus* are believed to be somewhat less polyphagic than many species of chalcidoids, and for that reason a question may arise as to whether or not the same species is involved in all these records. Unfortunately it is impossible to verify this, since no descriptions are given of those species said to have been reared from coccids. In North America *C. elegans* to date has been reared from no other host than the hessian fly.

Investigations carried on by Myers, Hill, and others at the Carlisle, Pa., laboratory indicate that the species is probably a primary, internal, solitary parasite of the spring generation of the fly, but that it may occasionally develop as a secondary parasite. Little is known regarding it, as attempts to breed it in the laboratory have not been successful. Emergence is from the puparium of the fly.

DISTRIBUTION

Cheiloneurus elegans appears to be well distributed in Europe, occurring, according to published records, in Great Britain, France, Sweden, Germany, Austria, Switzerland, Italy, and Spain.

In North America this species has been taken in the States of New York, New Jersey, Pennsylvania, Maryland, Virginia, and the Province of Ontario, Canada. Records of the Bureau of Entomology laboratory at Carlisle, Pa., furnished by C. C. Hill, show it to be present in at least 14 counties in Pennsylvania. Fewer records are available from the other four States mentioned and only one from Canada, probably because the parasites of the fly have been less intensively investigated in those areas than in Pennsylvania. Enough records are available, however, to indicate that the species is widely, and perhaps generally, distributed throughout the Eastern States. Apparently it does not yet occur in the Ohio and Mississippi Valleys nor in the far Western States.

IMPORTANCE

This species can be rated as of only minor importance in relation to hessian-fly control. According to Hill and Smith a yearly average of 0.05 percent of the hessian-fly pupae collected in Virginia, Maryland, and Pennsylvania over a 10-year period were killed by it.

Family PTEROMALIDAE

AMBLYMERUS MAYETIOLAE (Gahan)[10]

(Fig. 15)

Eutelus mayetiolae Gahan, U.S. Natl. Mus. Proc. 55: 128, 1919; Packard, U.S. Dept. Agr. Tech. Bul. 81: 14, 1928.

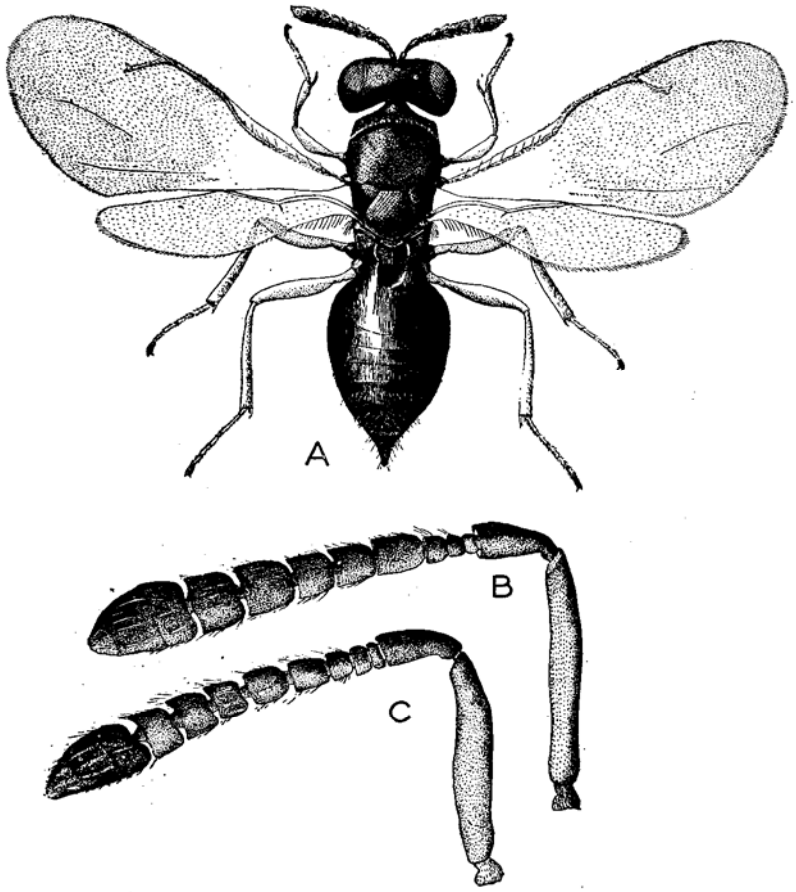


FIGURE 15.—*Amblymerus mayetiolae* Gahan: *A*, Adult female; *B*, antenna of female; *C*, antenna of male. *A*, × 26.

DESCRIPTION

The immargined occiput, 5-jointed funicle, neckless propodeum, hyaline wings, wholly metallic abdomen, pale legs, and the black antennal club of the male distinguish *Amblymerus mayetiolae* from all the related North American parasites of the fly.

Female.—Length 1.5 to 2.25 mm. Head very slightly broader than thorax, fully three times as broad as thick antero-posteriorly at the middle, the occiput

[10] Gahan and Fagan (U.S. Natl. Mus. Bul. 124: 10, 64, 1923) pointed out that *Amblymerus* Walker and *Eutelus* Walker have the same species as genotype. Since *Amblymerus* has page precedence in publication, that name should be used in place of *Eutelus*. Hence *Eutelus mayetiolae* Gahan becomes *Amblymerus mayetiolae*.

distinctly concave; temples retracted somewhat posteriorly, not distinctly defined, appearing approximately equal to one third the width of the eyes; postocellar line equal to nearly twice the ocellocular line, the latter equal to about twice the diameter of an ocellus; head viewed from in front broader than high (29:25), narrowed below the eyes, truncate at the mouth; malar space equal to not more than one third the eye height; antennal scrobe shallow; eyes moderately large, ovate, bare; clypeus very finely striated, rest of head nearly uniformly finely reticulate-punctate; right mandible distinctly quadridentate, left mandible tridentate, the inner tooth broad and very slightly concave at apex; maxillary palpi 4-jointed. Antenna 13-jointed, inserted a little below middle of head on a line with the lower extremities of the eyes, distinctly clavate; scape attaining the level of front ocellus, subcylindrical; pedicel a little more than twice as long as broad at apex, not quite so long as the ring joints plus first funicle joint; three distinct ring joints, the first smaller than the others, second and third subquadrate or not over twice as broad as long; funicle 5-jointed, the joints successively increasing a little in width and decreasing very slightly in length; first funicle joint a little longer than broad, about equal to the three ring joints combined; fifth funicle joint a little broader than long; club distinctly thicker than the funicle, ovate, a little longer than the two preceding funicle joints; funicle and club joints clothed with short inconspicuous hairs. Thorax more than one and one half times as long as broad (about 40:25); pronotum short, the dorsal aspect strongly transverse, a little narrower than the mesonotum, and nearly in the same horizontal plane as mesoscutum, sculptured like mesoscutum, frequently with a delicate marginal carina anteriorly, the declivous anterior portion nearly perpendicular; mesoscutum weakly convex, finely reticulate-punctate, about one and one half times as broad as long (24:15), the parapsidal grooves weakly impressed anteriorly but effaced posteriorly; scutellum sculptured like mesoscutum, weakly convex, distinctly shorter than mesoscutum and approximately as broad as long; axillae sculptured like scutellum and broadly separated; propodeum a little more than half as long as scutellum, without a neck, with a weak median carina, the lateral folds well developed and complete; spiracular sulci shallow; surface of propodeum between the folds distinctly wrinkled, laterad from the folds smooth and shining; spiracles short elliptical; pleura mostly sculptured like the dorsum but with the upper margin of mesopleura and the metapleura smooth. Legs normal, hind coxae distinctly reticulated outwardly. Fore wings about two and one half times as long as broad, extending beyond apex of abdomen, bare basally; marginal cilia short; marginal vein a little longer than postmarginal and twice as long as stigmal. Abdomen ovate or conic-ovate, about as long as thorax, and as broad as or a little broader than thorax, smooth and polished dorsally at base, the apical tergites and all the sternites with faint reticulation; ovipositor tip barely visible from above.

Head and thorax dull metallic green with a brassy cast; abdomen usually steel blue at base above, the rest of dorsum usually black and the whole venter with a strong coppery cast, but in some cases nearly the whole abdomen is blue-green, while in others it is in great part copper colored; antennal scape reddish testaceous, the flagellum usually dark brown but frequently nearly the color of scape; mandibles yellowish; coxae all concolorous with thorax, remainder of legs pale testaceous; wings hyaline, the venation testaceous.

Male.—Length 1.5 to 2 mm. Antennae almost exactly like the female in shape and proportions of the segments, the scape, pedicel, and funicle testaceous, the club black; abdomen nearly elliptical, as broad as thorax and usually about as long as thorax; head and abdomen more strongly tinted with copper color than in the female and the legs usually paler. Otherwise answering description of female.

REVIEW OF LITERATURE

Amblymerus mayetiolae was originally described in 1919 from representatives of both sexes reared by C. M. Packard from puparia of the hessian fly collected at Salinas, Calif. It has been mentioned in literature only once since its original description, when Packard in 1928 discussed it very briefly in a bulletin on the hessian fly in California.

HOSTS AND LIFE HISTORY

All except 1 of the 30 specimens of this species that have been seen by the writer were reared from *Phytophaga destructor*. The one exception is a female said to have been reared, by T. R. Chamberlin, from *Harmolita* sp. infesting the stems of canary grass at Gaston, Oreg.

According to Packard the parasite oviposits in the puparium of the fly in the spring and summer. It is apparently a primary parasite and probably feeds externally upon the host within its puparium. Emergence takes place in the spring, a single parasite issuing from each parasitized host puparium.

DISTRIBUTION

This species is apparently confined to the Pacific coast of the United States. Packard states that its distribution is apparently limited to the Salinas Valley in California, but one specimen in the National Museum collection was reared from the hessian fly by M. C. Lane at Chehalis, Wash., and, as already mentioned, another specimen was reared from *Harmolita* sp. collected at Gaston, Oreg.

IMPORTANCE

According to Packard this species is the predominant parasite of the fly in the Salinas Valley. Elsewhere it must be of very little importance, if one may judge by the rarity with which it has been sent in for identification.

POLYSCELIS MODESTUS Gahan

(Fig. 16)

Polyscelis modestus Gahan, U.S. Natl. Mus. Proc. 61 (art. 24): 11, 1922; Myers, Jour. Agr. Research 29: 289, figs. 1 and 2, 1924; Hill and Smith, Jour. Agr. Research 36: 153, 155, 1928; Ent. Soc. Wash. Proc. 33: 182, pl. 12, 1931.

DESCRIPTION

The combination of a 6-jointed funicle, 3-jointed club, an immargined occiput, prominent neck on the propodeum, and the presence of a subcircular but often rather faint cloud on the disk of the fore wing in females of *Polyscelis modestus* distinguishes it from all other species attacking the fly. Males may be recognized at once by the fact that all the legs are pale yellow except the middle tibiae, which are in large part black or dark brown. This peculiar combination of leg markings occurs in no other species attacking the fly.

The original description of the species was as follows:

Female.—Length 2.2 mm. Head and thorax closely and strongly punctate; abdomen polished. Head transverse, a little more than three times as broad as thick antero-posteriorly; viewed from in front, slightly broader than long, not or but slightly narrowed below, clypeal area with converging striae; malar space equal to about half the eye height; eyes ovate, without pubescence; ocellocular and postocellar lines approximately equal; occiput concave, transversely reticulate, without any indication of a marginal carina; antennae rather slender, subclavate, with two ring joints, a 6-jointed funicle, and a 3-jointed club; first funicle joint and ring joint combined distinctly longer than the pedicel; all funicle joints a little longer than broad, the last nearly quadrate; club slightly longer than the two preceding funicle joints combined; pronotum

sculptured like the occiput, but with the narrow posterior margin of the strongly transverse dorsal portion smooth; mesoscutum with the parapsidal grooves deeply impressed anteriorly, but fading out entirely posteriorly; sculpture of scutellum and axillae similar to that of mesoscutum, but more dense, the punctures somewhat smaller; propodeum with a large subglobose neck, which

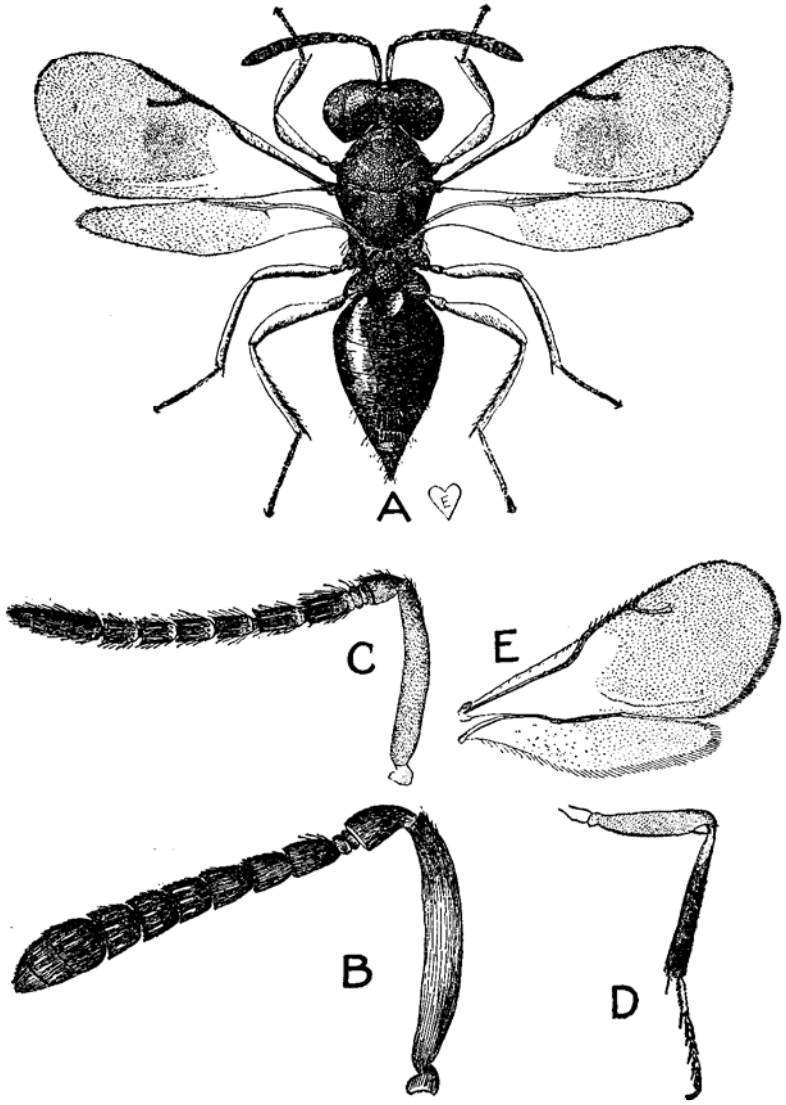


FIGURE 16.—*Polyscelis modestus* Gahan: *A*, Adult female; *B*, antenna of female; *C*, antenna of male; *D*, median leg of male; *E*, wings of male. *A*, × 26.

is set off from the rest of the propodeum by a rather deep transverse groove or constriction; lateral folds of propodeum strongly developed, median longitudinal carina weak, the area between the folds weakly sculptured and densely hairy; anterior wings reaching beyond the apex of abdomen; postmarginal vein distinctly longer than the stigmal and subequal to or very slightly shorter than the marginal; hind coxae conspicuously covered with hairs dorsally;

abdomen pointed ovate, about as long as thorax, weakly convex dorsally, the first and second tergites combined constituting about half its length, the first tergite equal to about twice the second. Head and thorax brassy-green, the clypeal region, under side of thorax, and the propodeum more or less tinged with bluish; antennal pedicel and flagellum blackish; scape reddish testaceous, with the apex fuscous; all coxae metallic like the thorax; remainder of legs reddish testaceous, the apical tarsal joint dark brown; abdomen black; wings hyaline, the fore wing with a large subcircular, not very distinct fuscous cloud in the middle.

Male.—Length 1.7 mm. Flagellum cylindrical, the club not or scarcely thickened, funicle joints each approximately one and one half times as long as broad and subequal; ocellocular line a little shorter than the postocellar; transverse constriction at base of propodeal neck not so deep as in the female; abdomen shorter than the thorax, ovate, not pointed at apex; median tibiae weakly clavate and slightly compressed towards apex. Head and thorax lightly metallic blue-green; scape pale, flagellum dark brown or fuscous; legs including all coxae pale testaceous, the middle tibiae except narrow base black; apical tarsal joint blackish; wings hyaline, without a fuscous spot. Otherwise like the female.

The type material consisted of 5 females and 35 males reared from *Phytophaga destructor* by W. R. McConnell and P. R. Myers at Hanover and Carlisle, Pa. Eight additional specimens are now in the National Museum collection.

REVIEW OF LITERATURE

The species was first reared from puparia of the hessian fly by P. R. Myers at Hanover, Pa., in 1917 and described 5 years later by the present author. Myers subsequently (in 1924) published a short paper on the biology and morphology of the early stages, and more recently (1931) Hill and Smith jointly have published additional facts regarding the same subjects.

HOSTS AND LIFE HISTORY

The species is normally a primary, solitary, external parasite of hessian-fly larvae and pupae, but it may develop as a secondary parasite through *Platygaster zosine* Walker, and possibly other fly parasites, according to Myers. It is said to attack both the spring and the fall generations of the fly. The egg is placed upon the host within its puparium, and development may take place upon either the larva or the pupa, according to Hill and Smith, who also state that five instars occur. The parasite emerges as an adult from the fly puparium.

DISTRIBUTION

The known distribution of this species is confined to Pennsylvania and Maryland and the Province of Ontario, Canada.

The type material was from Hanover and Carlisle, Pa. Specimens have also been taken by McConnell and Myers at Andersonburg, Gettysburg, Montoursville, Perkasie, and Sellersville, Pa., and at Hagerstown, Md. One specimen in the National Museum collection was reared by H. D. Smith from a puparium taken at Mount Holly Springs, Pa., and another received from J. McDunnough was reared from a puparium taken at an unknown locality in Ontario, Canada.

IMPORTANCE

Myers recorded a maximum of 0.85 percent of the spring generation and 1.5 percent of the fall generation of the fly attacked by this

species. Hill and Smith state that in one instance a sample of 100 fly puparia taken in May from a field at Mount Holly Springs, Pa., disclosed 33 percent parasitization. The latter observation indicates that at times and under favorable circumstances the species may be an important factor in the control of its host.

MERAPORUS CRASSICORNIS Kurdjumov

Meraporus crassicornis Kurdjumov, Messager Ent. 2 (1) : 4, 1913; Znamenski, Poltava Agr. Expt. Sta., Ent. Dept. Bul. 2, 1923 (abstract in Rev. Appl. Ent. (A) 12: 291, 1924).

Meraporus crassicornis is very similar to *Amblymerus mayetiolae* Gahan. It differs, however, by having the dorsal aspect of the pronotum shorter, almost transversely linear, the antennal flagellum slightly shorter, the marginal vein not over one and one half times the length of the stigmal vein, the propodeum more rugulose between the lateral folds, and the abdomen slightly broader in proportion to its length.

Female.—Length 2 mm. Head a little broader than thorax, viewed from above about three times as wide as thick antero-posteriorly, slightly convex in front, broadly but not deeply concave behind; temples very narrow, less than one fourth the eye width; postocellar line much longer than ocellocular line, the latter equal to a little more than twice the diameter of an ocellus; ocelli small, the ocellar triangle obtuse; head viewed from in front broader than high (about as 28:23); scrobe shallow but distinct; malar space equal to approximately one third of the eye height; eyes ovate, bare; clypeus slightly rounded at apex; whole head finely reticulate-punctate, the clypeal area with some very weak striae. Antennae 13-jointed, strongly clavate, the flagellum rather short; scape cylindrical, not reaching to front ocellus; pedicel fully twice as long as thick, about equal in length to the three ring joints and the first funicle joint combined; first two ring joints smaller than the third, which is about twice as broad as long; funicle 5-jointed, the first funicle joint subquadrate, second also subquadrate and broader than the first, following joints broader than long and successively increasing a little in thickness, the last funicle joint approximately twice as broad as long; club ovate, as long as the three preceding funicle joints together, distinctly 3-jointed. Thorax rather short and compact, not over one and one half times as long as broad, finely reticulate-punctate; prothorax short, transversely linear dorsally; mesoscutum twice as broad as long, not strongly convex, the parapsidal grooves effaced; scutellum as long as, or a little longer than, mesoscutum, subconvex; axillae broadly separated, sculptured like scutellum; propodeum short, without a neck, with well-developed median carina and lateral folds, finely punctate over the whole surface, the area between lateral folds somewhat wrinkled; pleura mostly punctate but with a polished area below the posterior wing. Legs not swollen; tarsi 5-jointed; hind tibia with one spur; hind basitarsus as long as the three following joints together; hind coxae distinctly but not strongly sculptured. Wings reaching beyond apex of abdomen, bare at base behind the submarginal vein; marginal cilia short; marginal and postmarginal veins equal, the stigmal vein over two thirds as long as marginal. Abdomen broadly ovate, a little longer than thorax, broadest at about apex of first tergite where it is broader than thorax; first tergite constituting approximately one fourth the total length of abdomen and perfectly smooth, following tergites shorter, subequal and with very weak reticulations; ovipositor concealed from above.

Head and thorax green with a slight coppery cast; scape pale testaceous, flagellum brownish; mandibles fuscotestaceous; all coxae metallic green; all femora fuscotestaceous; all tibiae and tarsi reddish testaceous; wings hyaline.

Described from one female specimen in the United States National Museum. According to the labeling this specimen was received from T. Cheviroff, St. Petersburg (now Leningrad), Russia, and was reared from *Phytophaga destructor*. It was first identified as *Meraporus crassicornis* by the writer.

This species was originally described by Kurdjumov in 1923 from specimens reared from the hessian fly in the governments of Kiev and Poltava, Russia. The only other reference to it in literature seems to be that by Znamenski, who ranked it fourth in abundance among hessian-fly parasites in the Ukraine in 1923.

Its known distribution is confined to the above-mentioned localities in Russia.

Kurdjumov states that the adults emerge from puparia of the host. Otherwise its life history is unknown.

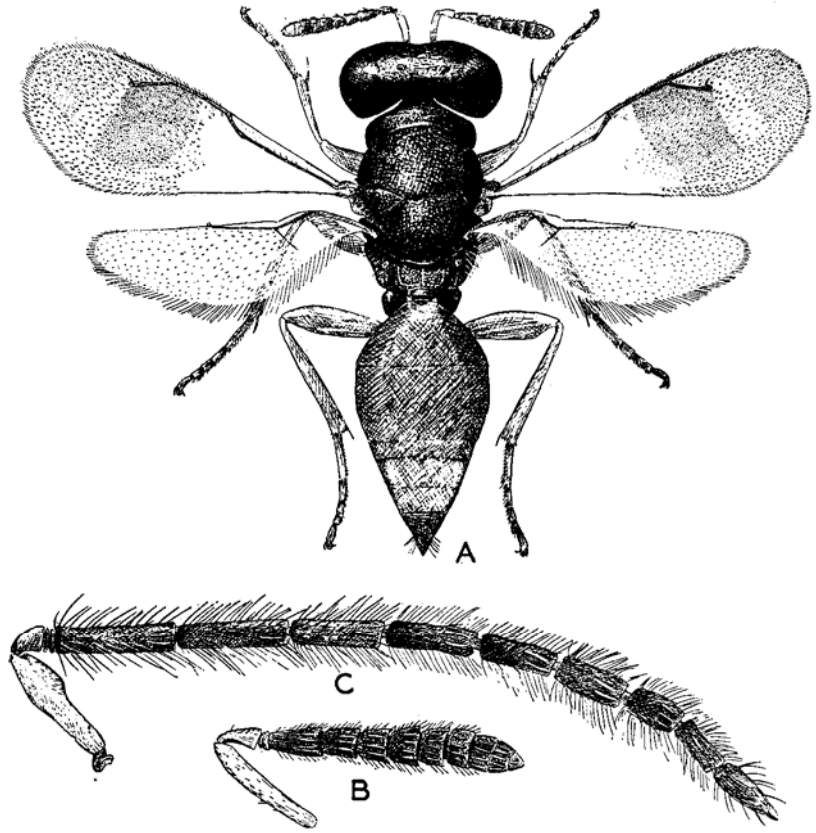


FIGURE 17.—*Arthrolytus maculipennis* (Walker) : *A*, Adult female ; *B*, antenna of female ; *C*, antenna of male. *A*, × 28.

ARTHROLYTUS MACULIPENNIS (Walker)

(Fig. 17)

Pteromalus maculipennis Walker, Ent. Mag. 3 : 191, 1836 ; Dalla Torre, Catalogus hymenopterorum . . ., v. 5, p. 134, 155, 1898 ; Schmiedeknecht, Hymenoptera, Fam. Chalcididae, *in* Wytsman, Genera insectorum, facs. 97, p. 347, 1909.

Pteromalus (*Arthrolytus*) *punctatus* Thomson, Scandinaviens Hymenoptera, v. 5, p. 158, 1878.

Arthrolytus punctatus Dalla Torre, Catalogus hymenopterorum . . ., v. 5, p. 155, 1898 ; Schmiedeknecht, Hymenoptera, Fam. Chalcididae, *in* Wytsman, Genera insectorum, fasc. 97, p. 359, 1909 ; Girault, Canad. Ent. 43 : 352, 1911.

Arthrolysis maculipennis Masi, Bul. Soc. Ent. Ital. 57 : 32, 1925.

Holcaeus cecidomyiae Ashmead (male), Psyche 8: 137, 1897; Marchal, Ann. Soc. Ent. France 66: 83, 1897.

Homoporus luniger Ashmead (not *luniger* Nees), Psyche 8: 137, 1897; Marchal, Ann. Soc. Ent. France 66: 83, 95, 1897 (spelled *laniger*).

DESCRIPTION

The female of *Arthrolytus maculipennis* may be distinguished from other related parasites of the hessian fly, except *Merisoporus chalcidiphagus* and *Polyscelis modestus*, by the distinct discal cloud in the fore wing. It differs from the first-named species by having the marginal vein not thickened, the antenna less slender and distinctly clavate, the funicle 6-jointed, the club 3-jointed and not acute at apex, and the lateral folds and median carina of propodeum well developed. The male antennae are similar to those of the species of *Merisus* but are much longer than those of any of the species in that genus except those of *M. febriculosus* Girault. The male is easily distinguished from *Merisus*, however, by the complete lateral folds on the propodeum. It may be distinguished from *P. modestus* by the absence of a neck on propodeum as well as by antennal and venational characters.

Female.—Length 1.6 to 2.5 mm. Head transverse, a little broader than thorax, viewed from above approximately three times as wide as thick anteroposteriorly at the middle, slightly convex in front and rather broadly but not deeply concave behind, narrowing behind the eyes, the temples receding from the eye margins and approximately one third as broad as the eyes; ocelli in a low triangle, the postocellar line longer than ocellocular line, the latter about equal to twice the diameter of an ocellus; head, viewed from in front, broader than high (about 30: 25), the cheeks rounded, the malar space equal to approximately one third the eye height; antennal scrobe shallow; eyes moderately large, ovate, bare; clypeus weakly striated or finely reticulate-punctate with a distinct tendency toward convergent striation, its anterior margin slightly sinuous; remainder of head with close deep reticulate-punctate sculpture, this sculpture below antennae very slightly finer than on frons; vestiture of head sparse and inconspicuous and of a dark color. (Mandibles and palpi not examined.) Antennae inserted below the middle but very slightly above the lower extremities of eyes, slightly incrassated, 13-jointed; scape cylindrical and slender, attaining the front ocellus; pedicel slender, a little more than twice as long as broad; two ring joints small, transverse, subequal; funicle 6-jointed, the first funicle joint narrower at base than at apex, longer than the pedicel and ring joints combined and longest of the funicle joints; second also narrower at base than at apex and about two thirds as long as the first; third about as long as broad; fourth and fifth subequal and each a little longer than broad; sixth distinctly broader than long and rather closely joined to the club; club short, ovate, 3-jointed, scarcely longer than the two preceding funicle joints combined, the two basal joints broader than long, the apical joint small and conical; funicle joints clothed with rather long, coarse, recumbent hairs, each joint with a single series of elongate sensoria which are located on the apical half of the segment; club joints also with one series of elongate sensoria which extend nearly the whole length of the segments. Thorax a little more than one and one half times as long as broad; prothorax with the dorsal aspect strongly transverse, not margined anteriorly, a little narrower than the mesonotum between tegulae, sculptured like the head and mesonotum; mesocutum about three fifths as long as broad (15: 25), closely reticulate-punctate, the punctures on the posterior middle portion a little coarser than anteriorly and laterally, the parapsidal grooves weakly impressed anteriorly, absent posteriorly; scutellum a little shorter than mesoscutum and a little more finely sculptured than middle of mesoscutum, but with its extreme apex more strongly sculptured than the dorsum; axillae widely separated, sculptured like scutellum; propodeum approximately half as long as scutellum, without a neck, the lateral folds and median carina well developed, spiracular sulci present but not deeply impressed, the area between lateral folds strongly punctate, laterad

of folds also distinctly punctate but not quite as strongly so as the middle area; spiracles nearly round; pleura strongly punctate except the usual smooth area along the dorsal margin. Legs normal, the hind coxae weakly sculptured on outer face. Fore wings reaching to apex of abdomen, about two and one half times as long as broad, bare at base for the length of submarginal vein, closely ciliated on the disk; marginal cilia very short; marginal vein very slightly more than half the length of submarginal, distinctly a little longer than the postmarginal; postmarginal and stigmal veins nearly equal, the former a little the longer; hind wings with marginal fringe rather short. Abdomen conic ovate, about as long as the head and thorax, as broad or a little broader than thorax, practically smooth, subpetiolate, the petiole very short, ovipositor tip very slightly exserted. The abdomen is somewhat variable in shape, sometimes broader than the thorax and less than twice as broad as long, at other times fully twice as long as broad and about as broad as the thorax.

Color of head and thorax dark metallic green; abdomen more or less cupreous with the first tergite metallic green at base and usually with a testaceous transverse band at apex; antennae brownish black with the scape entirely pale testaceous, the pedicel and ring joints usually more or less brownish testaceous; legs, except coxae, testaceous, the femora frequently brownish; fore and middle coxae often partly testaceous with the outer face metallic; hind coxae mostly metallic; fore wing with a fuscous cloud behind the marginal and stigmal veins and extending nearly to the posterior margin.

Male.—Length 2 to 2.4 mm. Antennae long and slender, nearly as long as the whole insect; scape not reaching beyond the front ocellus, cylindrical at base, the apical half slightly thickened, this enlargement sometimes forming a definite projection on the under side just beyond the middle and covered with small round papillae; pedicel short, about one and one half times as long as broad; both ring joints small and transverse; first flagellar joint very slightly longer than the scape, cylindrical, 6 or 7 times as long as broad; club not differentiated; the joints from base to apex of flagellum beginning with the first joint beyond the ring joints having approximately the following proportions: 20, 17, 14, 14, 12, 11, 9, 8, 11; all the flagellar joints clothed with rather coarse hairs which are a little less than twice as long as the transverse diameter of segments, each joint also with 3 or 4 elongate sensoria toward the apex; apical joint terminating in a small tubercle. Abdomen subelliptical, about as long as thorax, petiolate, the petiole slender and about as long as broad. Head and thorax bluish green, the scutellum usually darker; abdomen with a pale spot near base; antennae black with the scape pale testaceous, the pedicel brownish; legs testaceous, the coxae metallic, and femora varying from brownish testaceous to slightly metallic; wings hyaline.

REVIEW OF LITERATURE

Pteromalus maculipennis was described by Walker in 1836 from specimens collected in grass fields near London, England. It was next mentioned by Thomson in 1878, when he described *Arthrolytus punctatus* from specimens collected in Sweden and cited *Pteromalus maculipennis* Walker as a probable synonym. Dalla Torre's catalog listed *maculipennis* Walker in the genus *Pteromalus* and as doubtfully the same as *Arthrolytus punctatus*. Schmiedeknecht did the same. In 1925 Masi recorded the species from Italy and France under the name of *Arthrolysis maculipennis*.[11]

In 1897 Ashmead described *Holcaeus cecidomyiae* from specimens reared by Marchal from the hessian fly in France, and at nearly the same time Marchal published this name without description or comment in a list of the parasites of the fly in France. In the United States National Museum collection is a male specimen bearing the name label in Ashmead's handwriting and also a small hand-written

[11] Apparently Masi and also Ruschka have confused the generic names *Arthrolysis* Foerster and *Arthrolytus* Thomson. The former has as a genotype *Pteromalus scabriculus* Nees and is isogenotypic with *Picroscytus* Thomson. *Arthrolytus* Thomson is a different genus, having as its genotype *Arthrolytus punctatus* Thomson, which is a synonym of *Arthrolytus maculipennis* (Walker).

label "Type." This specimen also bears labels showing that it was reared from the hessian fly in France, and since it agrees with Ashmead's description of the male, there can be no doubt that it is the type male of Ashmead's species. This specimen has been compared with a male specimen determined by Foerster as *Pteromalus maculipennis* Walker and found to be apparently the same species. The female type of *Holcaeus cecidomyiae* is not identified in the collection by label. Associated with the type male in the collection is another pin without labels except for a small tab upon which is the figure 3, and bearing a card point upon which are mounted a male specimen of the same species as the male type and beside it a female which is easily recognized as *Merisus destructor*. A third pin associated with the male type bears a male of *M. destructor* and a female which the writer has identified as *Arthrolytus maculipennis*. This pin also bears a label "France" and a small tab with the figure 3 exactly like that on the pin previously mentioned. There can be no doubt that all these specimens were received by Ashmead from Marchal. Comparison of Ashmead's description with the female of *M. destructor* shows it to fit that specimen completely, except in the matter of the antenna. His description of the antenna cannot apply to *M. destructor*, but it does fit very completely the antenna of the female identified by the writer as *A. maculipennis*. It appears certain, therefore, that the two females associated with the male type were the basis of Ashmead's description and that he drew the main part of his description from the female of *M. destructor* but took the description of the antenna from the *A. maculipennis* female. In view of the fact that neither of these specimens fits the description completely, neither can rightfully be considered the holotype of the species. The male, however, does agree with the description and it is therefore chosen as the holotype.

The National Museum possesses a male and a female specimen identified by Foerster as *Pteromalus maculipennis* Walker; also a male and a female identified by Ruschka as that species. These specimens were obtained through an exchange with the Naturhistorisches Museum in Vienna, and were taken by the writer to the British Museum, where they were compared with Walker's types of *P. maculipennis* and found to agree completely. The above-discussed male type of *Holcaeus cecidomyiae* and the female identified as *A. maculipennis* associated with it have been compared with these specimens and found to agree in all essential details.

Arthrolytus punctatus Thomson and *Pteromalus maculipennis* Walker are certainly the same species. The specimens identified by Foerster as *maculipennis* and found by the writer to agree with Walker's type also agree with Thomson's description of *punctatus* and with a specimen in the National Museum collection identified by Schmiedeknecht as Thomson's species. This species is the genotype of *Arthrolytus*. It does not agree with the description of *Holcaeus*, being excluded by the fact that the dorsum of the prothorax is not acute anteriorly, the head is not triangular, and the conformation of the abdomen is different.

In the same paper in which he described *Holcaeus cecidomyiae*, Ashmead listed *Homoporus luniger* (Nees) as a parasite of *Mayetiola avenae* Marchal. This record was also published by Marchal,

but with the specific name spelled *laniger*. One female specimen is in the National Museum collection labeled "*Homoporus luniger*" by Ashmead and bearing the further label "France", which establishes it as part of the Marchal material identified by Ashmead. Another female specimen is labeled "*Homoporus laniger*." This specimen was also a part of the original material involved in the Ashmead and Marchal records, having been returned by Ashmead to Marchal at the time of the identification but again sent to the Museum by Marchal through L. O. Howard in 1921. Both of these specimens are *Arthrolytus maculipennis* (Walker), not *H. luniger* (Nees). Presumably, therefore, the record of *H. luniger* by Ashmead and Marchal refers instead to *A. maculipennis*, since no specimens of the true *H. luniger* have been found either in the material retained by Ashmead or among the specimens sent back to Marchal and subsequently returned by him to the Museum.

The Girault reference is merely a quotation of the Walker and Thomson descriptions of the genus and species together with a redescription of the genus.

LIFE HISTORY AND HOSTS

The only host records for this species seem to be those by Marchal from *Phytophaga destructor* and *Mayetiola avenae*, the first mentioned under the name of *Holcaeus cecidomyiae* and the second as *Homoporus luniger*. In view of the apparent abundance and wide distribution of the species and the fact that it has been recorded but once from each of these common insect pests, it seems hardly likely that either of them is the normal host of the species.

Nothing appears to be known of its biology except that the adult emerges from the puparium of its host.

DISTRIBUTION

Arthrolytus maculipennis does not occur in North America, so far as is known at present. Apparently it is widely distributed in Europe. Walker recorded it from England, Thomson from Lapland to southern Sweden, Masi from northern Italy and France, and Ashmead and Marchal from the Vendée in France. Specimens in the collection determined by Schmiedeknecht are from Blankenburg, Thuringia, and one specimen identified by Ruschka is labeled "Siegenfeld, Lower Austria." The specimen determined by Foerster is without locality label.

IMPORTANCE

This species is apparently of very little importance as a parasite of the hessian fly.

EUPTEROMALUS FULVIPES (Forbes)

(Fig. 18)

Ceraphron destructor Say (in part), Jour. Acad. Nat. Sci. Phila. (1) 1: 63, 1817.

Eurytoma destructor Herrick (in part), Amer. Jour. Sci. Arts 41: 153–158, 1841.

Pteromalus ? fulvipes Forbes, Ill. State Ent. Rpt. 14: 47, 1885; Packard Amer. Nat. 19: 1105, 1885.

Merisus (*Homoporus*) *subapterus* Riley, U.S. Natl. Mus. Proc. (1885) 8:416, pl. 21, fig. 2, 1886; Packard, Amer. Nat. 19: 1104, 1885; Riley, Amer. Assoc. Adv. Sci. Proc. (1885) 34: 333, 1886; Enock, Entomologist 21: 203, 1888.

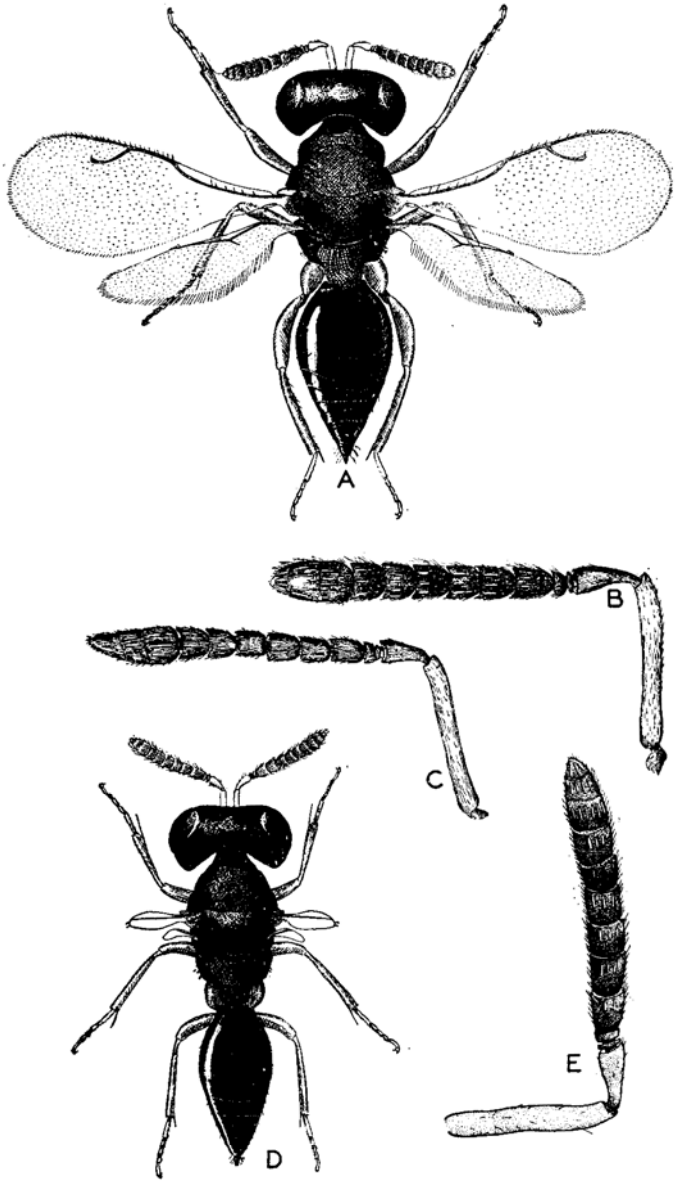


FIGURE 18.—*Eupteromalus fulvipes* (Forbes): *A*, Adult winged female; *B*, antenna of winged female; *C*, antenna of male; *D*, adult subapterous female; *E*, antenna of subapterous female. *A* and *D*, × 26.

Merisus fulvipes Cresson, Synopsis of the families and genera of the Hymenoptera of America, north of Mexico . . ., p. 242, 1887; Dalla Torre, Catalogus hymenopterorum . . ., v. 5, p. 90, 1898; Viereck, *in* Smith, Insects of New Jersey . . ., p. 642, 1910.

Merisus subapterus Cresson, Synopsis of the families and genera of the Hymenoptera of America, north of Mexico . . ., p .242, 1887; Lindeman, Bul. Soc. Nat. Moscou (2) 1: 178, 1887; Viereck, Conn. State Geol. and Nat. Hist. Survey Bul. 22: 480, 1916.

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Homoporus subapterus Dalla Torre, Catalogus hymenoterorum . . ., v. 5, p. 91, 1898; Viereck, *in* Smith, Insects of New Jersey . . ., p. 642, 1910; Meyer, Rpt. Appl. Ent. Leningrad 4: 241, 1929.

Micromelus subapterus Ashmead, *in* Smith, Insects of New Jersey . . ., p. 558, 1900; Kurdjumov, Messager Ent. [Kiev] 2: 1, 1913; Packard, Jour. Agr. Research 6: 377, 1916; McColloch, Kans. Agr. Expt. Sta. Tech. Bul. 11: 63, 67, 1924.

Nemicromelus subapterus Girault, Descriptiones hymenopterorum chalcidoidicarum variorum cum observationibus, no. 3, p. 4, 1917; Gahan and Fagan, U.S. Natl. Mus. Bul. 124: 94, 1923.

Nemicromelus fulvipes Myers, Ent. Soc. Wash. Proc. 26: 222, 1924; Hill and Smith, Jour. Agr. Research 36: 153, 155, 1928.

Eupteromalus micropterus Hill and Smith (not Lindeman), Jour. Agr. Research 36: 153, 155, 1928.

Meraporus graminicola Blunck (*Pteromalus fulvipes* Forbes and *Merisus subapterus* Riley in synonymy of), Ztschr. Angew. Ent. 18: 588, 1931.

DESCRIPTION

Eupteromalus fulvipes is extremely variable. Subapterous, half-winged, and fully winged individuals of both sexes are common. Furthermore, both sexes exhibit very marked variations in color. The coxae in both sexes may be either wholly testaceous or wholly metallic. Antennae of the male may be wholly testaceous or testaceous with the last funicle joint and the club fuscous or blackish. The body color ranges from nearly dead black with a very slight aeneous tinge to strongly copper colored with greenish reflections on some parts. The subapterous forms are usually metallic in color with legs, including their coxae, all reddish testaceous, while the winged forms are usually darker with the coxae more frequently metallic than otherwise, but occasionally a winged female with the coxae testaceous and the body strongly tinted with aeneous occurs. Intermediate stages both as regards color and extent of development of the wings are present. Length may vary from 0.8 to 2.5 mm.

The species may be separated from all other hessian-fly parasites except *Euteromalus micropterus* (Lindeman) and *E. americanus*, new species, by the presence of a delicate but distinct carina bounding the occipital foramen. From both these species it may be separated by the longer first tergite and the finer and deeper punctation of the scutellum and mesoscutum. In females of this species the first tergite (not counting the short petiole) is usually about as long as broad and constituted approximately half the length of the abdomen, sometimes a little less than half, sometimes distinctly more than half, depending upon the extent to which the apical tergites are retracted. Males have the first tergite longer than in the other species, usually about as long as broad, the apical segments frequently almost wholly retracted within the first but also frequently distended so that the first does not constitute nearly half the total length.

Subapterous female.—Length 1 to 2.3 mm. Head much broader than the thorax, thick antero-posteriorly, about twice as broad as thick at the middle; occiput slightly concave, distinctly margined by a delicate carina; ocelli in a low triangle, the postocellar line a little longer than the ocellocular, the latter equal to two or three times the diameter of an ocellus; temples receding, less than half as wide as the eyes; antennal scrobes very shallow, almost absent, the frons slightly convex; head viewed from in front broader than high (about 30:25); cheeks rounded; malar space equal to approximately one third the eye height; the malar furrow nearly effaced; eyes ovate, bare; clypeus not distinctly separated from the face, its anterior margin straight; clypeal area convergently striated, the rest of head strongly reticulate-punctate, this sculpture a little deeper on the frons than elsewhere; mandibles rather stout, each with four teeth; maxillary palpi 4-jointed, the apical joint nearly as long as the other three together; labial palpi 3-jointed. Antennae inserted a little above a line connecting the lower margins of eyes, 13-jointed, weakly clavate; scape cylindrical, attaining nearly the front ocellus; pedicel a little more than twice as long as thick, very slightly longer than first funicle joint together with the ring joints; two distinct ring joints, the first usually about half as large as the second, both transverse; first and second funicle joints subequal and each usually a little longer than broad, sometimes quadrate; funicle joints 3 to 6 subquadrate or slightly transverse; club 3-jointed, not quite so long as the three preceding joints, ovate, rounded at apex; elongate sensoria consisting of a single series on each of the funicle and club joints. Thorax a little less than twice as long as broad; prothorax short, pronotum strongly declivous and transversely lineolated or reticulated in front, the dorsal portion strongly transverse, a little wider laterally than at the middle, on a plane a little lower than mesonotum, reticulate-punctate, its anterior margin subacute without a marginal carina; mesoscutum convex, twice as broad as long, finely reticulate-punctate, the punctures close and deep, the parapsidal grooves very faintly indicated anteriorly, entirely effaced posteriorly; scutellum weakly convex, about as long as mesoscutum and similarly sculptured; axillae broadly separated and sculptured like scutellum; propodeum about as long as scutellum, with a broad neck which is set off by a slight transverse depression at its base, without a median carina, the lateral folds usually indistinct except basally, the area between the folds and on neck with deep and rather coarse reticulate-punctate sculpture, laterad of the folds mostly smooth; spiracles small, subelliptical; spiracular grooves shallow and reticulate-punctate. Wings consisting of short hyaline stubs which usually do not extend beyond the base of propodeum. Legs normal, the hind tibia with one apical spur. Abdomen conic-ovate, subpetiolate, about as long as head and thorax together and usually a little broader than thorax, convex above, nearly smooth but with some very faint reticulations on all the tergites, the first tergite (not counting the petiole) constituting half or a little less than half its total length, the second usually equal to approximately one fourth the first, the third to fifth tergites subequal or successively diminishing slightly in length, the sixth and seventh a little longer and subequal; first to fourth tergites each with a single transverse row of pale hairs, following tergites with more than one row; apex of ovipositor sheaths barely exserted.

General color aeneous; abdomen black, the first tergite usually more or less metallic green; flagellum black; scape, pedicel, and all legs, including their coxae, usually pale testaceous; mandibles testaceous with their teeth dark brown; palpi more or less metallic.

Winged female.—Like the subapterous form except in the following particulars: The wings may vary from less than half normal in size to fully developed. The fully developed fore wing extends a little beyond apex of abdomen and is about two and one half times as long as broad, bare behind marginal vein, normally ciliated beyond; marginal cilia short; submarginal vein more than twice as long as marginal; postmarginal and marginal veins subequal; stigmal vein two thirds as long as marginal, curved, slightly thickened at apex, the stylet usually distinct. In individuals having the wings smaller than normal, the postmarginal and stigmal veins may be equal and less than half the marginal, the stigmal vein not at all thickened at apex, and the stylet may be entirely absent. The lateral folds on propodeum are usually distinctly developed from base of propodeum to the base of the propodeal neck. The head is usually a little less thick antero-posteriorly, in some individuals fully three times as broad as long as viewed from above. The body color may vary from

strongly aeneous to blackish with only a slight aeneous tinge. The pedicel and scape are always testaceous, as are also the femora, tibiae, and tarsi, but the coxae may be either wholly concolorous with the thorax or wholly testaceous. Frequently the front and middle coxae are testaceous and the posterior pair more or less metallic. The wings are hyaline.

Male.—Length 0.9 to 2.3 mm. Antennae more slender than in the female, the flagellum increasing very slightly in thickness from base to middle of club, the funicle joints a little longer than broad, except the sixth, which is quadrate; club ovate, scarcely thicker than the funicle, subacute at apex; funicle and club joints sparsely hairy. Wings varying from mere stubs to fully developed and normal. Abdomen a little more distinctly petiolate than in the female, the first tergite about as long as broad, apical tergites frequently almost wholly retracted, the petiole not so long as broad and finely rugulosely sculptured. Color varying as in the female, the subapterous form usually strongly aeneous with testaceous coxae and the winged form most frequently darker with dark or metallic coxae. The male antennae are entirely reddish testaceous or fuscotestaceous in the subapterous form, and usually testaceous with the last funicle joint and the club blackish in the winged form.

REMARKS ON VARIATION

The astonishing variability of the species is not easily accounted for. The presence of both winged and subapterous forms of the female was recorded by Riley, but without mention of winged males and without reference to the variations in color of both sexes. Riley remarked that the proportion of the wingless to the winged forms varied at different seasons and in different parts of the country, a statement that is borne out by the present study. In discussing Riley's remark, Osborn expressed the opinion that there may be much the same retardation of development in this parasite as in the host, and that the appearance of adults in autumn or in the following spring may be a matter of conditions.

Any doubt that may have existed regarding whether or not the subapterous and winged individuals were representatives of the same species was dispelled by the work of C. M. Packard, who bred a subapterous female from a winged parent and who also observed subapterous males mating freely with winged females. In unpublished notes on experiments conducted by W. R. McConnell at Hagerstown, Md., a winged female with all red coxae produced five males, the coxae of all of which were metallic, thus showing that this difference is not specific.

In line with Riley's and Osborn's statements regarding the appearance of the different forms at different seasons and in different parts of the country, it appears from study of the material at hand that the development or nondevelopment of wings and differences in color in this species are related, to a large extent at least, to the length of the developmental period as determined by temperature and humidity. The subapterous form is the common one in the Mississippi Valley during the hot summer months of July and August and may occur as far north as Ontario, Canada, in August. The winged form, on the other hand, occurs in late autumn and early spring in the Mississippi Valley and seems to be the commoner form in such sections as North Dakota, Oregon, and the mountainous portions of the eastern part of the United States, where the mean temperatures are relatively low and the developmental period is correspondingly longer. Overwintering individuals seemingly are usually, if not always, winged.

The color differences apparently coincide more or less closely with the differences in wing development and are probably governed largely by the same factors. The subapterous form and an occasional winged individual have the coxae testaceous while the winged form as a rule has dark coxae and a less metallic-colored body.

REVIEW OF LITERATURE

The subapterous form of this species was first mentioned in 1817 by Say, when he characterized it as a form of his *Ceraphron destructor* which had cast off its wings. Herrick likewise considered it as doubtfully belonging to Say's species which he treated in the genus *Eurytoma*, but he disproved Say's theory of the casting off of the wings.

In 1885 Forbes described the rudimentary winged form in both sexes from specimens reared from hessian-fly puparia collected at DuQuoin, Marshall, and Robinson, Ill., naming it *Pteromalus ? fulvipes*. In the same year and at nearly the same time the description of *Merisus* (*Homoporus*) *subapterus* by Riley appeared. Riley's description was based upon specimens reared from hessian-fly puparia at Cadet, Mo., and included winged females as well as subapterous females and males. A review of the Riley and Forbes papers by Packard (1885) mentioned both names, and one by Riley in 1886 suggested that the two descriptions probably referred to the same species. In his Synopsis of the Hymenoptera of North America, Cresson, in 1887, listed both names in *Merisus* and indicated that they were the same species, but he did not give preference to either name. In the same year Lindeman mentioned *subapterus* as a parasite of the fly in North America. Enock in 1888 listed *Merisus* (*Homoporus*) *subapterus* as having been reared by him from the fly in England. Marchal in 1897 mentioned *subapterus* as an American parasite of the fly, placing it in the genus *Baeotomus*, and in 1898 Osborn referred to it under that name and stated that it was second in importance only to *M. destructor* as a parasite of the fly. At the same time *fulvipes* was cited as a synonym by Osborn. Dalla Torre in 1898 cataloged *subapterus* in the genus *Homoporus* with *fulvipes* as a synonym but at the same time also listed *fulvipes* in the genus *Merisus*. In 1900 Ashmead transferred *subapterus* to *Micromelus*. The species was figured and discussed briefly by Felt in 1902, and by Webster in 1906 and again in 1915. In 1913 Kurdjumov listed the species as a parasite of the fly in Russia and expressed the opinion that it was probably the same as *Micromelus rufomaculatus* Walker. Viereck, in the 1910 edition of Smith's Insects of New Jersey, listed *subapterus* in *Homoporus* and *fulvipes* in *Merisus* and in the catalog of Hymenoptera of Connecticut published in 1916 described *subapterus* in *Merisus*. Packard gave a detailed account of the life history of *Micromelus subapterus* in 1916. In 1917 Girault erected the genus *Nemicromelus* and named *Merisus* (*Homoporus*) *subapterus* Riley as the genotype, with *Pteromalus fulvipes* Forbes as a synonym. However, in 1924 Myers definitely established the fact that the description of *P. fulvipes* Forbes appeared in print and was distributed at least 2 weeks in advance of Riley's description of *subapterus* and in accordance with the accepted rules of nomenclature recognized *fulvipes* as the

valid name for the species with *subapterus* Riley as the synonym. The generic name *Nemicromelus* Girault was accepted by Myers. Hill and Smith in 1928 mentioned the species in a paper in which the status of hessian-fly parasites in Pennsylvania, Maryland, and Virginia was discussed.[12] In 1929 Meyer again listed *Micromelus subapterus* as a parasite of the fly in Russia.

Blunck in 1931 placed both *Pteromalus fulvipes* Forbes and *Merisus* (*Homoporus*) *subapterus* Riley in synonymy with *Meraporus graminicola* Walker.

From this summary of the literature it will be seen that this species has been placed at various times under no less than eight different genera. It is therefore with a sense of regret that the writer is compelled to place it under still a different generic name. It obviously has no relation to *Ceraphron* or *Eurytoma*, belonging in an entirely different family. It is at once separated from *Pteromalus*, *Merisus*, *Micromelus* (=*Baeotomus*), and *Homoporus* by the fact that the occiput is distinctly margined. It also differs from *Pteromalus* in the shape of the head, in venation, and in abdominal characters, while from the other three named genera it differs by obvious antennal and propodeal characters as well as in habitus. The margined occiput, venation, neck on the propodeum, shortly petioled and conic-ovate abdomen, as well as all other characters, place it in *Eupteromalus* Kurdjumov, a genus many species of which have similar habits of parasitizing Diptera. Since *Eupteromalus* is an older name than *Nemicromelus*, the latter was unnecessary.

The specific names *fulvipes* Forbes and *subapterus* Riley undoubtedly refer to the same species. Also there can be no question but that Myers was correct in stating that *fulvipes* was published first and hence is the name to use.

The conclusion by Bïro, published by Blunck, that this species is identical with *Meraporus graminicola* Walker is certainly erroneous. The writer has studied the type of *graminicola* in the British Museum and found it to have an immargined occiput, a 5-jointed funicle, and a propodeum which is without a distinct neck, characters which definitely mark it as generically, as well as specifically, different from *fulvipes*.

HOSTS AND LIFE HISTORY

So far as known, this parasite normally attacks only *Phytophaga destructor*, although in one instance, according to Myers' unpublished manuscript, a single specimen of it was reared from a puparium which contained also an adult of *Platygaster*, and observations published by Packard in 1916 indicate its ability occasionally to develop as a secondary parasite.

Normally, however, it is a primary, solitary, external parasite of the hessian fly. According to Packard, the egg is deposited in the flaxseed and the resulting larva feeds externally upon the host larva or pupa until full grown, when it pupates within the fly pupa-

[12] The reference to *Eupteromalus micropterus* by Hill and Smith is a misidentification for which the present writer is responsible. The specimens referred to under that name are now believed to be winged specimens of *E. fulvipes* having dark or metallic coxae.

rium. The number of instars is said to be five. The egg stage ranged in Packard's experiments from 1½ to 5 days, the larval stage from 7 to 10 days, and the pupal stage from 7 to 13 days. Little is known of the seasonal history. Emergence dates on the specimens examined range through all the months of the year, but since many of these specimens were reared under laboratory conditions these dates do not give a true picture of the seasonal history. It appears likely that several generations occur in certain localities.

DISTRIBUTION

The writer has seen no specimens of this species from Europe, and although it is recorded from England by Enock and from Russia by both Kurdjumov and Meyer, none of these writers described or figured the specimens in question. It is therefore impossible to confirm or deny its presence in the Old World.

In North America *Eupteromalus fulvipes* is widely distributed. Specimens at hand, together with records by the Bureau of Entomology, show it to have been reared from the hessian fly in Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Michigan, Minnesota, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Tennessee, and Virginia. Specimens from Ontario, Canada, are also in the National Museum collection. The above records embrace an area extending from Ontario, Canada, to North Carolina and westward to Oklahoma and Kansas and in the Northwest to Oregon. In the Mississippi Valley and eastward its distribution seems to be general, as indicated by numerous individual records from those States in which extensive investigations have been pursued. In all probability its distribution actually embraces an area somewhat wider than that indicated. It apparently does not at present occur in California.

IMPORTANCE

Opinions vary as to the usefulness of this species in controlling the fly. Early writers ranked it as second only to *Merisus destructor*, but Hill and Smith consider it of very minor importance, at least in the Middle Atlantic States.

EUPTEROMALUS AMERICANUS, new species

(Fig. 19)

Eupteromalus americanus can be separated from *E. fulvipes* by the shorter first tergite, the shallower and very slightly coarser punctation of the mesoscutum and scutellum, and certain differences in color, of which the most striking is the fact that the scape, except at the base, and the pedicel are fuscous or brownish. As elsewhere pointed out, it is extremely similar to *E. micropterus* Lindeman and may eventually prove to be that species. The two can be distinguished only by very slight differences in color and sculpture, *E. micropterus* being distinctly greenish with slightly coarser punctures on the mesoscutum and scutellum.

Female.—Length 1.5 to 2.3 mm. Head transverse, a little broader than thorax at tegulae, nearly three times as broad as thick antero-posteriorly at the middle, moderately concave behind and very slightly convex in front; occiput distinctly margined; ocelli in a low triangle, the postocellar and

ocellocular lines subequal, the latter approximately three times the diameter of an ocellus; temples strongly receding, less than half the width of eyes; antennal scrobe shallow; head, viewed from in front, broader than high (about as 30:25); malar space equal to approximately half the eye height, the malar groove nearly effaced; cheeks convexly rounded; eyes ovate, moderate in size, bare; clypeus not distinctly set off from face, finely convergently striated, its anterior margin slightly sinuous or nearly straight; mandibles each with four

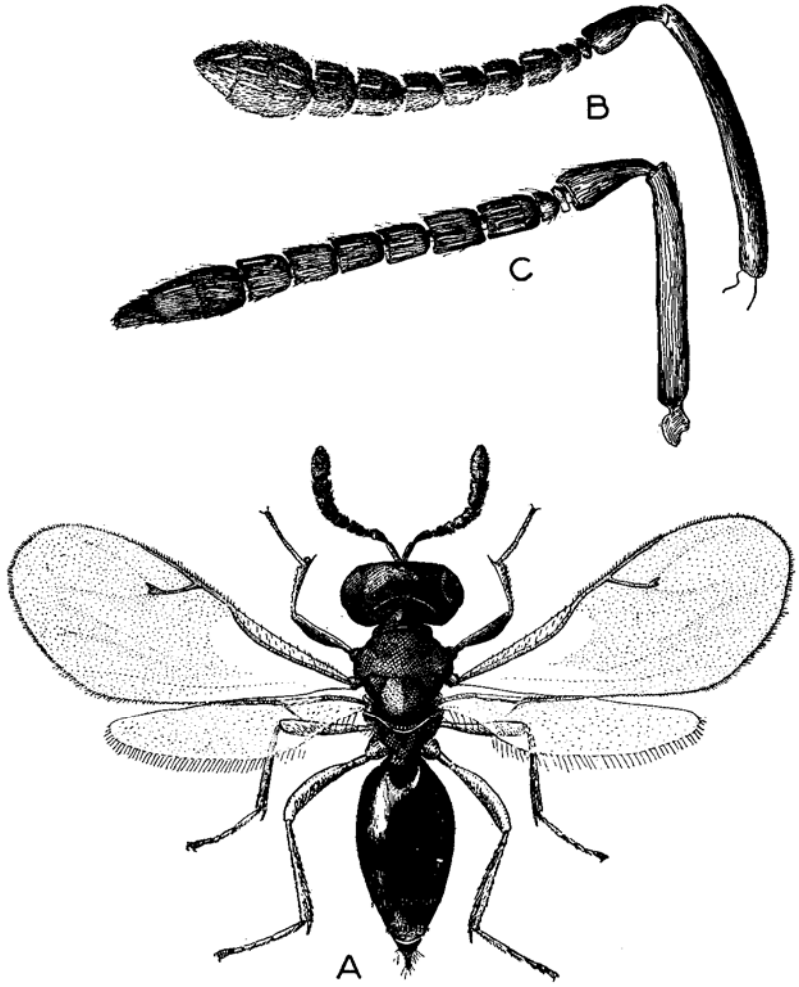


FIGURE 19.—*Eupteromalus americanus* Gahan: *A*, Adult female; *B*, antenna of female; *C*, antenna of male. *A*, × 26.

teeth, the teeth all acute and subequal; maxillary palpi 4-jointed, the last joint a little longer than the two preceding together; labial palpi 3-jointed, the first and third joints subequal, the second very small; whole head strongly reticulate punctate, the clypeal area finely convergently striated. Antennae inserted on a line with lower extremities of the eyes or slightly above such line, weakly clavate, 13-jointed; scape extending nearly to the front ocellus, cylindrical; pedicel about twice as long as broad, subequal in length to the two ring joints and first funicle joint combined; second ring joint about twice the size of first; first funicle joint very slightly longer than broad, second to fifth subquadrate,

the sixth slightly broader than long; club distinctly 3-jointed, elongate ovate, not so long as the last three funicle joints combined; each funicle and club joint with a single series of elongate sensoria which extend about two thirds the length of each segment. Thorax about one and one half times as long as broad; pronotum short, mostly declivous, the dorsal portion shorter than in *fulvipes*, immargined; mesoscutum twice as broad as long, the parapsidal grooves sharply impressed for approximately two thirds the length of mesoscutum, effaced posteriorly; scutellum about as long as mesoscutum, moderately convex; axillae broadly separated at base; the punctures on mesoscutum close, those on posterior middle slightly larger and deeper than elsewhere; punctures on scutellum a little finer and shallower than on mesoscutum; axillae sculptured like scutellum; propodeum shorter than scutellum with a prominent neck which is constricted at base above, lateral folds distinct and complete and a median carina usually present; the area between the folds much more closely punctate than the scutellum, laterad of the folds mostly smooth or weakly shagreened and hairy; spiracular sulci impressed and usually not foveolate; spiracles elongate ovate or elliptical. Legs normal. Fore wing about two and one half times as long as broad, bare at base for the whole length of submarginal vein, marginal cilia short; submarginal vein a little more than twice as long as marginal; postmarginal vein longer than marginal; stigmal vein three fourths as long as marginal, only slightly thickened at apex, the stylet usually present but short; hind wing more than three times as long as broad and reaching nearly to apex of abdomen in normally winged individuals. Abdomen conic-ovate, as long as head and thorax or nearly so, about as broad as thorax, convex above, and practically smooth; first tergite (except the very short petiole) distinctly broader than long, forming approximately one third the length of abdomen, perfectly smooth and bare except for a patch of hairs on each side near base; second tergite one third to nearly one half as long as first, smooth or with only very faint traces of reticulation, and bare; third to fifth tergites subequal, and each about half as long as second, the third and fourth bare, the fifth with a transverse row of short hairs; sixth nearly as long as second, faintly reticulated and sparsely hairy; seventh short; ovipositor sheaths barely showing at apex.

Color dull greenish with a slight aeneous tinge; abdomen shining black with an aeneous tinge, the first tergite often more or less bluish or greenish; antennae black or blackish with the pedicel and most of scape fuscous or dark brown, the base of scape testaceous; all coxae concolorous with the thorax; femora, tibiae, and tarsi varying from bright testaceous to dark brown, the femora usually somewhat darker than their tibiae; wings hyaline.

Male.—Length 1.4 to 1.9 mm. Antennae more slender than in the female, and less clavate; pedicel about as long as ring joints and first funicle joint; ring joints nearly equal; first funicle joint variable, usually distinctly longer than broad, but less than twice as long as broad, frequently no longer than broad; sixth joint quadrate; club slender, conico-cylindrical, and about equal to the three preceding joints; wings fully developed like those of the female and reaching much beyond apex of abdomen. Abdomen retracted apically in dead specimens, the first tergite transverse but constituting half or more than half the length of abdomen and 2 or 3 times the length of the second tergite, the following tergites often almost entirely retracted.

Color more strongly aeneous than in the female, the frons often brassy green. The eyes vary in size from nearly normal, as in the female, to much larger than those of the female. In specimens with small eyes the malar space is often fully half as long as the eye, the ocellocular line is more than twice as long as the diameter of an ocellus, and the frons is broad; while in those with large eyes the malar space is sometimes less than one fourth the length of the eye, the ocellocular line is scarcely longer than the diameter of an ocellus, and the frons is correspondingly narrowed. So far as the material at hand shows, the wings are always developed and functional, but they vary to some extent in size. None has been seen in which the wings do not extend beyond the apex of the abdomen.

The difference between small-eyed and normal-eyed males of this species is so striking that with only a few specimens for examination one would hardly suspect that the two forms are the same species. Examination of a large number of specimens shows considerable gradation but still might leave one in some doubt as to the real relationship. That the two forms are the same species, however, is definitely proved by the series of bred specimens bearing

Sacramento nos. 19938 and 19939, mentioned in the enumeration of paratypes. The female parent of this series has normal eyes. The male parent has unmistakably large eyes. The progeny of this pair consist of 5 females and 7 males; and in all the progeny, both male and female, the eyes are normal. Unfertilized females of the species normally produce only males, and it is quite certain, therefore, that this female was fertilized. The notes on this experiment by M. C. Lane show that the mating of this pair took place under his observation and that the female deposited 45 eggs, of which 13 developed into adults.

Type locality.—Birds Landing, Calif.

Type.—Catalog no. 44839, U.S. National Museum.

Described from the following material, all reared from *Phytophaga destructor;* Holotype female reared by M. Marshall at Birds Landing, Calif., June 20, 1923, under Sacramento no. 23125; allotype male and 6 female and 11 male paratypes, all progeny of the holotype female, reared at the same place and by the same collector, and bearing the same laboratory note number as the female parent, the emergence dates ranging from July 14 to August 2, 1923; male parent of the above allotype and paratypes and bearing the same data as the holotype; 1 male and 1 female reared at Birds Landing, Calif., June 10, 1919, by M. C. Lane under Sacramento nos. 19938 and 19939, respectively, together with 5 females and 7 males of which this male and female were the parents; 1 female reared by Lane at Birds Landing, Calif., June 17, 1919, under Berkeley no. 19951, together with a male and female which are her progeny. Other paratypes from Birds Landing reared by Lane in 1919 bear Berkeley nos. 19892, 19909, 19910, 19920, 19923, 19927, 19931, 19936, 19950, 19961, 19971, 19972, 19986, 19987, 19992, 19996, and 191070. Still other paratypes are: 8 males, all progeny of 1 female, reared by C. M. Packard at Salinas, Calif., under Pasadena no. 16181; 1 female parent and 6 of her progeny from Concord, Calif., under Berkeley no. 19935, Lane collector; 1 female, Berkeley no. 19917, and 4 of her progeny including 1 of a second generation, the progeny numbered, respectively, 19993, 19998, 191040, and 191746, all from Concord, Calif., Lane collector; 2 specimens bearing Berkeley no. 19371, 3 specimens, Berkeley nos. 19502, 19158, and 19315, all from Concord, Calif., Packard collector; 2 specimens, Berkeley nos. 16140 and 16170, Salinas, Calif., Packard collector; 28 specimens reared at Forest Grove, Oreg., by M. M. Reeher under Forest Grove no. 26.

Other material of this species examined, but not included in the type series, bear the following records: Centralia, Wash., Reeher collector, Forest Grove nos. 19-40B and 19-40BA; Forest Grove, Oreg., Reeher collector, Forest Grove nos. 20-1GB, 20-2B, and 20-2BA; Kent, Wash., Reeher collector, Forest Grove no. 19-39B; Forest Grove, Oreg., M. C. Lane, Forest Grove no. 18-34G; Dickinson, N.Dak., C. N. Ainslie, Webster nos. 23393 and 24218; Beach, N.Dak., C. N. Ainslie collector, Webster nos. 24206, 24229, and 24236; Finnegal, N.Dak., F. M. Webster collector, Webster no. 2027; Tower City, N.Dak., G. I. Reeves, Webster no. 3106; Onawa, Iowa, C. N. Ainslie, Webster no. 24205; Charleston, Mo., J. R. Horton; Okemos, Mich., Mich. Agr. Coll. Exp. no. 770.

HOSTS AND LIFE HISTORY

This *Eupteromalus* is not known to attack any host other than *Phytophaga destructor.*

Its life history is not known to the writer, but it is believed to be a primary solitary parasite which feeds externally upon the host larva within the puparium or flaxseed and emerges therefrom as an adult.

DISTRIBUTION

As may be seen from the foregoing records, this species has been found in California, Oregon, Washington, North Dakota, Iowa, Missouri, and Michigan. It seems to be common in all these States except Missouri and Iowa. Apparently it does not occur in Europe.

Some features of the distribution of this species are worthy of special note. Perhaps the most interesting is the fact that where it is commonest *E. fulvipes* appears to be either absent or rare, and where *E. fulvipes* is most plentiful *E. americanus* is seemingly rare or absent. The two species overlap to some extent, both being present along the northern border of the United States from Oregon to Michigan. In California *E. americanus* alone is present; in Oregon *americanus* is apparently common and *fulvipes* rare; in North Dakota and Michigan the two seem to be about equally common; in Iowa and Missouri *fulvipes* is the common species and *americanus* apparently uncommon, while east of the Mississippi River, except in Michigan, *americanus* does not occur in the material studied. Considering this distribution in conjunction with the close relationship of the two species and the great variability exhibited by both, one is led to wonder whether, after all, the supposed specific differences are really anything more than extremes of variations brought about by climatic influences which tend to shorten or lengthen the developmental period. Only careful breeding experiments can settle this question.

IMPORTANCE

In California and throughout the northern tier of States from Michigan to Oregon this parasite apparently is of considerable importance, if one may judge by the frequency with which it is collected. Not enough is known of it, however, to form much of an idea of its relative value in control of the hessian fly as compared to the other and better-known species.

EUPTEROMALUS MICROPTERUS (Lindeman)

Merisus intermedius var. *microptera* Lindeman, Bul. Soc. Imp. Nat. Moscou (2) 1:182, 1887; Ormerod, Entomologist 20:317, 1887.

Baeotomus coxalis Ashmead, Psyche 8:83, 1897; Marchal, Ann. Soc. Ent. France 66:83, 1897.

Eupteromalus arvensis Kurdjumov, Messager Ent. [Kiev] 2:3, 1913; Znamenski, Poltava Agr. Expt. Sta., Ent. Dept. Bul. 2, 1923 (abstract in Rev. Appl. Ent. (A) 12:291, 1924); Meyer, Rpt. Appl. Ent. Lenigrad 4:241, 1929.

Meraporus graminicola Blunck (*Mersius intermedius* var. *micropterus* Lindeman and *Baeotomus coxalis* in synonymy of), Ztschr. Angew. Ent. 18:588, 1931.

DESCRIPTION

Eupteromalus micropterus is very similar to *E. fulvipes* in habitus and in most details, but it may be distinguished by the following characteristics:

Female.—Very slightly more robust than in *fulvipes;* head thinner than in *fulvipes,* about three times as broad as thick antero-posteriorly; viewed from in front the width to the height is in about the ratio 30 to 24; postocellar line

very slightly longer than ocellocular, the latter equal to 2½ to 3 times the diameter of an ocellus; temples poorly defined, strongly receding from the eye margins. Antennae inserted slightly below the middle of head; pedicel shorter than in *fulvipes*, about twice as long as broad, not longer than first funicle joint plus the ring joints; first, second, and third funicle joints a little longer than broad, fourth to sixth subquadrate. Thorax about one and one half times as long as broad; parapsidal grooves shallow but distinct anteriorly, effaced posteriorly; propodeum not so long as scutellum, the neck with a deep constriction basally above, the lateral folds strong and complete; the area between the folds coarsely punctate, laterad of the folds mostly punctate, the spiracles elongate oval or elliptical. Fully developed wing about two and one third times as long as broad, the venation as in *fulvipes*. Abdomen as broad as thorax, a little more robust than usual in *fulvipes*, conic-ovate, convex above, the first tergite much broader than long and constituting less than half the length of abdomen, the second tergite one third as long as the first, the first tergite perfectly smooth and polished and without a transverse row of hairs, the second to fourth also polished and bare. Color bluish green with little or no aeneous cast; the scape, at least apically, and the pedicel more or less dark fuscous; the flagellum brownish to black; the coxae all metallic green; the remainder of legs pale yellow.

Male.—Differing from the male of *fulvipes* by being metallic green in color and by having the first tergite more transverse. Wings varying in development from mere short stubs to those of normal length, but the coxae, even in subapterous individuals, metallic. Funicle joints variable in length but in typical examples all longer than broad. Propodeum usually with a weak median carina.

No subapterous females have been seen, but the wings of at least two of the specimens studied are distinctly smaller than the normal wing, and it is probable that subapterous females do occur.

The relatively shorter first tergite, the slightly shorter antennal pedicel, the slightly larger punctures on scutellum and mesoscutum, together with the more distinctly green color of the head, thorax, and abdomen, will have to be depended upon for separation of this species from the fully winged form of *fulvipes* having metallic coxae.

REVIEW OF LITERATURE

This species was first described by Lindeman, who characterized it as a variety of his *Merisus intermedius*, a species now considered to by the same as *M. destructor* (Say). Lindeman's specimens were from Russia. Miss Ormerod records sending to Lindeman specimens which were reared in England from the hessian fly and which he determined as belonging to *M. intermedius* var. *micropterus*.

Baeotomus coxalis Ashmead was described in 1897 from specimens reared by Marchal in France, and reference to this identification was made by Marchal at nearly the same time that the original description was published. Ashmead indicated both *Phytophaga destructor* and *Mayetiola avenae* (Marchal) as hosts, but Marchal noted only the last-named species.

In 1913 Kurdjumov described *Eupteromalus arvensis* in a paper dealing with the Pteromalidae parasitic upon the hessian fly in Russia, and this species was subsequently mentioned as a parasite of the fly in Russia by both Znamenski and Meyer. On the authority of L. Bïro, Hans Blunck, in 1931, placed Lindeman's *Merisus intermedius* var. *micropterus* and Ashmead's *Baeotomus coxalis* in synonymy with *Meraporus graminicola* Walker.

In the United States National Museum are 5 male specimens and 1 female mounted with minuten pins on a piece of cork and bearing the label "*Merisus intermedius* var. *micropterus* Lindeman." The

writer has been assured by L. O. Howard that these specimens were originally received from Lindeman himself and that the label is in Lindeman's handwriting. Howard believes that they represent a part of Lindeman's type material. These specimens have been compared with Ashmead's types of *Baeotomus coxalis* comprising 1 female and 4 male specimens and have been found to agree perfectly. The specimens of both Lindeman and Ashmead seem to fit the description of *Eupteromalus arvensis* Kurdjumov in every particular. Kurdjumov states that he found specimens of *arvensis* among Lindeman's types of *Merisus intermedius*, but for some reason he failed to recognize these as belonging to the variety *micropterus*, which he did not mention. There seems to be no doubt that both *coxalis* and *arvensis* are identical with *micropterus;* and since the Lindeman name is the oldest, the species should be known as *Eupteromalus micropterus* (Lindeman).

This species is not a synonym of *Meraporus graminicola* Walker, as treated by Blunck. The type of *graminicola* which the writer saw in the British Museum in 1927 differs from *micropterus* by having an immargined occiput, a 5-jointed funicle, and a propodeum which is short and without a distinct neck at the apex. These characters not only separate the species specifically but place them in different genera according to the present understanding of Pteromalidae.

The National Museum possesses one additional female of this species received from T. Cheviroff, Leningrad (St. Petersburg), Russia. This was originally mounted on the same pin with the specimen elsewhere referred to in this paper as *Meraporus crassicornis* Kurdjumov. Both species had been originally identified by someone as *Ceraphron destructor* Say.

In addition to the above-noted European material there are in the National Museum collection two females and several males which appear to be thoroughly typical representatives of *micropterus* and which bear the label "Wooster, Ohio." These specimens have proved very puzzling. They carry the identification label "*Merisus destructor* Say", and on one pin is the label "*C. destructor*", indicating that they were reared from the hessian fly. It is believed that they were originally obtained by F. M. Webster about 1890 to 1900, but their exact history cannot now be definitely traced. Of the many hundreds of specimens since reared from the fly in North America, none seems to agree exactly with these specimens. It seems incredible, if this species was actually established in America many years ago, that it should not have been again reared. For this reason, also because Webster is known to have received samples of hessian-fly parasites from abroad, the writer is inclined to question whether these specimens were actually reared from material collected in Ohio. It seems possible that they may be European specimens which have been wrongly labeled.

The species described in this paper as *Eupteromalus americanus*, new species, is extremely similar to *micropterus*, and at one time specimens of it were identified by the writer as that species, this identification forming the basis for the use of that name by C. M. Packard in 1928.[13] At that time, and because of the above-mentioned Ohio specimens, *micropterus* Lindeman was believed to be present

[13] Packard, C. M., U.S. Dept. Agr. Tech. Bul. 81: 14, 1928.

in America, and the slight differences noted between typical specimens of *micropterus* and the American material reared by Packard and others were ascribed to variation supposedly caused by climatic or other conditions. As a matter of fact, there still remains some doubt regarding the real specific distinctness of this American form and the European species, but since certain apparent differences in sculpture and color do exist between the two, and since no typical specimens of *micropterus*, except the somewhat doubtful ones from Ohio, have been found in American material, it seems wisest to consider them as different species.

HOSTS AND LIFE HISTORY

So far as is known, the species has been reared only from *Phytophaga destructor* (Say) and *Mayetiola avenae* (Marchal).

Little or nothing is known of its life history. No doubt its development will be found to be similar to that of *Eupteromalus fulvipes*.

DISTRIBUTION

In Europe this species seems to be widely distributed, having been recorded from England, Poitou and Vendée in France, and from various parts of Russia. Kurdjumov remarks that it is a common parasite of the hessian fly in Russia.

Aside from the questionable records already discussed of its having been reared by Webster at Wooster, Ohio, it is not known to occur in North America.

MERISUS DESTRUCTOR (Say)[14]

(Fig. 20)

Ceraphron destructor Say, Jour. Acad. Nat. Sci. Phila. (1) 1: 47–48, 63, 1817; Amer. Farmer, Aug. 30, 1822; New England Farmer 1: 113, 1822; 9: 9, 1830; Westwood, An introduction to the modern classification of insects . . ., v. 2, p. 160, 1840; Harris, Insects injurious to vegetation, p. 432, 1842; Fitch, The hessian fly (private publication), Albany, N.Y., p. 43, 1847; Say, Complete writings (ed. by LeConte), v. 2, p. 6, 1859; Howard, Psyche 4: 206, 1884.

Eurytoma destructor Harris, Insects injurious to vegetation, p. 432, 1842; Herrick, Amer. Jour. Sci. Arts 41: 153–158, 1841; Fitch, Cult. and Country Gent. 28: 354, 1866.

Pteromalus destructor Curtis, Jour. Roy. Agr. Soc. England 6: 139, 1846.

Raphitelus (*Storthygocerus*) *destructor* Harris, Insects injurious to vegetation, p. 469, 1852; p. 586, 1862 (reprinted in 1890).

Semiotellus destructor Fitch, N.Y. State Ent. Rpt. 7: 827–828, 1862; Packard, U.S.Dept.Int., Geol. and Geogr. Survey Rpt. (1875) 9: 696, fig. 3, 1877; Cook, Mich. State Bd. Agr. Rept. 16: 375, 1877; Packard, Rpt. U.S. Ent. Comm., Bul. 4: 18–20, 1880; and U.S. Ent. Comm. Rpt. 3: 216–218, 1883; Forbes, Ill.,

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[14] In a recent paper by Blunck (Ztschr. Angew. Ent. 18: 586, 1931) a parasite in Pomerania of *Mayetiola phalaris* Barnes is treated under the name *Semiotellus destructor* (Say). In a footnote, the identification of the parasite is attributed to the late L. Bïro, of Budapest, and a quotation from a letter from Bïro discussing the differences between the genera *Semiotellus* and *Merisus* is given in which it is stated that in *Semiotellus* the parapsidal furrows are complete and distinct, the antennae 13-jointed, and the antennal club rounded at apex, while in *Merisus* the parapsidal furrows are weak and indistinct, the antennae 13-jointed, and the antennal club pointed at apex.. The quotation closes with the observation that the species can now be placed definitely in *Semiotellus*. Only one conclusion can be drawn from this statement, viz that the identification of the species is incorrect. Say's species *destructor* agrees precisely with the characters cited for *Merisus* and not with those given for *Semiotellus*. Notes on the type of *Semiotes mundus* Walker, genotype of *Semiotellus*, made by the writer during a visit to the British Museum in 1927, confirm Bïro's observations regarding the characters of this genus. If Blunck's specimens really conform to the characters cited for *Semiotellus* as indicated, then they represent a species quite different from *destructor* Say, which agrees exactly with Bïro's characterization of *Merisus*.

State Ent., Rpt. 14: 44, 49, 1885; U.S.Dept.Agr., Div. Ent., Insect Life 4: 181, 1891; Dalla Torre, Catalogus hymenopterorum. . . . , v. 5, 211, 1898.

Merisus destructor Riley, U.S. Natl. Mus. Proc. (1885) 8: 413–415, 1886; Amer. Assoc. Adv. Sci. Proc. (1885) 34: 333, 1886; Packard, Amer. Nat. 19: 1104, 1885; Cresson, Synopsis of the families and genera of the Hymenoptera of America, north of Mexico . . . , p. 242, 1887; Ormerod, Entomologist 20: 317, 1887; Lindeman, Bul. Soc. Imp. Nat. Moscou (2) 1: 178–192, 1887; Enock, Ent.

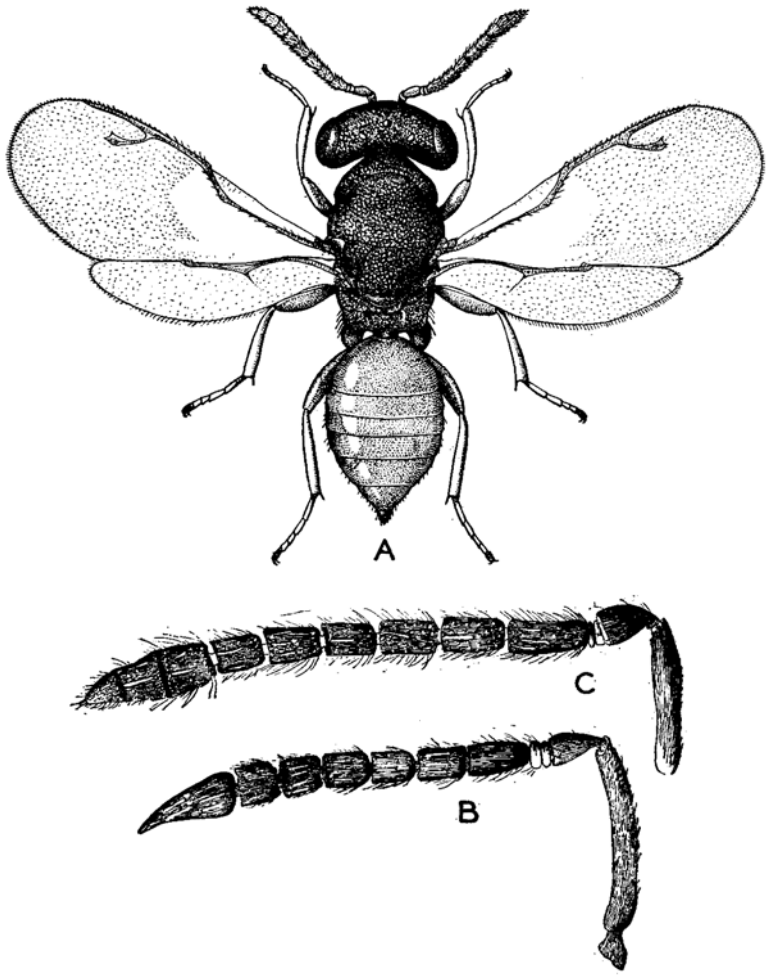


FIGURE 20.—*Merisus destructor* (Say): *A*, Adult female; *B*, antenna of female; *C*, antenna of male. *A*, × 23.

Soc. London, Trans. 1888, proc., p. xviii; Smith, Insects of New Jersey . . . , p. 40, 1890; p. 642, 1910; Ashmead, Psyche 8: 135, 1897; Marchal, Ann. Soc. Ent. France 66: 81, 83, 94, 1897; Osborn, U.S.Dept.Agr., Div. Ent. Bul. (n.s.) 16: 28, 29, 31, 33, 1898; Dalla Torre, Catalogus hymenopterorum . . ., v. 5, p. 90, 1898; Lugger, Minn. Agr. Expt. Sta. Bul. 64: 556, 1899; Pospjelov, Illus. Ztschr. Ent. 5: 263, 1900; Felt, N.Y. State Ent. Rpt. 17 (Mus. Bul. 53): 721, fig. 2, 1902; Stedman, Missouri State Bd. Agr. Rpt. 34: 55–141, 1902; Washburn, Minn. State Ent. Rpt. 7 (Bul. 77): 6–7, 1902; Webster, U.S.Dept.Agr., Bur. Ent, Circ, 70: 12, 13, 1906; Pospjelov, Choziajstva [Kiev] 2: 101–106, 149–156, 1907;

Bachmetjev, Ztschr. Wiss. Insektenbiol. 4:350, Kurdjumov, Messager Ent. [Kiev] 2: 2, 1913; Headlee and Parker, Kans. Agr. Expt. Sta. Bul. 188: 109, 1913; Felt, N.Y. State Ent. Rpt. 28 (Mus. Bul. 165): 39, 1913; Webster, U.S. Dept.Agr. Farmers' Bul. 640: 16, 18, 1915; Viereck, Conn. State Geol. and Nat. Hist. Survey Bul. 22: 479, 1916; Spassky, Ann. Don Polyt. Inst. Novotcherkassk 5, no. 1, pt. 2, 1916 (abstract in Rev. Appl. Ent. (A) 5: 29, 1917); Packard, Jour. Agr. Research 6: 367, 373–377, 1916; Fyles, Ontario Ent. Soc. Rpt. 46: 56, 1916; Collin, Ann. Appl. Biol. 5: 81–86, 1918 (abstract in Rev. Appl. Ent. (A) 7: 70, 1919); McColloch, Kans. Agr. Expt. Sta. Tech. Bul. 11: 63, 66, 67, 1923; Znamenski, Poltava Agr. Expt. Sta., Ent. Dept. Bul. 2, 1923 (abstract in Rev. Appl. Ent. (A) 12: 291, 1924); Hill and Smith, Jour. Agr. Research 36: 153, 1928; Packard, U.S. Dept. Agr. Tech. Bul. 81: 14, 1928; Meyer, Rpt. Appl. Ent. Leningrad 4: 241, 1929.

Merisus intermedius Lindeman, Bul. Soc. Imp. Nat. Moscou (2) 1: 179–183, 192, 1887; Riley, U.S.Dept.Agr., Div. Ent., Insect Life 1: 132, 1888; Marchal, Ann. Soc. Ent. France 66: 81–82, 1897; Osborn, U.S.Dept.Agr., Div. Ent. Bul. (n.s.) 16: 28, 29, 1898; Dalla Torre, Catalogus hymenopterorum . . . , v. 5, p. 90, 1898; Pospjelov, Illus. Ztschr. Ent. 5: 26, 1900; Meyer, Ztschr. Angew. Ent. 9: 113, 118, 1923; Rpt. Appl. Ent. Leningrad 4: 236, 242, 1929; Vojnovskaja-Krieger, Rpt. Appl. Ent. Leningrad 4: 187, 1929; Imms, Parasitology 22: 33, 1930.

Baeotomus destructor Fletcher, Canada Dept. Agr., Rpt. Ent. and Bot. (1899), p. 169, 1900.

Micromelus destructor Ashmead, *in* Smith, Insects of New Jersey . . ., p. 558, 1900.

Merisus species Washburn, Minn. State Ent. Rpt. 8 (Bul. 84): 10, fig. 7, 1903.

DESCRIPTION

Merisus destructor may be distinguished from most of the other parasites of the fly by the antennal club, which in the female is solid and tapered to a sharp point and in the male is indistinctly 3-jointed. It differs from *M. febriculosus* and *M. mordellistenae* in the more robust form of the thorax and in the darker abdomen. It may be distinguished from *Eupteromalus fulvipes* by the immargined occiput and darker colored legs, from *Merisoporus chalcidiphagus* by the entirely hyaline wings, and from *Callitula bicolor* by the 6-jointed funicle and the lack of a neck on the propodeum.

Female.—Length 1.9 to 2.8 mm. Head transverse, a little broader than thorax, three or more times as broad as thick antero-posteriorly at the middle, slightly concave behind, the occiput immargined; temples not more than one third as wide as the eyes, receding from the eye margin; ocelli in an obtuse triangle, the lateral ocelli fully three times their own diameter from the eye margins; postocellar line a little longer than the ocellocular; head, viewed from in front, a little broader than high, subelliptical; malar space equal to less than half the eye height; eyes bare; mandibles each with four teeth; labial palpi 3-jointed; maxillary palpi 4-jointed, the apical joint about as long as the second and third joints combined; whole head strongly reticulate-punctate, the punctures below the antennae somewhat finer than those on the frons, the clypeal area convergently striated. Antennae inserted a little below middle of head, but distinctly above lower margin of eyes, 11-jointed, consisting of a cylindrical scape which reaches to the anterior ocellus, a pedicel about twice as long as broad, two transverse but distinct ring joints, six funicle joints of which the first is usually nearly twice as long as broad, the sixth not longer than broad, and a solid club which tapers from its base to a sharp and slightly curved point at apex and which is distinctly longer than the two preceding funicle joints; all funicle joints sparsely clothed with hairs. Thorax as broad posteriorly as anteriorly, and a little less than one and one half times as long as broad; pronotum strongly transverse, nearly as broad as the mesonotum, sculptured like the occiput; mesoscutum moderately convex, not quite twice as broad as long, sculptured like the head; the parapsidal grooves weakly impressed anteriorly, entirely effaced behind the middle; scutellum subconvex, not quite so long as mesoscutum, sculptured like mesoscutum; axillae broadly separated by base of scutellum, sculptured

like mesoscutum; propodeum broad, without an apical neck and without carinae, the lateral folds represented by a large smooth fovea on each side of the middle about half way between the median line and the spiracles, spiracular grooves absent, spiracles elliptical, surface of propodeum sculptured like scutellum but with punctures a little smaller; mesopleura sculptured like propodeum but with a smooth area along the dorsal margin; metapleura weakly punctate. Legs normal; the hind tibia with a single spur; tarsi 5-jointed, the posterior basitarsus short, not longer than the two following joints combined. Fore wing extending a little beyond the apex of abdomen, approximately two and one third times as long as broad, its surface bare from base to a little beyond the apex of submarginal vein except for a few cilia in the costal cell, marginal cilia very short; marginal and postmarginal veins subequal, the stigmal approximately three fourths as long as marginal. Abdomen about as long as thorax, broadly ovate, as broad as or a little broader than the thorax, sessile, practically smooth, the apical segments with some very faint reticulation; ovipositor sheaths slightly exposed at apex.

Color of head and thorax metallic dark green, the abdomen usually dark brown or blackish with a strong metallic luster but frequently with a reddish testaceous spot basally, this spot sometimes embracing most of the basal half of abdomen; antennae brownish testaceous with the scape, pedicel, and club usually somewhat paler testaceous; mandibles reddish testaceous with their apices dark brown; legs with all coxae metallic green, all femora usually dark brownish or fuscous but frequently all testaceous, the tibiae and tarsi pale yellowish with the tarsal claws dark brown; wings hyaline, the venation brownish yellow.

Male.—Length 1.8 to 2.6 mm. Antennae 13-jointed, moderately long and slender, the flagellar joints and club joints evenly clothed with hairs which are approximately as long as the joints are thick; pedicel a little longer than thick; ring joints transverse but distinct; funicle 6-jointed, the first funicle joint usually nearly three times as long as broad, two following joints successively a little shorter, the fourth and fifth subequal to each other, each a little shorter than the third and a little longer than the sixth, which is usually about one and one half times as long as thick; club 3-jointed, long oval, a little longer than the two preceding joints together; the joints separated by sutures but not distinctly set off as are the joints of funicle. Thorax a little more slender than in female. Abdomen not so long as thorax, elliptical, and usually not so broad as the thorax. Antennal flagellum entirely and frequently the scape and pedicel black or blackish, the scape usually pale at base and frequently mostly pale. Other characters as in the female.

Description drawn from specimens reared from the hessian fly.

REVIEW OF LITERATURE

Merisus destructor was originally described by Thomas Say in 1817 under the name *Ceraphron destructor*. Say recorded it as a parasite of the hessian fly and described its oviposition and emergence from the puparium of its host. In 1840 Westwood expressed the opinion that the species was one of the Eulophides. Herrick in 1841 referred it to the genus *Eurytoma* and stated it to be the principal parasite of the fly; the following year Harris treated it under the same name, giving a short account of its habits. In 1846 Curtis placed it in the genus *Pteromalus*, on the authority of Westwood, and in the second and third editions of Insects Injurious to Vegetation by Harris, published, respectively, in 1852 and 1862, it was treated under the name *Rhaphiteles* (*Storthygocerus*) *destructor*. The species was next referred to the genus *Semiotellus* by Fitch, who in 1862 discussed fully his reasons for so doing and gave a good description of the adult together with some observations on its habits and stated that it was the most important parasite of the fly. Cook in 1877 and Packard in 1880 and again in 1883 redescribed the species

and discussed its oviposition habits and importance. In 1885 Forbes treated it under the generic name *Semiotellus*, described the adult in some detail, and discussed briefly its life history. At the same time he described as *Pteromalus fulvipes* a rudimentary-winged parasite of the fly, this being the first recognition as a distinct species of this rudimentary-winged form which Say, Herrick, and others had considered to be a form of *destructor*. In the same year Riley transferred *destructor* to the genus *Merisus*, where it still remains. Riley also recognized as a distinct species the short-winged parasite of the fly, which he described under the name *Merisus subapterus*.

In a treatise on the parasites of the hessian fly in Russia, published by Lindeman in 1887, *Merisus destructor* (Say) is mentioned as a parasite of the fly in North America. Lindeman states that he at first identified as this species specimens reared from the hessian fly in Russia, but that upon comparing them with Riley's redescription of *destructor* he decided that they were not that species but a new species which he described under the name *Merisus intermedius*, so called because it seemed to represent a species intermediate between *M. destructor* (Say) and *M. subapterus* Riley. At the same time he characterized two alleged varieties of *intermedius*, one of which he called *rufiventris* and the other *microptera*. Enock recorded *Merisus destructor* from England in 1888, and Riley the same year identified material from England as *M. intermedius*. Both Ashmead and Marchal in 1897 recorded *M. destructor* as parasitic upon *Mayetiola avenae* (Marchal), *Cecidomyia tritici* Kirby, and *Phytophaga destructor* Say in France. The following year Osborn stated that the species occurred not only throughout the American territory affected by the fly but also in England and continental Europe. It was recorded from Canada in 1899 by Fletcher under the name *Baeotomus destructor*.

Pospjelov in 1900 stated that Russian parasites of the fly could as well be placed in *Merisus destructor* as in *M. intermedius*. He evidently believed these two species to be identical, although he did not definitely say so, and he treated the species under the latter name. The 1900 edition of Smith's Catalog of the Insects of New Jersey listed the species as *Micromelus destructor*. Felt in 1902 referred to *Merisus destructor* as one of the most efficient parasites of the fly and stated that it occurred in Europe as well as in North America. In 1913 Kurdjumov, after a personal study of Lindeman's types in the Rural Economy Institute at Moscow, stated that he was firmly convinced that *Merisus destructor* (Say) and *M. intermedius* Lindeman were identical but noted that he also found representatives of *Eupteromalus arvensis* Kurdjumov among these types. C. M. Packard in 1916 gave what is probably the most comprehensive account of the life history of *M. destructor*. Collin in 1918, and Meyer in 1923, recorded it as a parasite upon *Oscinella frit*, and the latter author in 1929 again referred to it as a parasite of the frit fly and the hessian fly and also named *Elachyptera cornuta* as one of its hosts. Other references to the species cited in the bibliography are for the most part either mere mentions of it or brief reviews of the work of others.

The writer has studied both European and American specimens of *Merisus* reared from the hessian fly. The European material ex-

amined includes specimens originally sent to Howard by Lindeman, labeled "*Merisus intermedius*" in Lindeman's handwriting, and also specimens of the variety *rufiventris*, likewise labeled by Lindeman. These specimens without much doubt constitute a part of the original type material. They cannot be distinguished in any way from American specimens of *M. destructor*. The two specimens labeled "variety *rufiventris*" have both lost their abdomens, but since many specimens of *destructor* have the abdomen as indicated in Lindeman's description, and since these probable cotypes otherwise agree in every way with *destructor*, there is no reason to think that this variety is anything more than a variation of *destructor*.

It is a pleasure thus to be able to confirm the conclusions of Kurdjumov and Pospjelov that *M. intermedius* and *M. destructor* are the same.

Lindeman's variety *microptera*, however, is not *Merisus destructor*, nor does it belong in the genus *Merisus*. It will be found discussed elsewhere under the name *Eupteromalus micropterus*.

The European material examined also embraced numerous specimens reared by Marchal in France and determined by Ashmead, these constituting the material upon which the Ashmead and Marchal notes published in 1887 were based. Also several slide mounts of specimens were examined which were prepared by Fred Enock, and which undoubtedly were a part of the material reared by him from the fly in England and about which he wrote in 1888. All this material is typical *M. destructor*.

Say's types of *destructor* were doubtless destroyed many years ago together with the rest of his collections. The American material studied, however, comprises several hundred specimens which agree with Say's description and includes many which have formed the bases for references to the species in the literature. Among the most interesting of these are a male and female from the collection of Asa Fitch labeled "*Semiotellus destructor*" in Fitch's handwriting. Other specimens studied were reared by Jas. Fletcher, F. M. Webster, E. P. Felt, E. G. Kelly, C. M. Packard, and by various other entomologists who have not treated of this species in the literature.

HOSTS AND LIFE HISTORY

Merisus destructor is known principally as a parasite of *Phytophaga destructor*, but according to Marchal it attacks *Mayetiola avenae* (Marchal) in France. Collin, Meyer, and Imms have recorded it as parasitizing *Oscinella frit* (Linnaeus) in Russia, and Meyer has also credited it with attacking *Elachyptera cornuta* Fallén.

In North America Packard has stated that W. H. Larrimer placed eggs of this parasite in glass cells with larvae of *Harmolita* (=*Isosoma*) and succeeded in rearing a few of the parasites to adults. So far as is known, however, the species has not been reared from field-collected material of *Harmolita*. In the unpublished manuscript of P. R. Myers he states that *M. destructor* occasionally destroys the larvae of its own species, as well as those of other parasites of the fly. One very small male specimen was reared from a fly puparium which also contained an adult of *Platygaster*.

The species is normally a solitary, primary, external parasite. Its eggs are laid in the hessian-fly flaxseed and, according to Packard, hatch in from 1½ to 14 days, depending upon the temperature. In his laboratory experiments Packard found that larvae reared in glass cells required 7 to 11 days to complete their larval development and that after completing their larval growth the majority of these remained quiescent for months. Pupation takes place as a naked pupa within the fly puparium, and the pupal period is said to occupy from 7 to 14 days.

The seasonal history of the species has not been thoroughly worked out. According to Packard it was found in the larval stage in Kansas in March. Forbes reports that the earliest emergence observed by him was June 3. Dated specimens in the series studied by the writer, however, indicate emergences as early as April 6 and ranging from that date through all the following months to October. In all probability there are at least 2 or 3 generations per year.

DISTRIBUTION

This species is recorded in Europe from England, France, and Russia, the distribution in Russia, according to Lindeman, extending from the government of Vologda in the north to that of the Don Cossacks on the shores of the Black Sea. These records indicate the probable occurrence of the species over the entire wheat-growing region of Europe, despite the fact that it has not been recorded, so far as is known, from any of the central European countries.

In North America it is almost certainly present wherever the fly occurs. Fletcher has recorded it from Manitoba and Prince Edward Island, Canada, and the writer has seen specimens from Ontario, Canada, as well as from practically every wheat-growing State in the United States from Vermont and North Carolina to California, Oregon, and Washington.

In the United States National Museum collection is a single male specimen of this species, the label of which shows it to have been reared from wheat straw from Tunis, Africa. Nothing further is known of the history of this specimen.

IMPORTANCE

This is undoubtedly one of the most important of the hessian-fly parasites. According to Hill and Smith it ranks fourth in effectiveness among parasites of the fly in the eastern part of the United States, being outranked by two of the *Platygasters* and *Eupelmus allynii*. In California it is probably of more importance because of the absence from that section of both *Platygaster hiemalis* and *P. zosine*.

MERISUS FEBRICULOSUS Girault

(Fig. 21)

Merisus isosomatis Webster, U.S.Dept.Agr., Div. Ent., Insect Life 5: 90, 1892; Viereck, *in* Smith, Insects of New Jersey . . ., p. 642, 1910; Viereck, Conn. State Geol. and Nat. Hist. Survey Bul. 22: 478, 1916.

Stictonotus isosomatis Webster, U.S.Dept.Agr., Bur. Ent. Bul. (n.s.) 42: 22, 1903; Ent. Soc. Wash. Proc. 7: 115, 1905; U.S.Dept. Agr., Bur. Ent. Circ. 66: 4, 1908; Kelly, Jour. Econ. Ent. 3: 202–204, 1910.

Semiotellus isosomatis Dalla Torre, Catalogus hymenopterorum . . ., v. 5, p. 211, 1898; Webster and Reeves, U.S.Dept.Agr., Bur. Ent. Circ. 106: 8, 9, fig. 11, 1909.

Merisus febriculosus Girault, Descriptiones stellarum novarum, p. 17, 1917; Gahan, Ent. Soc. Wash. Proc. 22: 238, 1920; Phillips and Poos, U.S. Dept. Agr. Farmers' Bul. 1323: 8, 1923; Hill and Smith, Jour. Agr. Research 36: 153, 1928.

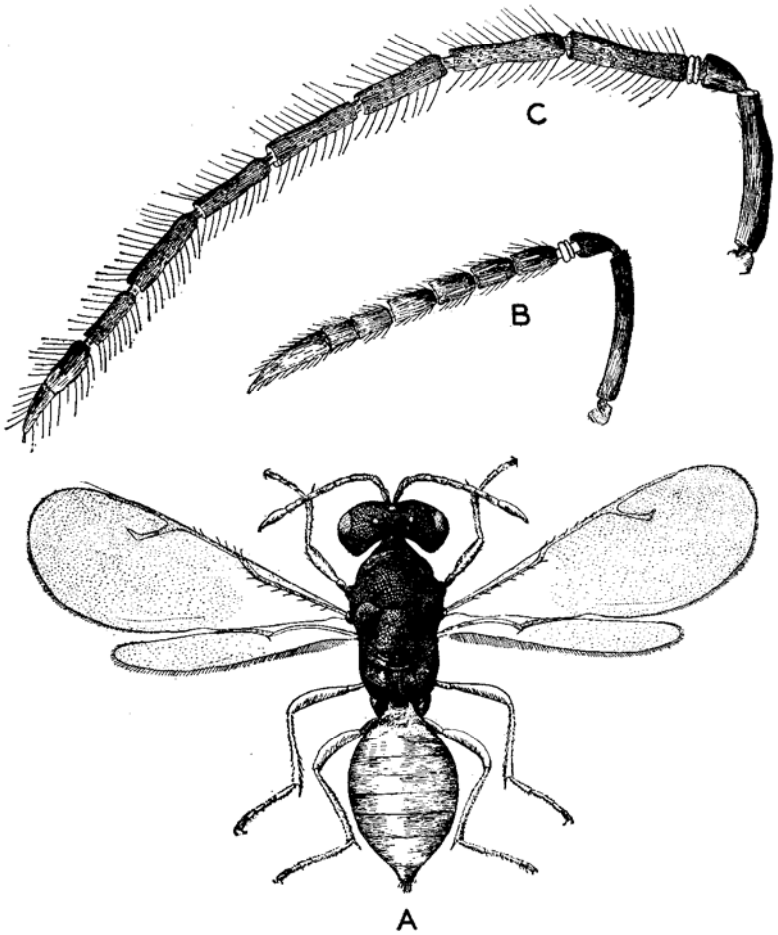


FIGURE 21.—*Merisus febriculosus* Girault: *A*, Adult female; *B*, antenna of female; *C*, antenna of male. *A*, × 21.

DESCRIPTION

The female of *Merisus febriculosus* is readily distinguished from other hessian-fly parasites, except *M. mordellistenae* Crawford, by its broadly ovate and almost wholly yellow abdomen. It is very similar to *M. mordellistenae*, which also occasionally attacks the hessian fly, but it may be distinguished from that species by its shallower and finer punctation, the much finer and less conspicuous hairs on the face and dorsum of the thorax, the longer antennal joints in both sexes, and its dark greenish color. It also resembles *Homoporus fulviventris* (Walker), but in that species, the type of which has been

examined, the propodeum is without a neck, the funicle joints are subquadrate, the sculpture is somewhat more shallow, and the abdomen has a broad black median stripe down the venter.

Female.—Length 2.0 to 2.8 mm. Head transverse, distinctly broader than the thorax, viewed from above fully three times as broad as long anteroposteriorly at the middle, weakly convex in front, and distinctly but not deeply concave behind, narrowing behind the eyes, the temples receding from the eye margin and distinctly less than half as wide as the eyes; ocelli in a very obtuse triangle, the postocellar line very slightly longer than the ocellocular line, the latter more than three times as long as the diameter of an ocellus; head viewed from in front distinctly broader than high, about in proportion of 35:27; eyes ovate, bare; malar space equal to approximately half the eye height; antennal scrobe shallow; clypeal margin nearly straight; mandibles each with four teeth; maxillary palpi 4-jointed, labial palpi 3-jointed; whole head closely and nearly evenly punctate; the clypeal region with fine converging striae. Antennae inserted at the middle of the head, 11-jointed, slender, not thickened toward apex; scape slender, slightly curved, and reaching to the vertex; pedicel about twice as long as broad, very slightly shorter than the ring joints and the first funicle joint together; two ring joints transverse, subequal; funicle 6-jointed, the first to fifth joints subequal, each about twice as long as broad, sixth joint usually a little shorter; club not thicker than funicle, very nearly as long as the three preceding funicle joints together, solid, tapering to a sharp point at apex but without an apical process. Thorax together with propodeum nearly twice as long as broad at tegulae; prothorax viewed from above declivous, in a much lower plane than the mesoscutum, somewhat narrower than mesothorax, and sculptured like the occiput; mesoscutum convex, much broader than long, the parapsidal grooves faintly indicated as shallow depressions but not impressed as grooves; scutellum convex, a little shorter than the mesoscutum; axillae broadly separated by base of scutellum; propodeum with a short but distinct neck, without a definite median carina and without spiracular sulci, the lateral folds represented by a broad, shallow, immargined depression on each side half way between the median line and the spiracle and extending from the base of propodeum half way to the apex; spiracles small, elliptical; whole surface of mesoscutum, axillae, scutellum, and propodeum closely punctate, the punctures on propodeum distinctly finer than those on mesoscutum; pleura sculptured like dorsum but with a smooth area beneath the wings. Legs slender; tarsi 5-jointed; hind tibia with one spur; hind coxae outwardly sculptured like the pleura, on inner side nearly smooth. Fore wings about twice as long as broad, extending beyond apex of abdomen, bare at base for the whole length of submarginal vein, the discal cilia rather weak, marginal cilia short; marginal, postmarginal, and stigmal veins in approximately the proportions of 19:15:8. Abdomen broadly ovate, about as long as head and thorax, broader than thorax and entirely smooth; first tergite comprising about one fourth the total length of abdomen, other tergites subequal; ovipositor barely showing at apex.

Color of head and thorax dark metallic green; abdomen pale yellow with the first tergite basally bordered with brown or black; mandibles testaceous, brown at apex; palpi pale; antennal scape pale yellow at base, dark brown to blackish on apical two thirds; pedicel dark brown; funicle brownish at base, usually becoming paler toward apex, the last funicle joint and the club usually pale testaceous; legs, except coxae, pale testaceous, the coxae concolorous with the thorax; wings hyaline, the venation pale yellowish.

Male.—Length 1.2 to 2.3 mm. Antennae long and slender, 13-jointed, the flagellum hairy; scape subcylindrical, thickest slightly beyond the middle; pedicel as broad as long; ring joints minute; first funicle joint very nearly four times as long as broad, fully two thirds as long as scape; following joints successively decreasing slightly in length and also very slightly in thickness, the sixth funicle joint about three fourths the length of first; club narrower than the funicle, distinctly 3-jointed, tapering to a point at apex, the joints subequal in length or the first somewhat the longest, the three club joints together about equal in length to the two preceding funicle joints together. Abdomen elliptical, with a very short petiole, not longer or broader than thorax. Antennae entirely dark brownish except base of scape, which is testaceous; abdomen brownish testaceous. Otherwise like the female.

REVIEW OF LITERATURE

For over a quarter of a century this species was confused in the literature with (*Stictonotus*) *Eridontomerus isosomatis* (Riley). During that time it was variously referred to as *Stictonotus isosomatis*, *Semiotellus isosomatis*, and *Merisus isosomatis*. In 1920 the present writer pointed out that the supposed type of *Stictonotus isosomatis* Riley in the National Museum, which had formed the basis for the current conception of that species, was a misidentification and that the real types of Riley's *isosomatis* represented a species belonging to the monodontomerine genus *Eridontomerus* Crawford. At the same time the *isosomatis* of authors (not Riley) was declared to be identical with *Merisus febriculosus* Girault, the description of which appeared in 1917.

Apparently the first reference in the literature to this species was that by Webster in 1893, when he recorded the rearing of what he called *Merisus isosomatis* from wheat stems infested with an unidentified species of jointworm. Webster referred to it again as an enemy of jointworms in 1903, 1905, and 1908. In 1909 Webster and Reeves published a figure of the adult female and characterized the species as a very efficient parasite of the wheat jointworm. It was first recorded as a parasite of the hessian fly in 1910 by Kelly, who gave a brief outline of its life history. It was listed as a parasite of *Harmolita tritici* in the 1910 edition of Smith's Insects of New Jersey, and again by Viereck in 1916 in his Hymenoptera of Connecticut. Girault described the species as new under the name of *Merisus febriculosus* in 1917, using as types specimens from Wooster, Ohio, which were probably reared from jointworm material by Webster and, as already stated, this name was applied to the *Merisus isosomatis* of authors (not Riley) by the present writer in 1920. Phillips and Poos mentioned it in 1923 as a parasite of *Harmolita grandis* (Riley), and in 1928 Hill and Smith included it in their discussion of the status of hessian-fly parasites in the Middle Atlantic States.

HOSTS AND LIFE HISTORY

Merisus febriculosus has been recorded as a parasite of *Harmolita grandis* (Riley), *H. tritici* (Fitch), *H. hordei* (Harris), and *Phytophaga destructor* (Say). Kelly has also stated that it sometimes develops as a secondary parasite through *Eupelmus allynii* French and that it is in turn sometimes attacked and destroyed by that species. Myers' unpublished manuscript avers that on one occasion a male specimen was reared from *Platygaster zosine* and that at other times the species was observed to attack the larvae of certain unidentified chalcidoid parasites.

The life history is not perfectly known, but the species is normally a primary parasite. According to Kelly the egg is deposited in the cell of the *Harmolita* or in the puparium of the hessian fly, not always in contact with the host larva, and hatching takes place in 3 to 6 days. The larva feeds externally upon the host larva and matures in from 6 to 15 days. Pupation takes place within the host cell or puparium, as the case may be, and the pupal period requires from 7 to 12 days in the summer time. The winter is passed as a pupa. Only one individual emerges from a single host. Kelly claims to have observed at least two generations per year.

DISTRIBUTION

Specimens of this species have been taken in the following named States of the United States, according to the records available in the Bureau of Entomology and the National Museum: Vermont, New York, Pennsylvania, Delaware, Maryland, Virginia, Tennessee, West Virginia, Ohio, Michigan, Illinois, Indiana, Minnesota, Missouri, Kansas, Iowa, and North Dakota. Very likely it will be found generally distributed over the entire region east of the Rocky Mountains wherever its hosts are to be found. It apparently does not occur in the Pacific Coast States.

This species has not been recorded from Europe unless under some other name. In the British Museum the writer has seen two female specimens collected on the Isle of Wight which seemed to agree in every way with American representatives of *febriculosus*. These two specimens constituted a part of the material identified as *Homoporus fulviventris* (Walker), a species to which *febriculosus* bears a striking resemblance, but they may be distinguished from the type of that species by the characters cited in the foregoing description as distinguishing *fulviventris* from *febriculosus*. If these two specimens are in reality *febriculosus*, then it is possible that some of the records of *Homoporus fulviventris* in Europe may refer to the present species.

IMPORTANCE

Merisus febriculosus is apparently of very little real importance as a parasite of the hessian fly. Hill and Smith state that it is present every year as a parasite of the fly in the eastern part of the United States and that it ranks sixth in abundance in that region. Data are not available for other parts of the country, but it is probable that the species is no more efficient as a fly parasite in other regions than in the territory surveyed by Hill and Smith. The preferred hosts are, without much doubt, the various species of *Harmolita*, and the species is probably a more or less important factor in the natural control of some of these.

MERISUS MORDELLISTENAE Crawford

(Fig. 22)

Merisus mordellistenae Crawford, Ent. Soc. Wash. Proc. 12: 145, 1910.

DESCRIPTION

Merisus mordellistenae resembles *M. febriculosus* but may be distinguished at once by the deep black color of head and thorax, the deeper punctation of the mesoscutum and scutellum, the presence on head and dorsum of thorax of sparse but conspicuous pale hairs, the fact that one mandible is tridentate and the other quadridentate, the somewhat narrower abdomen in the female, and the much shorter funicle joints in the male. It is more closely related to the new species (*cognatus*) described in this publication, but it is much more deeply sculptured, the postmarginal vein is not longer than the marginal, the antennae are less slender, the second funicle joint is subquadrate, and the club is not three times as long as broad.

Female.—Length 1.9 to 2.5 mm. Head distinctly broader than thorax, fully three times as broad as thick antero-posteriorly, very slightly convex in

front, and weakly concave behind; temples receding from the eye margins, narrow and poorly defined; ocelli in a low triangle; postocellar line longer than ocellocular, the latter equal to about twice the greatest diameter of an ocellus; head viewed from in front broader than high (29:24), narrowing slightly toward the mouth; malar space nearly equal to the eye height; antennal scrobe very shallow; eyes short, oval, bare; clypeal area and lower part of face with fine converging striae, anterior margin of clypeus straight; vertex

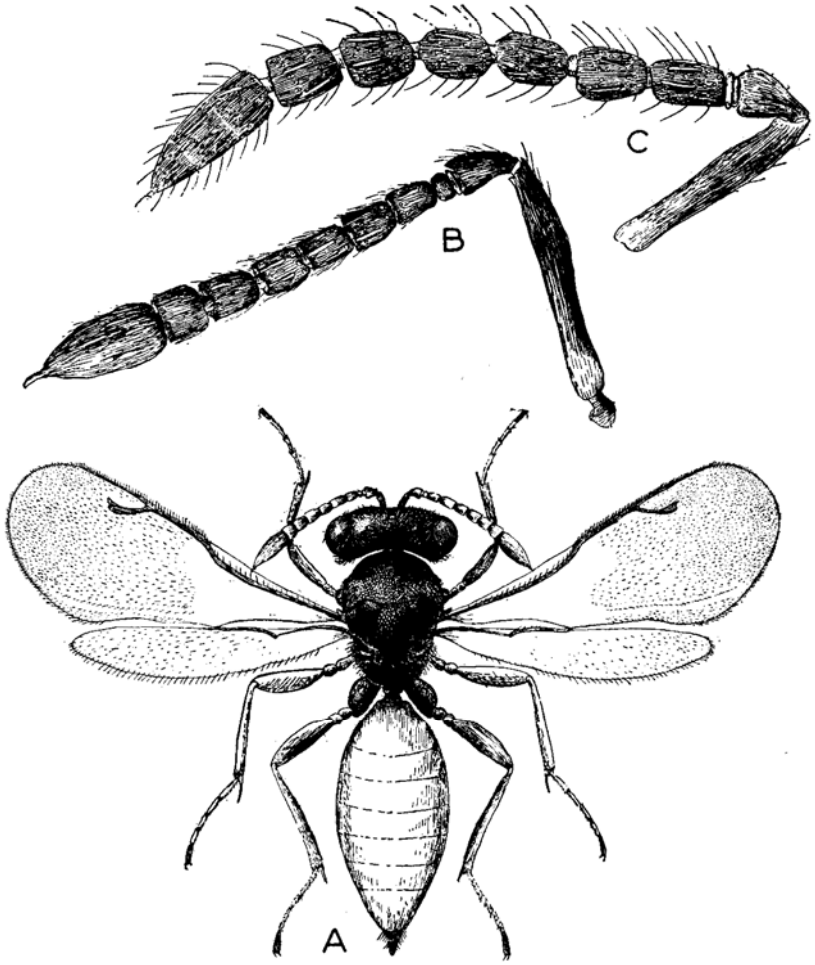


FIGURE 22.—*Merisus mordellistenae* Crawford: *A*, Adult female; *B*, antenna of female; *C*, antenna of male. *A*, × 26.

very weakly sculptured, nearly smooth; rest of head distinctly, strongly reticulate-punctate, the whole head sparsely clothed with conspicuous white hairs; left mandible distinctly tridentate, right mandible distinctly quadridentate; maxillary palpi 4-jointed. Antennae inserted on a line with the lower extremities of the eyes, 11-jointed, not especially slender, weakly clavate; scape cylindrical, reaching to the front ocellus; pedicel one and one half times as long as broad at apex; first ring joint minute, second about twice as broad as long and narrower than the first funicle joint; funicle 6-jointed, the first joint a little longer than broad, about equal to pedicel plus ring joints; second to fifth funicle joints also usually a little longer than broad, the sixth subquadrate

or very slightly broader than long; club solid, distinctly broader than the last funicle joint, as long as the three preceding joints combined, ovate, and terminating in a slender process which is approximately one fifth as long as the rest of the club. Thorax one and one half times as long as broad, nearly elliptical in dorsal outline; pronotum short, a little narrower than mesoscutum, mostly declivous or nearly perpendicular, the dorsal aspect consisting of a very narrow transverse and smooth line which is bounded anteriorly by a delicate carina; mesoscutum nearly twice as broad as long, strongly punctate, the punctures deeper than in most of the other species; parapsidal grooves weakly impressed anteriorly, entirely effaced on the dorsum; scutellum a little shorter than the mesoscutum and with similar sculpture, about as broad as long; axillae broadly separated, very weakly sculptured and more or less shining; propodeum approximately two thirds as long as scutellum, with a very short rounded neck at apical middle, without carinae, the lateral folds absent except for a small rounded fovea on each side at basal margin, spiracular sulci weakly impressed posteriorly, spiracles oval, the whole surface of propodeum weakly reticulated and somewhat shining; pleura mostly shining but with a depressed area in middle of each mesopleuron punctate and dull; pronotum posteriorly, mesoscutum and scutellum sparsely clothed with conspicuous silvery hairs, the propodeum laterally with longer and more numerous hairs. Legs slender, the hind coxae weakly reticulated. Fore wings extending to apex of abdomen, twice as long as broad, bare behind the submarginal vein, the discal cilia weak and marginal cilia short; submarginal veins about twice as long as marginal, postmarginal and marginal veins about equal, stigmal vein about half as long as marginal. Abdomen smooth, about as long as head and thorax and about as broad as thorax, long ovate, pointed at apex; first tergite comprising about one fourth of the total length of abdomen; ovipositor, except its extreme apex, concealed from above.

Head and thorax deep black, abdomen yellowish testaceous above and beneath, with the lateral margins from base to apex of fourth or fifth tergites narrowly blackish; antennal scape blackish or dark brown, often paler at base; pedicel also blackish or brownish; flagellum usually entirely dark testaceous or honey yellow; mandibles reddish; coxae black, the posterior pair often more or less yellowish on the inner side; rest of the legs honey yellow, the femora usually darker than their tibiae; wings hyaline, the venation testaceous; ovipositor sheath black.

Male.—Length 1.2 to 2.4 mm. Antenna not or very slightly clavate, 13-jointed, the flagellar joints covered with hairs that are nearly equal in length to the segments; pedicel as long as broad; ring joints small; first funicle joint a little longer than the pedicel and also a little longer than any of the other funicle joints; second and following funicle joints subequal in length, each set off from the preceding joint by a short but distinct pedicel, and each usually a little longer than broad but in some specimens subquadrate. Abdomen elliptical with a very short petiole, narrower than the thorax, and usually a little longer than the thorax. Whole antennae black or very dark brown; legs also blackish or fuscous with the knees, apices of tibiae, and the tarsi usually testaceous; abdomen variable in color but usually dark brown or blackish at base and apex as well as laterally, with a large yellowish spot medially above and below. Otherwise like the female.

The female holotype of *mordellistenae* agrees with the foregoing description, but the male associated with this holotype female by Crawford does not agree with the males here described and is believed to be a different species. This male differs from the female in some ways that cannot be reconciled as sexual differences. The dorsal aspect of the pronotum is as wide as the mesonotum and in nearly the same horizontal plane as the mesoscutum. It is also distinctly punctate and lacks the delicate carina at the edge of the declivity. The marginal vein of the fore wing is distinctly a little longer than the postmarginal vein. The vertex of the head is strongly punctate instead of nearly smooth, and the propodeum and pleura are much more strongly sculptured than in the female. The scape extends well above the front ocellus. The female is deep black, while this male

has a purplish cast. The holotype and the alleged allotype were taken in different localities; and while both are said by Crawford to have been reared from *Mordellistena ustulata* Leconte, the laboratory notes of W. J. Phillips, the collector, indicate that the female was taken as a pupa from the burrow of *Mordellistena ustulata*, at La Fayette, Ind., while the male emerged in a cage containing timothy straws infested by *Mordellistena* which had been collected at Wilmington, Ohio.

On the other hand, the males herein ascribed to *mordellistenae* agree with the female type of that species in all the characters mentioned by which the alleged allotype disagrees with the type, and in one instance at least, a male was reared in association with females which cannot be separated from the typical female.

The writer is forced to the conclusion that the allotype male is wrongly associated with the female holotype.

The accompanying description is based upon the holotype female and 7 other females and 9 males in the National Museum collection.

REVIEW OF LITERATURE

The original description is believed to be the only reference to this species in the literature.

HOSTS AND LIFE HISTORY

As already stated, the type was collected as a pupa in the burrow of *Mordellistena ustulata* and was probably parasitic upon that insect. Three females in the National Museum collection were reared from puparia of *Phytophaga destructor* by P. R. Myers, and one male from the same host by E. G. Kelly. Three other specimens in the same collection are said to have been reared by H. T. Osborn from wheat straw infested with *Harmolita* species.

DISTRIBUTION

Specimens before the writer show the following distribution for this species: Berryville, Strasburg, and Woodstock, Va.; Mount Holly Springs, Pa.; Washington, D.C.; La Fayette, Ind.; Wakeeney and Wellington, Kans.; and Plano, Tex.

IMPORTANCE

The species is evidently of little or no importance as a parasite of the hessian fly, since only four specimens have thus far been reared from that host.

MERISUS COGNATUS, new species

(Fig. 23)

Merisus cognatus, n.sp., superficially resembles *M. febriculosus*, but it may be distinguished by the deep black color of head and thorax, the longer malar space, the weaker sculpture of head and thorax, the shorter and more weakly sculptured propodeum, the fact that both mandibles are not quadridentate, and the fact that the postmarginal vein is longer than the marginal. It is more closely related to *M. mordellistenae* but is easily distinguished by the much shallower sculpture of head and thorax, the different proportions of the veins of the fore wing, and slight differences in the antennae.

Female.—Length 2 mm. Head a little broader than thorax, viewed from above nearly three times as broad as thick antero-posteriorly, very slightly convex in front and very slightly concave behind, the temples receding from the eye margins and poorly defined; ocelli in a low triangle, the postocellar line much longer than the ocellocular, the latter equal to about twice the diameter of an ocellus; head, viewed from in front, a little broader than high, subtriangular in outline; malar space appearing nearly equal to height of eye; antennal scrobe very shallow, almost absent; eyes short oval, with a few very short and inconspicuous cilia; clypeal area very weakly convergently striated, rest of head with shallow reticulate sculpture which is strongest on the frons and behind the vertex, the vertex very nearly smooth; head posteriorly and anteriorly sparsely clothed with fine pale hairs; right mandible 4-toothed, left mandible 3-toothed; labial palpi 3-jointed, maxillary palpi 4-jointed. Antennae slender, slightly thickened apically, 13-jointed, the scape cylindrical, very

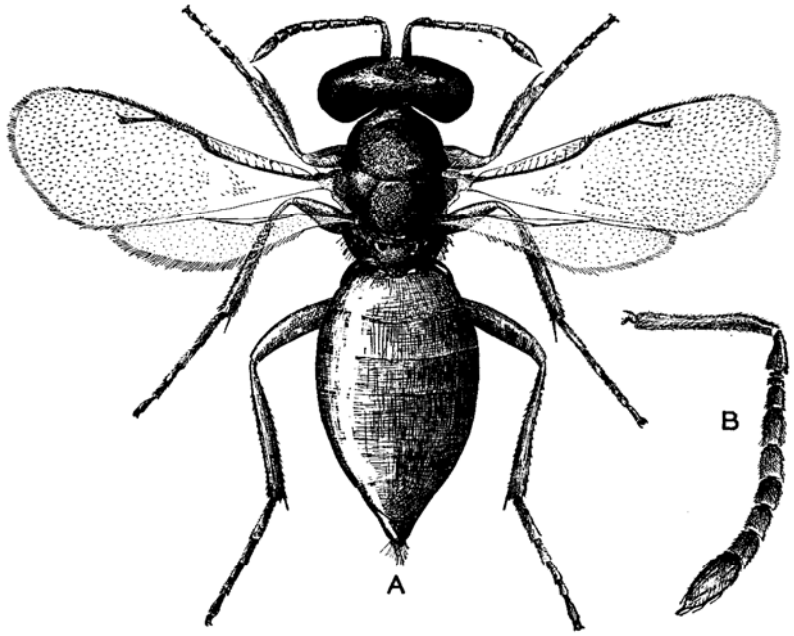


FIGURE 23.—*Merisus cognatus* Gahan: *A*, Adult female; *B*, antenna of female. *A*, × 33.

nearly as long as the six following joints combined; pedicel fully twice as long as broad; first ring joint transverse, minute, the second ring joint also transverse, about half as long as broad and at least twice as long as the first; first funicle joint slender, cylindrical, one and one half times as long as broad, not or very little thicker than the ring joints; second funicle joint about equal in length to two ring joints and the first funicle joint combined, a little thicker at apex than at base and distinctly a little longer than the third joint; third funicle joint approximately one fourth longer than broad, the following joints very slightly shorter than or subequal to the third; club solid, very little thicker than the funicle, nearly as long as the three preceding funicle joints, three times as long as broad, elongate ovate, and terminating in a distinct straight process. Thorax subovate, one and one half times as long as broad, shining, with distinct but very shallow reticulate sculpture which is a little stronger on scutellum than elsewhere; pronotum short, rounded in front, a little narrower than the mesoscutum, almost wholly declivous and nearly smooth; mesoscutum nearly twice as broad as long, the parapsidal grooves weakly impressed anteriorly, entirely effaced posteriorly; scutellum subconvex, a little shorter than mesoscutum and about as broad as long; axillae broadly separated and sculptured like mesoscutum; propodeum about half as long as

scutellum, medially sculptured about like scutellum, laterally more weakly sculptured, without a neck and without carinae or spiracular sulci, the lateral folds also absent except for very small and shallow foveae at basal margin; spiracles small, elliptical; pleura mostly smooth except for a depressed and punctate area below the anterior wing; dorsum of thorax sparsely clothed with fine but rather conspicuous pale hairs, the propodeum bare except laterally. Legs slender, the hind coxae very weakly sculptured; tarsi 5-jointed; inner spur of hind tibia very short and inconspicuous. Fore wings approximately twice as long as broad, not attaining the apex of abdomen in the type; mostly bare to apex of submarginal vein except for a few cilia marking the position of obsolete basal vein; marginal cilia short; postmarginal vein distinctly longer than marginal, stigmal vein fully two thirds the length of marginal. Abdomen longer and broader than thorax, broadly ovate, the first tergite comprising not over one fourth total length of abdomen, the whole tergum practically smooth or with only very faint traces of sculpture, the apical tergites sparsely hairy; ovipositor barely visible at apex.

Color of head and thorax deep black, somewhat shining; abdomen dark reddish testaceous with the lateral margins somewhat darker; ovipositor sheaths black; antennae dark brown to brownish testaceous with the scape and pedicel darker than the flagellum; legs reddish testaceous with the coxae all black and the front femora blackish; wings hyaline, the venation brownish testaceous; mandibles reddish; palpi dark.

Type locality.—Concord, Calif.

Type.—Catalog no. 44840, U.S. National Museum.

Described from two females from the type locality; the holotype reared from wheat containing *Phytophaga destructor*, August 4, 1919, by M. C. Lane, and recorded in the Bureau of Entomology under Webster no. 13346, Berkeley no. 191137; the paratype reared from *Phytophaga destructor*, July 9, 1919, by the same collector and recorded under the same Webster number but Berkeley no. 191054. The abdomen of the paratype is missing. One antenna, the mandibles, the palpi, one fore wing, and a hind wing from the paratype are mounted on a slide in balsam. The type and remainder of paratype are mounted on card points.

The only representatives of this species thus far known are the two type specimens, and its known distribution is therefore confined to the type locality. Likewise all that is known of its life history is the fact that it attacks the hessian fly occasionally, at least, and that it emerges from the puparium of this host in midsummer. In all probability the species is normally parasitic upon some other host, possibly some grass-infesting *Harmolita*. Apparently it is of little or no real importance as a parasite of the hessian fly.

MERISOPORUS CHALCIDIPHAGUS (Walsh and Riley)

(Fig. 24)

Semiotellus chalcidiphagus Walsh and Riley, Amer. Ent. 1: 152, 1869; Provancher, Additions et corrections au volume II de la faune entomologique du Canada, traitant les hyménoptères, p. 202, 1889; Webster, U.S.Dept.Agr., Div. Ent., Insect Life 5: 90, 1892; 6: 151, 1893; Dalla Torre, Catalogus hymenopterorum . . . , v. 5, p. 210, 1898; Webster, U.S.Dept.Agr., Bur. Ent. Bul. (n.s.) 67: 97, 1907.

Semiotellus chalcidephagus Walsh, Amer. Ent. and Bot. 2: 368, 1870: Cresson, Synopsis of the families and genera of the Hymenoptera of America, north of Mexico . . . , p. 241, 1887; Smith, Insects of New Jersey . . . , p. 40, 1890; Webster, Ent. Soc. Wash. Proc. 7: 115, 1905.

Homoporus chalcidiphagus Ashmead, *in* Smith, Insects of New Jersey . . ., p. 558, 1900; Webster, U.S.Dept.Agr., Bur. Ent. Bul. (n.s.) 42: 22, 33, 1903; Viereck, *in* Smith, Insects of New Jersey . . . , p. 642, 1910; Phillips, Jour. Econ. Ent. 10: 145, 1917; U.S. Dept. Agr. Farmers' Bul. 1006: 13, 1918; Lochhead, Class book of economic entomology . . . , p. 354, 1919.

Homoporus chalcidiphagus Webster, U.S.Dept.Agr., Bur. Ent. Circ. (rev.) 66: 4, 1908; Webster and Reeves, U.S.Dept.Agr., Bur. Ent. Circ. 106: 8, 9, 1909; Treherne, Ontario Ent. Soc. Rpt. 46: 186, 1915; Phillips and Poos, Jour. Agr. Research 21: 405, 415–420, 1921; Pettit and McDaniel, Mich. State Bd. Agr. Ann. Rpt. Sec. (1918/19) 58:272, 1920; Phillips and Poos, U.S. Dept. Agr. Farmers' Bul. 1323: 8, 1923; Jour. Agr. Research 34: 475, 1927; Phillips, Jour. Agr. Research 34: 751, 1927.

Merisus (*Phaenacra*) *chalcidiphagus* Viereck, Conn. State Geol. and Nat. Hist. Survey Bul. 22: 479, 1916.

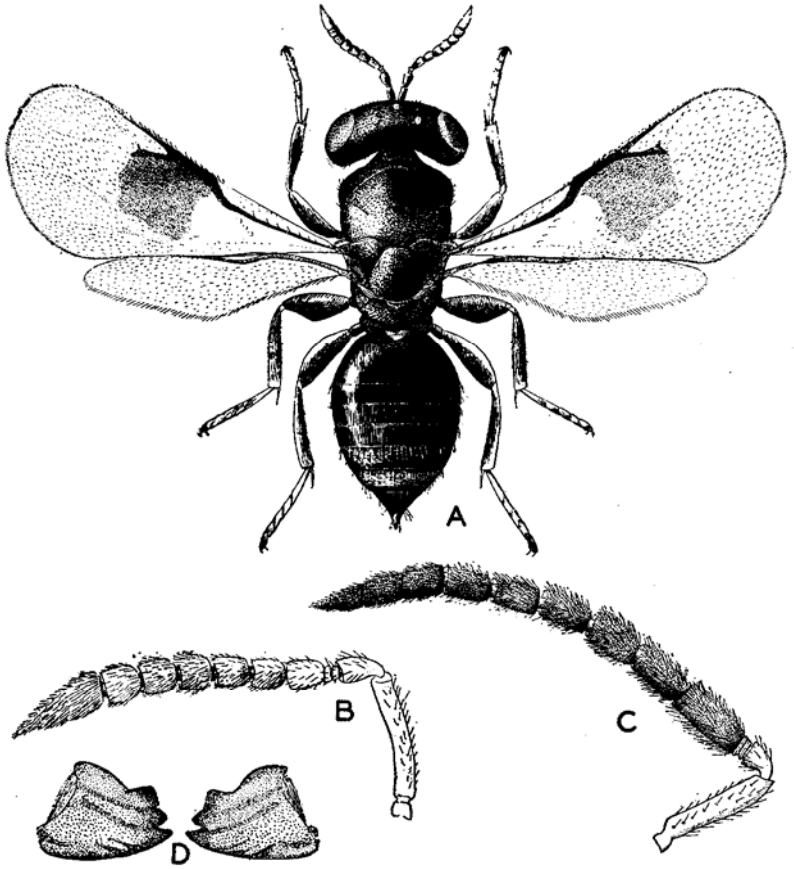


FIGURE 24.—*Merisoporus chalcidiphagus* (Walsh and Riley): *A*, Adult female; *B*, antenna of female; *C*, antenna of male; *D*, mandibles of female. *A*, × 23.

Merisus (*Homoporus*) *crassinervis* Thomson, Skandinaviens Hymenoptera, v. 5, p. 68, 1878.

Homoporus crassinervis Rimsky-Korsakov, Trudi Bur. Ent. [Russia] 10 (11): 67, 1914; Ferriere and Faure, Ann. Épiphyties 11: 228, 1925; Meyer, Rpt. Appl. Ent. Leningrad 4: 239, 1929.

Merisoporus crassinervis Masi, Ann. Mus. Civ. Stor. Nat. Genova **(3) 10:230**, 1924.

DESCRIPTION

The distinct fuscous cloud in the fore wing, pointed antennal club, absence of lateral folds on the propodeum, and the blue-black color of head and thorax distinguish *Merisoporus chalcidiphagus* from

other parasites of the hessian fly. In the antennae, propodeum, and general appearance it resembles *Merisus destructor*, but it may be distinguished at once by the spot on the wing.

Female.—Length 2 to 3 mm. Head transverse, distinctly a little broader than the thorax, viewed from above nearly four times as broad as thick at the middle, convex in front, broadly but not deeply concave behind, the temples narrow, not over one fourth as broad as the width of eyes; ocelli in an obtuse triangle, the postocellar line distinctly longer than the ocellocular, the latter equal to about twice the diameter of an ocellus; head viewed from in front broader than high, about in the proportion of 38 to 30; malar space equal to about one third the eye height; mandibles both 3-toothed; clypeal margin straight or nearly so; eyes ovate and bare; antennal groove very shallow and small; whole head with strong reticulate-punctate sculpture, the clypeal area convergently striated; labial palpi 3-jointed, maxillary palpi 4-jointed. Antennae inserted very slightly below the middle of face, very weakly clavate, and clothed with short hairs; scape cylindrical, slightly curved, and approximately equal in length to the five following joints; pedicel 1½ to 2 times as long as broad, two ring joints transverse but very distinct; funicle 6-jointed, the first funicle joint a little longer than broad, the following joints subquadrate; club a little shorter than the three preceding joints together, acuminate at apex, and nearly solid but with the two transverse grooves usually indicated. Thorax a little more than one and one half times as long as broad, about as broad posteriorly as anteriorly; pronotum as broad as mesonotum, strongly reticulate-punctate; mesoscutum moderately strongly convex, sculptured like pronotum, much broader than long, the parapsidal grooves weakly impressed anteriorly but absent posteriorly; scutellum convex, strongly sculptured like mesoscutum, shorter than mesoscutum, the punctation at apex finer than on the disk; axillae separated by base of scutellum, sculptured like scutellum; propodeum broad, without a neck and without carinae, the lateral folds and spiracular grooves also absent, the lateral folds usually represented by a fovea on each side of the middle, whole surface of propodeum evenly reticulate-punctate; spiracles small, elliptical. Legs rather stout; hind tibia with one spur; hind tarsi a little shorter than their tibiae, the hind basitarsus not long. Wings fully developed, extending a little beyond apex of abdomen, bare at base for the whole length of the submarginal vein, the marginal cilia short; marginal vein thickened, 4 to 5 times as long as broad, thickest at base; stigmal vein usually about three fourths as long as the marginal vein, but frequently very nearly equal to it, the stigmal knob moderately large, rounded at apex, with a distinct stylet; postmarginal vein thin and about one and one half times the length of marginal vein. Abdomen approximately the same length as thorax and as broad as thorax or a little broader, ovate, acute or subacute at apex, rather thick dorsoventrally, nearly smooth or with very obscure reticulation, the first tergite comprising about one third its total length; ovipositor not exserted.

Color of head and thorax bluish black, the face often with a slight greenish cast and the sides of thorax sometimes purplish; antennae frequently entirely reddish testaceous but usually with the funicle joints more or less brownish and the rest of the antennae testaceous; coxae concolorous with the thorax; all femora dark brownish or blackish; all tibiae and tarsi testaceous, the tibiae usually somewhat fuscous basally and the tarsal claws dark; abdomen brownish black, the basal tergite usually with a metallic reflection; fore wing with a large, rounded, fuscous cloud behind the marginal vein extending from the base of marginal to apex of stigmal vein and embracing about three fourths of the width of wing; rest of fore wing and the hind wing hyaline.

Male.—Length 1.6 to 2.3 mm. Antennae longer than in female and more hairy, not clavate, 13-jointed, the pedicel as broad as long, ring joints transverse but distinct; first funicle joint nearly three times as long as broad, second about twice as long as broad, the sixth about one and one half times as long as broad; club a little longer than the two preceding joints, tapering to a point at apex, 3-jointed, the transverse grooves distinct and deep. Wings hyaline without a cloud. Abdomen with a distinct short petiole, the body of abdomen shorter and usually narrower than the thorax, the apical segments often strongly retracted in dead specimens. Other characters as in the female, except that the legs are somewhat darker.

REVIEW OF LITERATURE

Semiotellus chalcidiphagus was first described and figured by Walsh and Riley in 1869 from specimens reared from galls of the barley jointworm, *Harmolita hordei* (Harris), collected in Canada. The following year Walsh gave a more complete technical description of the species accompanied by the same figures and stated that the material originated at Grimsby, Ontario. Cresson in 1887, Provancher in 1889, and Ashmead in 1890 listed the species, and Webster in 1892 and again in 1893 mentioned it as an important parasite of the jointworm. In Smith's Catalog of the Insects of New Jersey, published in 1900, Ashmead transferred the species to the genus *Homoporus*, and subsequent writers have used that combination, with the exception of Viereck, who listed it as *Merisus* (*Phaenacra*) *chalcidiphagus* in the catalog of the Hymenoptera of Connecticut. Webster, as well as Phillips and Poos, published additional articles in which they mentioned this species as parasitic upon one or another of the jointworm flies. The most important of these papers is that by Phillips and Poos in 1921, which gives in detail descriptions of the egg and larva, a list of the hosts attacked, and an account of the life history.

Meanwhile in 1878 in Europe Thomson had described *Homoporus crassinervis* from specimens collected in Sweden. In 1914 Rimsky-Korsakov, writing on the jointworm flies of cereals and their parasites in Russia, recorded *H. crassinervis* as a parasite of (*Isosoma*) *Harmolita rossicum* (Rimsky-Korsakov). In 1924 Masi erected the new genus *Merisoporus* for the reception of *Homoporus luniger* Thomson and *H. crassinervis* Thomson, separating the new genus from *Homoporus* by the fact that in the former both mandibles are 3-toothed whereas in the latter both are 4-toothed. The following year Ferriere and Faure included the species in a key to the species of the genus *Homoporus*, and in 1929 Meyer again listed it as a parasite of *Harmolita rossicum* in Russia.

On the occasion of a visit to European museums in 1927 the writer found at the British Museum that the late James Waterston had obtained, through the good offices of B. Uvarov, the loan of the material upon which the paper by Rimsky-Korsakov dealing with the joint-worms of cereals and their parasites in Russia had been based, and that among the parasites were specimens labeled "*Homoporus* sp." Specimens of *Homoporus chalcidiphagus* reared from jointworms in North America were compared with these Russian specimens, and in the opinion of both Waterston and the writer they proved to be the same species. Later the writer was privileged to study, in the Natural History Museum at Vienna, the collections of Mayr and Ruschka. Under the name *H. crassinervis* specimens identified by Mayr were found, the labeling of which showed that they had been reared from jointworm material by Rimsky-Korsakov. These specimens also agreed in every way with the American species. The United States National Museum possesses one female specimen determined by Schmiedeknecht as *crassinervis*, which differs in no way from the above-mentioned material. The type of *H. crassinervis*, which is probably at Lund, Sweden, was not seen, but the material studied, both American and European, agrees with Thomson's de-

scription and is believed to be correctly determined. In the opinion of the writer, therefore, *crassinervis* Thomson is a synonym of *chalcidiphagus* Walsh and Riley.[15]

Both mandibles of *chalcidiphagus* (=*crassinervis*) are 3-toothed, as Masi has correctly pointed out. Since this character does not conform to the genus *Homoporus*, it seems necessary to accept Masi's proposal of the genus *Merisoporus* and to call the species *Merisoporus chalcidiphagus*.

HOSTS AND LIFE HISTORY

Merisoporus chalcidiphagus is normally a primary parasite of the jointworm flies. Phillips and Poos have recorded as hosts for it *Harmolita tritici* (Fitch), *vaginicola* (Doane), *secalis* (Fitch), *hordei* (Harris), *elymicola* Phillips and Poos, and *atlantica* Phillips and Poos, and in Europe it is recorded from *H. rossicum* (Rimsky-Korsakov). Phillips states that in a single instance he was able to get it to reproduce successfully on *Ditropinotus aureoviridis* Crawford, a primary parasite of jointworms.

Myers' unpublished manuscript records that on July 12, 1919, a single female of this species was reared from a puparium of *Phytophaga destructor* which he had collected at Mount Holly Springs, Pa., on July 4, 1932. The fly puparium had been isolated in a small capsule immediately after collection, and there appears to be no doubt as to the authenticity of the record.

This species is a primary, solitary parasite feeding externally upon the jointworms within their galls and develops in the same manner upon the hessian-fly larva within its puparium. Phillips and Poos state that adults appear in the latitude of Virginia in the latter part of May and continue breeding until October. Five complete generations per year may occur. The egg is laid externally upon the host larva within the wheat stem, and the winter is passed as a full-grown larva in the jointworm cell or in the puparium of the hessian fly.

DISTRIBUTION

Merisoporus chalcidiphagus is a widely distributed species both in Europe and in North America. European records indicate its occurrence in Sweden, Italy, and Russia. One specimen in the National Museum collection is from Lille, France, the collector and host not indicated; another specimen determined by Schmiedeknecht is without locality label but probably was taken in Germany.

In American literature it has been recorded from the States of Ohio, Illinois, Indiana, Michigan, Kentucky, Tennessee, Missouri,

[15] There is some doubt in the mind of the writer as to whether or not *chalcidiphagus* is really a different species from *luniger* Nees. Rimsky-Korsakov has recorded both *luniger* and *crassinervis* as parasitic upon *Harmolita rossicum*, these identifications apparently having been made for him by Mayr. In the Mayr collection at Vienna are specimens under both names which upon a hurried examination seemed to the writer to be the same. The description of *luniger* as given by Thomson, however, will not apply exactly, with respect to the marginal vein, to any of the material now at hand. In all the specimens, both American and European, now available for study, the marginal vein is thickened, and in none of them is it over one and one fourth times as long as the stigmal vein. According to Thomson the marginal vein of *luniger* is not thickened and is one and one half times the length of the stigmal vein. According to Masi, on the other hand, the proportion of marginal vein to stigmal is as 100 : 78 in *luniger* and exactly the same in *crassicornis*. There is some variation in the thickness of the marginal vein shown by the specimens at hand, as there is also in the proportional length of marginal and stigmal veins, but the range of this variation does not appear to be sufficient to include *luniger* as defined by Thomson. If Thomson's description is accurate, then *luniger* is apparently distinct from *crassinervis*.

and Virginia, and from Ontario, Canada. Additional records taken from specimens in the National Museum collection and from the note files of the Bureau of Entomology show that it occurs in Maryland, Pennsylvania, District of Columbia, North Carolina, South Carolina, Kansas, Nebraska, Wisconsin, Minnesota, North Dakota, Montana, and Oregon. It probably occurs wherever the various species of *Harmolita*, its preferred hosts, are to be found.

IMPORTANCE

While this species is one of the more important parasites of the jointworm flies, it is apparently of no importance as a parasite of the hessian fly. The single instance thus far observed of its development upon this host was very likely purely incidental.

CALLITULA BICOLOR Spinola

(Fig. 25)

Callitula bicolor Spinola, Ann. Mus. Hist. Nat. Paris 17: 151, 1811; Gahan and Fagan, U.S. Natl. Mus. Bul. 124: 26, 1923; Hill and Smith, Jour. Agr. Research 36: 153, 1928; Imms, Parasitology 22: 33, 1930: 24; 442, 1932.

Micromelus rufomaculatus Walker, Ent. Mag. 1: 465, 1833; Blanchard, Histoire naturelle des insectes . . ., v. 3, p. 267, 1840; Westwood, An introduction to the modern classification of insects . . ., v. 2, synopsis, p. 69, 1840; Reinhard, Berlin. Ent. Ztschr. 2: 18, 1858; Schmiedeknecht, Hymenoptera, Fam. Chalcididae, *in* Wytsman, Genera insectorum, fasc. 97, p. 363, 1909; Kurdjumov, Messager Ent. [Kiev] 2: 2, 1913; Znamenski, Poltava Agr. Expt. Sta., Ent. Dept. Bul. 2, 1923 (abstract in Rev. Appl. Ent. (A) 12: 291, 1924. Meyer, Rpt. Appl. Ent. Leningrad 4: 241, 1929; Tzuigankov, Trans. Poltava Agr. Expt. Sta., no. 90, Ent. Div. no. xvi, 1930 (abstract in Rev. Appl. Ent. (A) 19: 385, 1931).

Pteromalus plagiatus Nees von Esenbeck, Hymenopterorum ichneumonibus affinium monographie . . ., v. 2, p. 115, 1834.

Boeotomus plagiatus Thomson, Skandinaviens Hymenoptera, v. 5, p. 61, 1878.

Baeotomus rufomaculatus Ashmead, Psyche 8: 134, 1897; Marchal, Ann. Soc. Ent. France 66: 83, 1897; Osborn, U.S.Dept.Agr., Div. Ent. Bul. (n. s.) 16: 29, 1898; Dalla Torre, Catalogus hymenopterorum . . ., v. 5, p. 89, 1898: Masi, Ann. Mus. Civ. Stor. Nat. Genova (3a) 10: 146, 1922.

DESCRIPTION

Callitula bicolor resembles the winged form of *Eupteromalus fulvipes*, but it may be distinguished by the 5-jointed funicle, the immargined occiput, and the prominent neck on the propodeum. These characters, combined with the fact that the legs, including all coxae, and usually a large spot at the base of the abdomen are reddish testaceous, will separate it from the other hessian-fly parasites.

Female.—Length 1.1 to 2.1 mm. Head transverse, broader than the thorax, fully two and one half times as broad as long antero-posteriorly at the middle; occiput very slightly concave, entirely immargined; ocelli in a low triangle, the lateral ocelli three or more times their own diameters from the eye margins; temples strongly receding, the head narrowing from the eye margins; antennal groove broad and shallow; viewed from in front, the head broader than high, the cheeks rounded; malar space equal in length to nearly half the eye height; malar furrow very delicate; eyes moderately large, ovate, and practically bare; clypeus not separated from the face, its anterior margin weakly sinuated; clypeal region very finely convergently striated, the rest of head reticulate-punctate, the punctures on back of head and on face and cheeks a little finer than those on upper part of frons and vertex; right mandible 3-toothed, left mandible 4-toothed. Antennae inserted a little below the middle of head, but distinctly above the lower extremity of eyes, 11-jointed, consisting of a slender scape which is cylindrical and reaches to the front ocellus, a

pedicel that is about twice as long as thick, three transverse but quite distinct ring joints, five cylindrical and subequal funicle joints and a solid club, the five funicle joints each very nearly one and one-half times as long as broad, the club longer than the two preceding joints, cylindrical at base but tapering to a long sharp point at apex. Thorax ovoid, narrowed behind; pronotum transverse, conical, viewed from above mostly declivous, distinctly sculptured

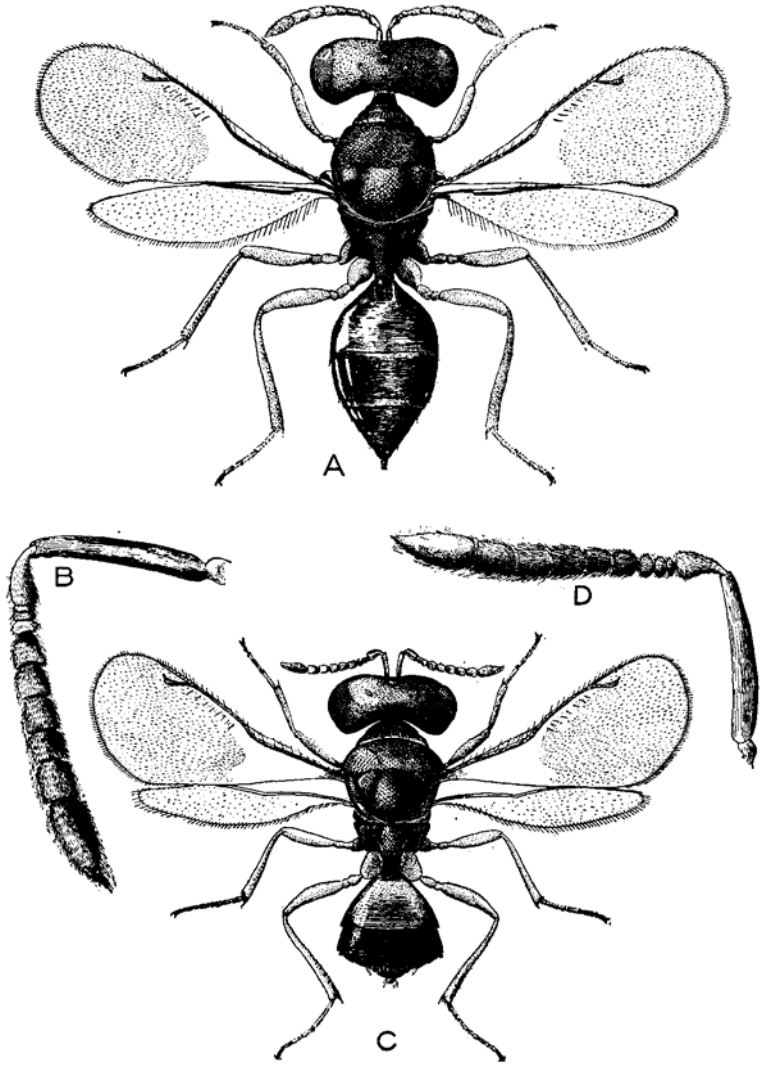


FIGURE 25.—*Callitula bicolor* Spinola: *A*, Adult female; *B*, antenna of female; *C*, adult male; *D*, antenna of male. *A* and *C*, × 30.

except a narrow border along the posterior margin which is smooth; mesoscutum fully twice as broad as long, higher than the pronotum, strongly reticulate-punctate like the vertex, the parapsidal grooves not at all impressed; scutellum as long as mesoscutum, and similarly but a little more finely sculptured, subconvex, with a broad base on mesoscutum, the axillae widely separated and sculptured like scutellum; propodeum narrowed at apex into a very prominent

neck, without a median carina but with the lateral folds usually distinct, the spiracles small and elliptical, the whole surface of propodeum reticulate-punctate, this sculpture a little stronger medially than laterally; pleura less strongly sculptured than the dorsum. Legs normal. Fore wings extending to the apex of abdomen or a little beyond the apex; submarginal vein a little longer than the marginal and postmarginal and two and one half to three times as long as stigmal; wing bare from base to apex of submarginal vein, this bare area prolonged somewhat under the marginal vein and along the posterior margin; ventral surface of wing with eight or nine long hairs in a row behind and paralleling the marginal vein; marginal cilia short; hind wing not bare basally, nearly uniformly but rather sparsely ciliated over the whole surface, its marginal cilia not over one fourth as long as the greatest width of wing. Abdomen about as long as thorax, pointed ovate, with a short petiole which is attached beneath the propodeal neck; first and second tergites beyond the petiole large and subequal, together comprising nearly two thirds of length of abdomen; entire abdomen smooth and polished; ovipositor sheaths slightly exposed at apex.

Color of head and thorax dark metallic green; abdomen blackish with a large, more or less rounded spot, which usually embraces most of the first and second tergites except their margins, yellowish testaceous; mandibles testaceous; antennal flagellum dark brownish or blackish, the scape and pedicel usually more or less brownish but frequently mostly pale testaceous; legs, including all coxae, pale testaceous; wings hyaline, the venation brownish testaceous. The yellowish marking on abdomen is variable, sometimes nearly absent, in other instances embracing most of the abdomen.

Male.—Length 1.2 to 2 mm. Similar to the female except that the antennal club is not prolonged into a slender process at apex, the first ring joint is smaller than in the female, the scape and pedicel are nearly always testaceous, and the abdomen is more distinctly petiolate, the petiole as long as broad, the body of abdomen short, about as long as broad, and yellowish except at apex.

Redescribed from specimens reared from the hessian fly in North America and also several specimens from Europe.

REVIEW OF LITERATURE

The genus *Callitula* was described by Spinola in 1811 in a generic key and *bicolor* named as the only included species, without further description and without indication of the locality from which his specimens came. In 1833 Walker described *Micromelus rufomaculatus* from specimens collected on grass in the vicinity of London. The following year *Pteromalus plagiatus* was described by Nees from specimens taken near Sickershausen and Carlsruhe, Germany, and *Callitula bicolor* Spinola was cited as a synonym. Westwood, in 1840, redescribed *Micromelus rufomaculatus* in his Introduction to the Modern Classification of Insects, and Blanchard also published a short description of it and stated that it was found near Paris and London. In 1856 Foerster proposed the generic name *Baeotomus* to replace *Micromelus* Walker which Foerster considered to be preoccupied by *Micromelum* Blume, a botanical name. Although this change was unnecessary and contrary to the present code of nomenclature, it was accepted by several subsequent authors and accounts for the later use by some of them of the combination *Baeotomus rufomaculatus*. In 1858 Reinhard stated that *Micromelus rufomaculatus* Walker and *Pteromalus plagiatus* Nees were the same species; at the same time he mentioned the fact that *Callitula bicolor* Spinola had been treated as a synonym by Nees but indicated that he considered this a manuscript name only. In 1878 Thomson redescribed the species under the name *Baeotomus plagia-*

tus and cited *rufomaculatus* Walker as a synonym.[16] This parasite was next referred to under the name *Baeotomus rufomaculatus* by Ashmead in 1897, when he recorded it for the first time as a parasite of the hessian fly, this record having been based on specimens reared in France by Marchal, who published the same information 1 month later. In 1898 the Marchal record was cited by Osborn, and in the same year the species was listed in Dalla Torre's catalog under the name *Baeotomus rufomaculatus* with *Callitula bicolor* cited as a synonym. Schmiedeknecht in 1909 listed the species as *Micromelus rufomaculatus*, with *Pteromalus plagiatus* cited as a synonym, but without mention of *Callitula bicolor*. *Micromelus rufomaculatus* was listed by Kurdjumov in 1913 as one of the parasites of the hessian fly reared in Poltava, Russia, and the opinion was expressed that it was probably the same as *Micromelus subapterus* Riley and that *M. pyrrhogaster* Walker was probably a wingless or semi-wingless variety of this species also. The species was mentioned by Masi in 1922 as occurring in the Tuscany Archipelago. In a catalog of the type species of the genera of Chalcidoidea, Gahan and Fagan in 1923 placed the genera *Micromelus* and *Baeotomus* in synonymy with *Callitula* and cited *Micromelus rufomaculatus* as a synonym of *Callitula bicolor*. Znamenski again recorded the species from Poltava in 1923, and in 1928 Hill and Smith listed it for the first time from North America. Meyer included the species in a list of parasites of the hessian fly in Russia, published in 1929, and in 1930 and 1932 Imms recorded it from England as a parasite of *Oscinella frit* (L.). Tzuigankov in 1930 recorded rearing it in Russia from *Meromyza saltatrix* (L.), *Lasiosina cinctipes* Meig., and *Chlorops taeniopus* Meig.

From the above résumé of the literature it will be seen that *Callitula bicolor* was early recognized by Nees as the same as *Pteromalus plagiatus*, which in turn has long been treated as being identical with *Micromelus rufomaculatus*. Although *Callitula bicolor* is a much older name than *Micromelus rufomaculatus*, it has been generally ignored because of the manner in which it was originally proposed. The rules of nomenclature, however, clearly provide that a species proposed as this one was (i.e., without description except that provided in the description of the genus of which it was the only species named) is valid. If Nees' statement that *Callitula bicolor* is the same as his *Pteromalus plagiatus* is correct, then Spinola's name should be used. Spinola's description is entirely inadequate for recognition of the species, and it must be assumed that Nees had knowledge other than that furnished by the description when he synonymized it. That this is possible is shown by the fact that Nees mentions that he had a number of specimens of other species from his colleague Spinola. He does not record that he had specimens of *C. bicolor* from its author, but the two were evidently in close touch with each other and it is highly probable that Nees' identification of *bicolor* is based either upon comparison of specimens or upon additional information given him by Spinola. In the absence of any evidence to the contrary,

[16] Thomson also listed as a synonym *Pteromalus futilis* Foerster. Apparently no species was described by Foerster under this name, and it is probable that *P. futilis* Walker was intended, since that is the only *futilis* listed among the chalcids in Dalla Torre's catalog. The description of this species does not appear to agree with *Callitula bicolor* and is therefore omitted from the synonymy.

Nees' statement as to the identity of *bicolor* and *plagiatus* is accepted as correct, and the older name is applied to the species.

The writer has seen Walker's type of *Micromelus rufomaculatus* in the British Museum and found it to agree with the description of *Pteromalus plagiatus* Nees, a fact first pointed out by Reinhard. *M. rufomaculatus* is thus a synonym of *Callitula bicolor*.

As already mentioned, Kurdjumov believed *Micromelus pyrrhogaster* Walker and *Micromelus subapterus* (Riley) to be probable synonyms of this species. The type of the former species has been examined by the writer and, although very similar to *bicolor*, differs from it by having a much thicker head and vestigial wings. So far as is known, the fully winged *bicolor* has never been associated in any rearings, either in North America or in Europe, with a vestigial-winged form, nor has *pyrrhogaster* ever been recorded from the hessian fly. In view of these facts it is believed that *pyrrhogaster* is probably a distinct species.

Riley's *subapterus* is a quite different species and is a synonym of *Eupteromalus fulvipes* Forbes, which is treated elsewhere in this publication.

HOSTS AND LIFE HISTORY

Little seems to be known regarding the life history of *Callitula bicolor*. It has been most commonly recorded as a parasite of *Phytophaga destructor*. As already shown, Imms has recorded it as a parasite of *Oscinella frit* (L.) in England, and Tzuigankov claims to have reared it from *Meromyza saltatrix* (L.), *Lasiosina cinctipes* Meig., and *Chlorops taeniopus* Meig. in Russia. Kurdjumov states that in studies of the hessian-fly parasites conducted in Poltava this species was always reared as a secondary parasite, and Znamenski makes a similar statement.

According to an unpublished manuscript of the late P. R. Myers, studies carried out at the Carlisle, Pa., laboratory of the Bureau of Entomology show that the species is normally a primary, external, solitary parasite of hessian-fly larvae of the spring generation. The parasite feeds externally upon the host larva within the host puparium and emerges as an adult from the puparium. In several instances, however, the species was found to have developed as a parasite of *Platygaster zosine*, and in one instance at the expense of another undetermined primary parasite of the fly.

DISTRIBUTION

Callitula bicolor is a widely distributed species both in Europe and in North America. In Europe it has been recorded from England, France, Germany, Italy, and Kiev and Poltava in Russia. The writer has also seen specimens in the collection of Ruschka at the Naturhistorisches Museum at Vienna which it is believed were collected in Austria.

In North America this species has been taken in New York, Pennsylvania, Maryland, Virginia, Ohio, Indiana, Michigan, and North Dakota. Records from Pennsylvania embrace numerous localities distributed in at least 10 different counties. Maryland records also include localities in several counties and range from tidewater to the mountainous western part of the State. Records from the other

States are much scarcer but are sufficient to indicate that the species is probably present over the greater part of the northern range of the hessian fly. It is apparently absent from the Pacific coast region, and seemingly also from the Kansas, Nebraska, and Oklahoma wheat sections. Although extensive studies of hessian-fly parasites have been made by various field men of the Bureau of Entomology and others in California, Oregon, and Washington, as well as in Kansas and Oklahoma, *Callitula bicolor* has never been received for identification from these sections. If present, it could hardly have escaped detection.

IMPORTANCE

This species is believed to be of very little importance as a parasite of the hessian fly. Comparatively few specimens have been found in North America, despite the extensive investigations of fly parasites that have been carried on.

BUBEKIA FALLAX, new species

(Fig. 26)

Although having a somewhat different habitus from the genotype, *Bubekia tricarinata* Ashmead, *B. fallax* seems to agree in the important generic characters and is believed to be correctly placed in that genus. It differs from *tricarinata* in having the pronotum shorter, the abdominal petiole shorter, and the abdomen conic-ovate instead of conico-cylindrical as in *tricarinata*.

The species may be distinguished from all other parasites of the hessian fly by the median tooth on the clypeus.

Female.—Length 1.9 to 2 mm. Head a little broader than thorax, fully three times as broad as thick antero-posteriorly at the middle, very slightly convex in front and weakly concave behind, the temples narrow and poorly defined; ocelli in a low triangle, the postocellar line very nearly twice as long as ocell-ocular line, the latter equal to about twice the diameter of an ocellus; head viewed from in front wider than high (approximately 30:25), the cheeks a little rounded in outline; malar space equal to about half the eye height; antennal scrobe shallow; eyes oval, with sparse inconspicuous ciliation; clypeus with a distinct short tooth at apical middle, not distinctly separated from face basally; mandibles each with four teeth, the teeth subequal and rounded at apex; maxillary palpi 4-jointed; whole head finely reticulate, more finely so on face and clypeus, the latter without any striae. Antennae inserted near middle of head, weakly clavate, 13-jointed; scape cylindrical, attaining front ocellus; pedicel about twice as long as broad, two ring joints strongly transverse, the first a little smaller than the second; funicle 6-jointed, the joints subquadrate, the first often a little longer than broad, the sixth a little broader than long; club ovate, about equal in length to the three preceding funicle joints and distinctly a little thicker than the last funicle joint, the joints subequal in length; first and second joints broader than long, third triangular or conical and terminating in a short process; funicle and club joints each with a single series of elongate sensoria which extend approximately three fourths the length of the segment and number 12 or more per segment. Thorax with its length to its breadth about in the ratio 40:25, reticulate-punctate; prothorax short, the pronotum mostly declivous, narrower than mesonotum, the dorsal portion very short and without a marginal carina anteriorly; mesonotum about twice as broad as long, the parapsidal grooves complete and sharply though not deeply impressed; axillae separated by a distance equal to approximately half their basal width; scutellum as long as mesoscutum, moderately convex, without a cross furrow, the reticulation a little finer than that of mesoscutum; propodeum a little more than half as long as scutellum, with distinct median carina, lateral folds, and spiracular sulci; the area between lateral folds finely

but strongly reticulate-punctate; spiracular sulci deep, the area laterad of these sulci weakly sculptured and clothed with a few long hairs; spiracles small; pleura reticulate-punctate, with a smooth ridge below the wings; metapleura weakly reticulated. Fore wing extending beyond apex of abdomen, a little more than twice as long as broad, bare behind submarginal vein, ciliated from base of marginal to apex of wing; marginal cilia short; marginal and postmarginal veins about equal; stigmal vein about two thirds as long as postmarginal, straight, slender at base with a rather elongate stylet; hind wing about three and one half times as long as broad. Legs not thickened; tarsi 5-jointed; hind tibia with two apical spurs, one very weak; hind coxae weakly reticulated. Abdomen conic-ovate, about as long and as broad as thorax, smooth and subpetiolate; petiole very short, much broader than long; first tergite beyond the petiole constituting about two fifths of the length of abdomen; second tergite nearly one third as long as first; third, fourth, and fifth tergites short and subsequal, the sixth and seventh each as long as or a little longer than the second; ovipositor not exserted.

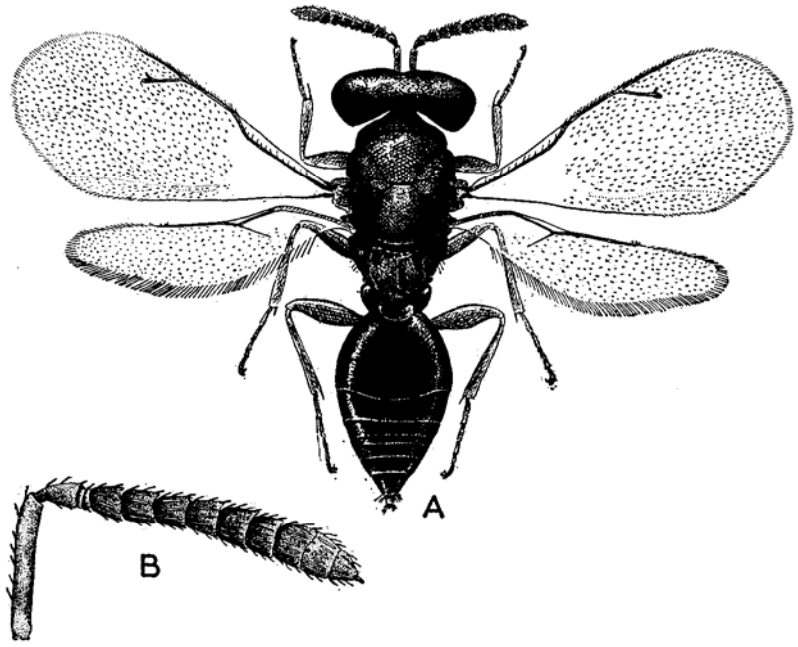


FIGURE 26.—*Bubekia fallax* Gahan: *A*, Adult female; *B*, antenna of female. *A*, × 29.

Head and thorax black, the head with a slight greenish cast; propodeum metallic green, and abdomen bluish green with a brassy reflection basally; antennal scape metallic with narrow band at base testaceous; pedicel and flagellum brownish black; mandibles reddish brown; palpi black; wings hyaline, the venation fuscous; coxae concolorous with thorax; all femora blackish or slightly metallic with their apices testaceous; all tibiae and tarsi reddish testaceous, the apical joint of each tarsus black.

Male.—Length, exclusive of head, 1.4 mm. Head missing from the type. Abdominal petiole more distinct than in the female but not so long as broad; body of abdomen ovate, somewhat more than half as long as thorax and narrower than thorax, the first segment beyond the petiole constituting half or more than half its length; scutellum a little shorter than mesoscutum; axillae less broadly separated than in female. Thorax, abdomen, and coxae metallic green; femora also more or less metallic; otherwise like the female. Head and antennal characters unknown.

Type locality.—Sioux City, Iowa.

Type.—Catalog no. 44841, U.S. National Museum.

Described from 13 specimens, 11 females and 2 males, as follows: Type female, allotype male, and 3 paratypes reared from *Meromyza americana* Fitch at Sioux City, Iowa, by C. N. Ainslie under Webster no. 24270; 4 paratypes from the same host and locality under Webster no. 24273; 1 female paratype reared from *Phytophaga destructor* (Say) at Columbia, Tenn., by Geo. G. Ainslie, May 15, 1922, LaFayette no. 21154; 1 female paratype from *P. destructor* at Attica, Ind., by E. G. Kelly, May 1916, under Webster no. 17322; 1 female paratype from *P. destructor* at Wakita, Okla., by E. G. Kelly, Webster no. 14492; and 1 female paratype from *P. destructor* at Randolph, Iowa, by E. G. Kelly under Expt. no. 152449.

This species is known only from the above-mentioned specimens. Its known distribution is confined to the few Middle Western States mentioned, and nothing is known of its life history. It is probably of little importance as a parasite of the hessian fly.

HALTICOPTERA AENEA (Walker)

Dicyclus aeneus Walker, Ent. Mag. 1: 456, 1833; Walker, Monographia chalciditum, p. 277, 1839; Westwood, An introduction to modern classification of insects . . . , v. 2, synopsis, p. 68, 1840; Gahan and Fagan, U.S. Natl. Mus. Bul. 124: 44, 1923.

Dicyclus fuscicornis Walker, Ent. Mag. 1: 456, 1833; Walker, Monographia chalciditum, p. 456, 1839; Cunliffe, Ann. Appl. Biol. 8, no. 2, 1921 (abstract in Rev. Appl. Ent. (A) 9: 533, 1921).

Cyrtogaster liqueatus Ashmead, Amer. Ent. Soc. Trans. 2:336, 1894; Girault, Descriptiones hymenopterorum chalcidoidicarum variorum cum observationibus, no. 3, p. 1, 1917; Griswold, Jour. Econ. Ent. 21: 856, 1928; Leonard, N.Y. (Cornell) Agr. Expt. Sta. Mem. 101: 980, 1928.

Cyrtogaster occidentalis Ashmead, Amer. Ent. Soc. Trans. 23: 230, 1896; Webster, U.S.Dept.Agr., Bur. Ent. Bul. (n.s.) 42: 56, 1903; Luginbill and Urbahns, U.S. Dept. Agr. Bul. 432: 15, 1916; Seamans, Jour. Agr. Research 9: 24, 1917; Aldrich, Jour. Agr. Research 18: 471, 1920.

Cyrtogaster citripes Ashmead, Amer. Ent. Soc. Trans. 23: 230, 1896.

Polycyrtus (sic) *floridanus* Ashmead, Amer. Ent. Soc. Trans. 23: 230, 1896.

Polycystus foersteri Crawford, U.S. Natl. Mus. Proc. 45: 313, 1913; Frost, N.Y. (Cornell) Agr. Expt. Sta. Mem. 78: 131, 1924.

Halticoptera fuscicornis Imms, Parasitology 22: 13, 1930; 24: 442, 1932.

DESCRIPTION

Halticoptera aenea is not likely to be confused with any of the other parasites of the hessian fly, if attention is given to the shape of clypeus, the smooth propodeum with its strong lateral folds and distinct median carina, the prominent abdominal petiole with its distinct median longitudinal carina, and the subtriangular abdomen. The males are readily recognized by their swollen and yellow maxillary palpi, their pale yellow antenna with darker club, and their pale legs.

Female.—Length 1.75 to 2.1 mm. Head transverse, plainly wider than thorax, nearly four times as broad as thick antero-posteriorly at the middle; very weakly concave behind; temples receding, narrow, approximately one fourth as wide as the eyes; ocelli in a very low triangle, the postocellar line a little longer than ocellocular line, the latter equal to nearly three times the diameter of an ocellus; head viewed from in front subtriangular, broader than high (about 30:25); cheeks slightly rounded, malar space equal to a little less than half the eye height; antennal scrobe shallow; eyes ovate with very short sparse pubescence; clypeus separated from face by a definite groove, its anterior margin produced into two short, blunt teeth which are separated by a deep median sinus; whole head with fine, shallow reticulate sculpture which is a little coarser on vertex and frons than below, the clypeal region without any con-

verging striae; frons and face with sparse pale hairs; mandibles each with four distinct teeth; labial palpi 3-jointed, maxillary palpi 4-jointed, the second and fourth joints of the latter much longer than the first or third. Antennae 13-jointed, weakly clavate; scape cylindrical; pedicel about twice as long as broad; two distinct transverse ring joints; funicle 6-jointed, the joints subquadrate; club 3-jointed, ovate, a little broader than funicle, the first and second joints subquadrate, the apical joint smaller and subtriangular; funicle and club joints each with a single series of elongate sensoria which extend from about the basal one fourth or one third of each segment to its apex; hairs on funicle and club short. Thorax a little over one and one half times as long as broad, tapering from tegulae to apex of propodeum; prothorax short, conical, a little narrower than mesonotum at tegulae, mostly declivous and without a transverse carina separating the declivous portion from the short dorsal portion; mesoscutum more than twice as broad as long; parapsidal grooves impressed anteriorly, usually faintly traceable for the whole length of mesoscutum but very indefinite on posterior half; scutellum about as long as mesoscutum; axillae separated by a distance much less than their own width at base, the groove between axillae and scutellum deep and weakly foveolated; sculpture of scutellum and axillae about like that of vertex of head, the mesoscutum with somewhat coarser reticulation; metanotum forming a narrow transverse smooth band; propodeum about two thirds as long as scutellum, smooth and shining, the median carina and lateral folds strongly developed, spiracular sulci deep and complete; spiracles small and ovate; area between lateral folds of propodeum broad and with a shallow depression at basal margin on each side about half way between the median carina and the lateral fold; pleura sculptured like the scutellum but with the usual smooth ridge beneath the wings. Legs moderately slender, their tarsi 5-jointed; hind tibiae with two spurs, one of which is very weak and not easily seen; hind coxae very weakly sculptured and with a few long hairs dorsally; front femora and tibiae approximately equal in length; middle and hind femora shorter than their tibiae. Wings extending far beyond the apex of abdomen, about two and one third times as long as broad, evenly ciliated from a little beyond apex of submarginal vein to apex of wing, bare basally except for a few hairs in the costal cell; marginal cilia short; submarginal vein twice as long as marginal vein; postmarginal vein subequal to marginal; stigmal vein half or a little more than half as long as marginal. Abdomen about as long as thorax, petiolate; petiole about twice as long as broad, reaching approximately to the apices of hind coxae, opaquely granular in sculpture with a distinct median longitudinal carina above; body of abdomen smooth, short ovate, subacute at apex, broadest at apex of first tergite beyond the petiole, this tergite constituting half or nearly half the length of abdomen exclusive of the petiole, its apical margin often, though not always, with a slight median emargination; following tergites successively diminishing a little in length, usually more or less retracted into the first segment; ovipositor not exserted.

Color of head and thorax varying from aeneous to dark green, the lower part of frons and the face usually blackish, and pleura usually less metallic than the dorsum of thorax; propodeum shining green or brassy; petiole dull black; abdomen beyond petiole metallic green or brassy green, the apical tergites sometimes blackish; antennal scape dark metallic with its base more or less testaceous; flagellum and pedicel dark fuscous or brownish black; wings hyaline; all coxae concolorous with the thorax, their femora and tibiae varying from dark testaceous to strongly fuscous with the apices somewhat paler; tarsi testaceous with the apical joint blackish.

Male.—Length 1.5 to 1.8 mm. Somewhat smaller than the female, the antenna similar in conformation to that of female, but slightly more slender; maxillary palpi with the two apical segments greatly enlarged to form an ovate vesicle; maxillae also enlarged; parapsidal grooves more sharply defined, usually complete but not deeply impressed posteriorly; head distinctly more finely and deeply sculptured than the thorax, especially so on the frons and face; abdomen shorter than the thorax; the petiole like that of female; body of abdomen subtriangular, appearing truncate at apex because of the retraction of the apical segments. Color a much brighter metallic green than in female, the front of head brilliant brassy green to bright blue; antennae yellow, the club and usually the pedicel fuscous; legs, except coxae, bright yellowish, their hind femora sometimes slightly fuscous, and the apical joint of all tarsi blackish.

REVIEW OF LITERATURE

Walker described *Dicyclus aeneus* in 1833 from specimens collected on grass near London, England, and Westwood named the species as type of the genus in 1840. *Dicyclus fuscicornis* Walker was described from the Isle of Wight in the same paper in which the description of the genotype species appeared. Both species were more fully described by Walker in his Monographia Chalciditum in 1839. Cunliffe in 1921 recorded *D. fuscicornis* as parasitic upon *Ocinella frit* (Linnaeus) in England, and in 1930 Imms published a paper giving observations on some parasites of the frit fly in England, in which he fully described and figured the same species but placed it in the genus *Halticoptera* instead of *Dicyclus*.

In 1894 Ashmead described *Cyrtogaster liqueatus* from one specimen said to have been reared from *Phloeosinus dentatus* Say, a scolytid. Two years later Ashmead described *Cyrtogaster occidentalis* from specimens taken in Indiana, Texas, District of Columbia, Virginia, South Dakota, and Colorado, with the further statement that the species had been reared by F. M. Webster from *Oscinis variabilis* Loew, *O. carbonaria* Loew, or *O. umbrosa* Loew mining stems of wheat, and in 1903 this record was repeated by Webster with the substitution of *O. soror* Macquart for *O. variabilis*. In the same paper in which *Cyrtogaster occidentalis* was described, Ashmead also gave descriptions of *C. citripes* and *Polycyrtus floridanus* from specimens collected in Florida. In one of his privately published pamphlets printed in 1917, Girault placed *C. occidentalis*, *C. citripes*, and *P. floridanus* in synonymy with *C. liqueatus* Ashmead. He also cited *P. foersteri* Crawford, described from specimens reared from *Agromyza angulata* Loew, as a synonym of the same species.

In 1916 Luginbill and Urbahns recorded rearing *Cyrtogaster occidentalis* from the corn leaf miner, *Cerodonta dorsalis* Loew, at Yuma, Ariz., Tulare, Calif., Columbia, S.C., Lakeland, Fla., and Greenwood, Miss. These authors gave a very fair figure of the adult female. The following year Seamans recorded the same species as parasitic upon *Cerodonta femoralis* Meigen in Montana. In 1920 J. M. Aldrich mentioned the Webster record of *Cyrtogaster occidentalis* as a parasite of the wheat stem miner in a paper dealing with *Oscinella frit*. Frost in 1924 repeated the record by Crawford of *Polycystus foersteri* from *Agromyza angulata*, and in 1928 Miss Griswold recorded the rearing of *Cyrtogaster liqueatus* from *Phytomyza delphiniae* Frost.

In 1920 James Waterston sent to the writer for examination a female and a male pteromalid reared from the frit fly in England. He had identified the female as *D. fuscicornis* Walker but was uncertain regarding the relationship of the male and also as to the proper generic placement for the Walkerian species. A specimen of *fuscicornis* (probably a cotype) identified by Walker was included in the sending. The reared specimens were apparently a part of the material upon which the record later published by Cunliffe was based. The agreement of the reared female with Walker's specimen of *fuscicornis* was found to be exact, and the fact that the male repre-

sented the same species was also established beyond question by the similarity of both sexes to what was then being called *Cyrtogaster liqueatus* Ashmead in North America, the two sexes of which had been associated by numerous breeding records. These conclusions were communicated to Waterston with the further statement that the only apparent differences between *fuscicornis* and *liqueatus* were that in *fuscicornis* the hind margin of the first tergite beyond the petiole was entire and the femora were strongly infuscated, whereas in *liqueatus* the hind margin of the first tergite showed a very slight emargination at the middle, and the femora were not so dark. In regard to the question of the proper generic placement of the species, it was pointed out that the type of the genus *Dicyclus* was *D. aeneus* Walker, and Waterston was advised to examine that species. This he did and later wrote that he was not sure that *aeneus* and *fuscicornis* were specifically distinct. At this point the matter was temporarily dropped, but in 1927 the writer was privileged to examine the type of *aeneus*, a female in the British collection at the British Museum, and concluded that it was the same species as *fuscicornis*.

Although the identity of the American *liqueatus* with *aeneus* was already suspected, some doubt still existed because of the apparent slight differences already pointed out. A careful examination of all the numerous specimens of this species in the United States National Museum has now shown that the very slight notch or emargination at the apex of the first tergite is absent about as frequently as it is present, while the color of the femora is to a considerable extent variable, frequently testaceous, but more often distinctly fuscous. The agreement with the detailed description and figures of *fuscicornis* by Imms leaves no doubt that *liqueatus* is identical with *fuscicornis*, which, as already pointed out, is believed to be the same as *aeneus*. The types of *Cyrtogaster occidentalis* Ashmead, *C. citripes* Ashmead, *Polycyrtus floridanus* Ashmead, and *Polycystus foersteri* Crawford have been studied and found to be the same as *liqueatus*, as stated by Girault, and therefore synonyms of *aeneus*.

Imms placed *fuscicornis* in the genus *Halticoptera* and in so doing pointed out certain alleged differences between this genus and *Dicyclus* Walker. These alleged differences are as follows: (1) In *Halticoptera* the marginal vein is longer than the stigmal, whereas in *Dicyclus* it is usually shorter than or, at most, equal in length to the stigmal vein; (2) in males of *Halticoptera* the two distal joints of the maxillary palpi are greatly inflated so that together they form a spheroid vesicle, whereas in *Dicyclus* they are unmodified as in the females of both genera. These supposed differences are believed to have been taken from the literature rather than based upon actual study of the genotype species, since they are essentially the same characters as those used by Ashmead to distinguish these two genera. Since the species *aeneus* Walker is, as already stated, the type species of *Dicyclus*, and since *fuscicornis* Walker is believed to be the same species, it is apparent that if this species belongs in *Halticoptera* then *Dicyclus* must be considered a synonym of that genus.

The writer has not seen the actual type species of *Halticoptera*, viz (*Diplolepis*) *Halticoptera flavicornis* (Spinola), but has examined specimens of *H. smaragdina* (Curtis), a species believed to be very

closely allied to the genotype species. Between *smaragdina* and *aeneus* there is essentially no difference in the relative proportions of the marginal and stigmal veins. Furthermore, the males of both species have the two distal joints of the maxillary palpi almost equally greatly enlarged. It follows, therefore, that *Dicyclus* and *Halticoptera* cannot be distinguished generically by either the venation or the characters of the male palpi, and apparently there are no other characters of sufficient importance to hold them apart. In *H. smaragdina* there is in both sexes a more or less distinct cross furrow on the scutellum at about the apical one third. In males of this species also, the basal lobe or stipes of maxilla is enormously enlarged, so much so that it appears as a very large, flat, smooth plate lying close against the back of the head and extending nearly to the vertex, where it is easily seen from above if the head is tipped slightly forward to expose the occiput. It was at first believed that these characters would distinguish *Halticoptera* from *Dicyclus*, but further study showed them to be merely relative. In many specimens of *aeneus* the cross furrow on the scutellum is absent, but in some specimens it is faintly indicated, although never so distinct as in the few specimens of *smaragdina* available for comparison. The stipes of the male maxilla in *aeneus* is not so enormously enlarged as in *smaragdina*, never extending above the neck and hence not visible from above, but it is much larger than usual in other *Pteromalidae* and essentially of the same type as in the latter species. In the light of this comparison it is deemed necessary to consider *Dicyclus* a synonym of *Halticoptera*.

Ashmead described the species three times in *Cyrtogaster* and once in *Polycyrtus* (a typographical error for *Polycystus*) and Crawford also placed it in *Polycystus*.

It has little relation to *Cyrtogaster*. Females of *Cyrtogaster* are at once distinguished from those of *Halticoptera* by having a broad, almost semicircular emargination of the first tergite, by the sharply margined pronotum, and by the rugosely sculptured propodeum, while the males differ not only by these same characters but in the maxillary palpi also, since in *Cyrtogaster* it is apparently the penultimate palpal joint which is enlarged, and this is always metallic,[2] the apical joint small and either club shaped (*vulgaris* Walker) or setiform (*glasgowi* Crawford) and located near the forward or ventral end of the penultimate joint when the palpi are at rest.

The true identity of *Polycystus* Westwood, of which *P. matthewsii* Westwood is the genotype species, is at present unknown to the writer.

HOSTS AND LIFE HISTORY

Halticoptera aenea is a solitary, primary parasite with a number of different hosts. According to Imms, it is an endoparasite of the larval stage of *Oscinella frit* emerging as an adult from the puparium of the host. Little else is known of its life history.

Oscinella frit is attacked by this species in both Europe and America. Cunliffe, as well as Imms, records it from that host in England. In North America the records by Ashmead and Webster of its having been reared from *Oscinis carbonaria* Loew, *O. variabilis* Loew, *O. soror* Macquart, or *O. umbrosa* Loew have been shown

by Aldrich to refer to *O. frit.* Other published records from North America, as already mentioned, comprise that by Ashmead from *Phloeosinus dentatus* (Say), those by Crawford and Frost from *Agromyza angulata* Loew, that by Luginbill and Urbahns from *Cerodonta dorsalis* Loew, the one by Seamans from *Cerodonta femoralis* Meigen, and the one by Griswold from *Phytomyza delphiniae* Frost. Of these records, the one from *Phloeosinus dentatus*, a scolytid, is perhaps open to some doubt. The others are probably correct.

In addition to these published records, material in the National Museum collection shows the following rearing records: From *Agromyza citreifrons* Malloch at Wooster, Ohio, by J. S. Houser, July 25, 1916; from *Agromyza pusilla* Meigen by C. C. Wilson at Sacramento, Calif., August 20, 1924; from *Agromyza coquilletti* Malloch in wheat leaf at Elk Point, S.Dak., October 1913; and from *Phytophaga destructor* (Say) at Clearwater, Kans., by E. G. Kelly, May 1915, at Randolph, Iowa, by E. G. Kelly, date not indicated, at Wellington, Kans., by E. G. Kelly, date not indicated, and at Centralia, Ill., by W. B. Cartwright, July 19, 1921. Several other specimens in the collection are said to have been reared from wheat, but without identification of the host.

DISTRIBUTION

So far as the records show, this species in Europe is present only in the British Isles. That its distribution is actually confined to this limited area, however, is very unlikely. Schander and Meyer [17] record *Halticoptera suilius* (Walker) as a parasite of *Oscinella frit* in Germany and it is possible that this may be *H. aeneus. Halticoptera petiolata* Thomson is also mentioned as a parasite of *O. frit* in Russia by Meyer [18] and this too may prove to be *H. aeneus.*

In North America specimens of *H. aenea* in the National Museum collection show the following distribution: New York, Pennsylvania, Maryland, District of Columbia, Virginia, South Carolina, Florida, West Virginia, Ohio, Indiana, Illinois, Wisconsin, Iowa, Missouri, Louisiana, Mississippi, Texas, Kansas, South Dakota, North Dakota, Montana, Colorado, Arizona, and California. Thus it will be seen that the species occurs from the Atlantic to the Pacific and from Wisconsin and North Dakota to the Gulf of Mexico. No doubt it will be found in many other States of the United States and probably in Canada.

IMPORTANCE

This species is an important parasite of the frit fly, but it apparently attacks the hessian fly only incidentally. The few records from that host indicate that it is of very little importance in its control.

Family APHELINIDAE

TUMIDISCAPUS FLAVUS Girault

(Fig. 27)

Tumidiscapus flavus Girault, Jour. N.Y. Ent. Soc. 19: 182, 1911; Mercet, Mus. Nac. Cien. Nat. [Spain] Trab. no. 10, p. 111, 1912; Gahan, U.S.Natl. Mus. Proc. 55: 405, fig. 3, 1919.

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[17] Schander and Meyer, Arch. Naturgesch. (Abt. A) 90 (12): 48, 1924.
[18] Meyer, Rpt. Appl. Ent. Leningrad 4: 242, 1929.

DESCRIPTION

In size and structural characters *Tumidiscapus flavus* is very similar to *Centrodora speciosissima*, but it is easily distinguished from that species by the nearly uniform yellow color of its body and the absence of any cloud in the fore wing. Structurally it differs in the female by having the fourth antennal joint as long as the fifth and by having the ovipositor less strongly exserted, while in the male the antennal scape is much more strongly thickened and the funicle joints are differently proportioned.

Female.—Length 0.75 to 1 mm. Head a little broader than thorax; vertex and frons very finely punctate; cheeks nearly smooth; mandibles each with three teeth; eyes bare. Antennae 6-jointed, inserted near the mouth; scape cylindrical; pedicel about half as long as scape and about as thick as scape; first funicle joint obliquely truncate at apex, its ventral margin fully twice

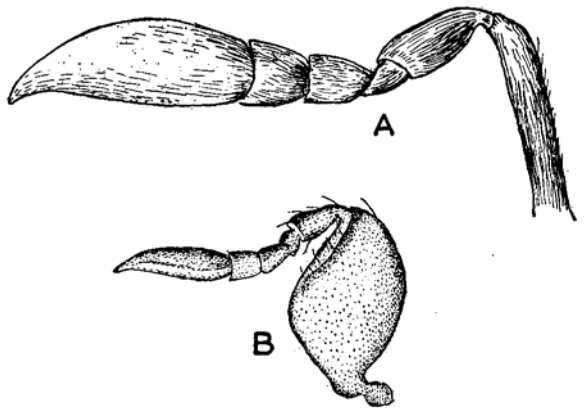


FIGURE 27.—*Tumidiscapus flavus* Girault: *A*, Antenna of female; *B*, antenna of male. × 270.

as long as its dorsal margin and a little longer than the width of segment; second funicle joint about one and one half times as long as broad, broader at apex than at base; third funicle joint about as long as second but thicker, broadest at apex and about as broad as long; club a little thicker than third funicle joint, longer than the three funicle joints combined, about equal in length to the scape, solid, its apex a little curved; elongate sensoria apparently lacking. Thorax dorsally with weak granular sculpture; prothorax short; mesoscutum about one and one half times as broad as long, apparently with a very delicate median groove and with a row of three or four short setae on each side of the middle, the parapsidal grooves complete and deeply impressed; scutellum about as broad as long or a little broader, rounded in outline, slightly convex, apparently with a very weak median groove and with four setae; axillae small and widely separated; propodeum a little shorter than scutellum, apparently smooth, always collapsed in dead specimens. Legs normal; tarsi 5-jointed. Wings well developed; fore wing extending beyond apex of ovipositor, three times as long as broad, mostly bare basally for the length of submarginal vein, ciliated elsewhere except for a narrow hairless area extending from the apex of stigmal vein obliquely inward and caudad but interrupted before reaching posterior margin of wing; marginal cilia moderately long; marginal vein a little longer than submarginal; stigmal vein short and sessile; postmarginal vein absent. Abdomen longer than head and thorax, conic-ovate, broadly sessile, smooth; ovipositor extending slightly beyond apex of abdomen. Color pale reddish yellow throughout, the head above and the abdomen usually a shade more reddish than the thorax, antennae and legs usually very slightly paler than the body; wings perfectly hyaline, venation yellowish.

Male.—Length 0.6 to 0.9 mm. Antennal scape greatly enlarged, ovoid, its length to its breadth about in ratio 7:5, pedicel not quite twice as long as broad; funicle joints a little shorter than in the female, the first funicle joint about as broad as long and not so obliquely truncate at apex; second joint a little thicker than the first and about one and one half times as long as broad; third joint about as long as broad at apex; club longer than the funicle and a little thicker than the last funicle joint, curved slightly at apex. Abdomen not longer than the head and thorax, ellipsoidal. Other characters as in the female.

Described from the type and 20 additional specimens in the National Museum collection.

REVIEW OF LITERATURE [19]

Girault described *Tumidiscapus flavus* from one male specimen collected on a window pane at Centralia, Ill. This specimen, which is not only the type of the species but of the genus also, is mounted on a slide in the National Museum collection. In 1912 a translation of the original description into Spanish was published by Garcia Mercet without adding anything to the knowledge of the species. The only other reference to it in the literature appears to be one by the writer in 1919, in which an outline figure of the male antenna is given in connection with a discussion of the relationship of the genus *Tumidiscapus* to *Paraphelinus* Perkins.

HOSTS AND LIFE HISTORY

Tumidiscapus flavus was first linked with a definite host when, in October 1923, 18 specimens which had been reared June 20, 1923, by W. B. Cartwright from two hessian-fly puparia collected at Union City, Tenn., were identified by the writer as being that species. A specimen reared from a puparium of the same host insect by P. R. Myers in 1915 at Montoursville, Pa., was subsequently identified as *T. flavus*. So far as the writer is aware, these two rearings constitute the only records to date of the species from *Phytophaga destructor*. Two additional specimens in the National Museum collection, which have been identified as *T. flavus*, are said to have been reared from *Lasioptera* on *Muhlenbergia* at Elk Point, S.Dak., by C. N. Ainslie, under Webster no. 11838, and three specimens are said to have been reared from *Muhlenbergia* by the same collector at Sioux City, Iowa, under Sioux City no. 2719.

Other species of the genus *Tumidiscapus* seem to be parasitic in the eggs of Orthoptera deposited in stems and canes, and it is highly probable that the normal host of this species will be found to be some orthopteron or other insect that oviposits in grass or weed stems.

No information is available regarding the life history of the species other than the fact that it emerges from the puparium of its host, as many as 10 specimens sometimes coming from a single puparium of the hessian fly. It is believed to be an internal, primary parasite, but this remains to be proved.

[19] This species was recorded by Metcalf and Colby (Jour. Econ. Ent. 23: 108, 1930) as parasitic in the eggs of *Orchelimum vulgare* Harris, the meadow grasshopper, the identification having been made by the writer. A subsequent reexamination of the parasite material retained showed it to represent a species different from *flavus*, and it has been recently described under the name of *Tumidiscapus orchelimumis* (Ann. Ent. Soc. Amer. 25: 741, 1932).

DISTRIBUTION

Present records, while few in number, indicate that this species may be distributed over much of the eastern and central portions of the United States. Specimens in the National Museum collection are from the following localities: Montoursville, Pa.; Union City, Tenn.; Centralia, Ill.; Sioux City, Iowa; and Elk Point, S.Dak.

IMPORTANCE

This species cannot be said to be of any importance as a check on the hessian fly. Its parasitism of that host is believed to be more in the nature of an accident than otherwise.

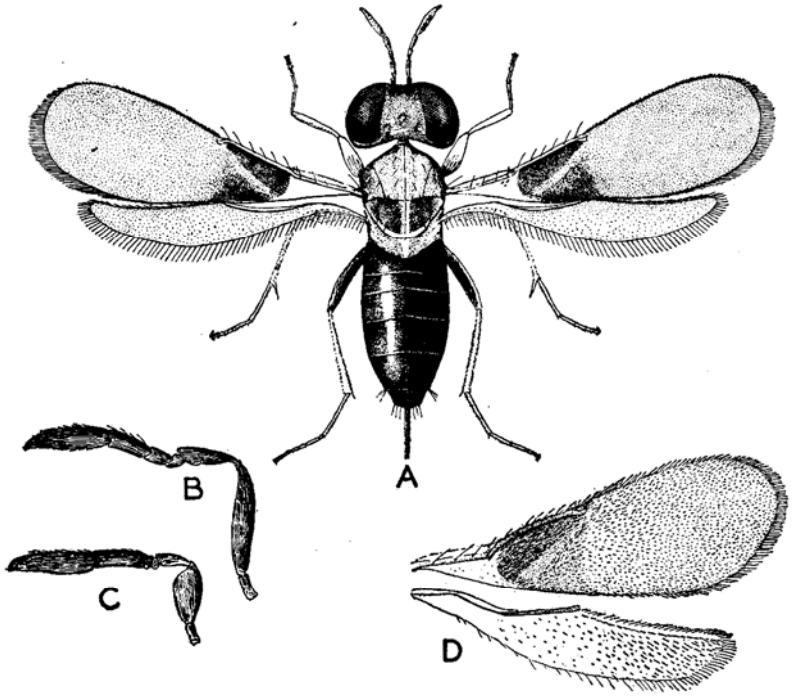


FIGURE 28.—*Centrodora speciosissima* (Girault): *A*, Adult female; *B*, female antenna; *C*, male antenna; *D*, wings of female. *A*, × 50

CENTRODORA SPECIOSISSIMA (Girault)

(Fig 28)

Paraphelinus speciosissimus Girault, Jour. N.Y. Ent. Soc. 19:181, 1911; Mercet, Mus. Cien. Nat. [Spain] Trab. no. 10, p. 108, 1912; Howard, Ent. Soc. Wash. Proc. 16:81, 1914; McConnell, Ann. Ent. Soc. Amer. 9:98, 1916; Girault, Ent. News 27: 405, 1916; Waterston, Bul. Ent. Research 8:52, 1917.

Centrodora speciosissima Mercet, Bol. R. Soc. Espan. Hist. Nat. 18:106, 109, 1918; Gahan, U.S. Natl. Mus. Proc. 55:403, figs. 1–2, 1919; Hill and Smith, Jour. Agr. Research 36:153, 155, 1928; Mercet, Eos 6:294, 1930.

DESCRIPTION

Centrodora speciosissima may be distinguished from all other parasites of the hessian fly by its unusual color pattern, the head being dark reddish above, strongly fuscous below, the thorax mostly bright

yellow with the mesopleura and sometimes a dorsal transverse band encompassing the scutellum and axillae fuscous, the abdomen wholly black, the legs mostly pale but with the hind coxae and femora fuscous or blackish, the antennae fuscotestaceous, and the wings hyaline with a conspicuous dark band across the fore wing behind the marginal vein.

Female.—Length, including ovipositor, 0.8 to 1.25 mm. Head transverse, about as broad as thorax, weakly sculptured, collapsed in dead specimens; eyes bare; mandibles each with three short subacute teeth, the outer tooth slightly the longest. Antennae inserted near the mouth, 6-jointed, scape slender; pedicel slender, obconic, nearly half as long as the scape excluding the radicle; first funicle joint small, oblique, its ventral margin more than twice its dorsal margin, its width equal to approximately half its greatest length; second funicle joint thicker and longer than the first, about half as wide as its greatest length, obliquely truncate at both base and apex, the upper and lower margins nearly equal; third funicle joint as long as the pedicel, a little thicker and about twice as long as the second funicle joint, gradually increasing in thickness from base to apex; club solid, a little thicker than the third funicle joint, a little longer than the entire funicle and nearly as long as the scape, slightly curved at apex; club with a few very slender elongate sensoria, but the funicle joints apparently without these. Thorax longer than broad; pronotum short, strongly transverse; mesoscutum about twice as broad as long, weakly sculptured, slightly shining, with a few short setae, including a row on each side of the middle line, the parapsidal grooves complete; scutellum broader than long, rounded posteriorly, subconvex, sculptured like mesoscutum, with four setae; propodeum nearly as long as scutellum, faintly sculptured. Legs with all tarsi 5-jointed, the hind femora rather broad. Fore wings well developed, extending beyond apex of abdomen, comparatively narrow, more than three times as long as broad; marginal vein a little longer than submarginal; postmarginal vein absent; stigmal vein sessile, short, forming a slightly curved continuation of marginal vein; the submarginal vein with four erect setae; the disk of wing behind submarginal vein practically bare, remainder of disk closely ciliated except for a line extending from near the stigmal vein obliquely proximo-caudad nearly to the posterior margin, the cilia basad of this hairless area distinctly coarser than distad of it; marginal cilia of fore wing not more than one eighth as long as the wing is wide, those of hind wing nearly equal to the wing width. Abdomen broadly sessile, as long as head and thorax or a little longer, the ovipositor exserted, usually about one fourth the length of abdomen.

Male.—Length 0.5 to 0.7 mm. Antennal scape a little expanded beneath, about twice as long as broad; pedicel half as long as scape; first and second funicle joints very small, both obliquely transverse, the first very slightly larger than second; third funicle joint very long, distinctly longer than the pedicel and first two funicle joints combined, usually about four times as long as thick and about two thirds as long as the club but variable both as to length and breadth; club solid, a little broader than funicle; funicle and club clothed with fine short hairs; abdomen about as long as thorax. Other characters including color about as in the female.

Both sexes are variable to some extent. The fuscous band across dorsum of thorax at axillae and scutellum is often entirely absent, the head sometimes appears entirely fuscous, the prothorax is often blackish, and the mesoscutum occasionally is more or less discolored. In slide-mounted specimens there appears to be a fine median longitudinal groove on mesoscutum and scutellum. In dry-mounted specimens this groove is not easily discernible, but there is always apparent a narrow median line of somewhat paler color.

Described from the type, 10 other slide-mounted specimens, and 44 card-mounted specimens in the National Museum collection.

REVIEW OF LITERATURE

This species was originally described as *Paraphelinus speciosissimus* by Girault in 1911, the type having been collected on the win-

dow of a granary at Urbana, Ill. A translation of the original description into Spanish was published by Garcia Mercet in 1912 in a revision of the then known aphelinids of the world. In 1914 Howard mentioned the species in connection with a discussion of the host relations of the species of *Paraphelinus*. He pointed out that two species of the genus were known to be parasitic in the eggs of Homoptera and Orthoptera placed in twigs and canes and suggested that all the species probably had similar habits. Waterston included *speciosissimus* in a key to the species of the genus *Paraphelinus* published in 1916, and at the same time gave a very interesting summary of the known facts regarding the genus. In the same year the first information regarding hosts of *speciosissimus* was published. A paper by McConnell, appearing in March of that year, recorded the species as attacking the hessian fly in Pennsylvania and gave short descriptions of egg, larva, pupa, and adult, as well as important details regarding its life history. In November a note by Girault recorded it as having been reared by W. J. Phillips at Richmond, Ind., from eggs of what was questionably identified as *Xiphidium* sp.

In 1918 the genus *Paraphelinus* Perkins was synonymized with *Centrodora* Foerster by Mercet and the species *speciosissima* listed in the latter genus. The same synonymy was arrived at by the present author and published in 1919, Mercet's paper at that time being unknown to him. Attention was called in this paper to the great similarity of the American *speciosissima* to the European *C. amoena* Foerster, and the opinion was expressed that the two were probably the same species, but it was deemed advisable to retain the name of *speciosissima* until European specimens could be obtained for comparison. At the same time it was suggested that *Centrodora amoena* and *Agonioneurus locustarum* Giraud were probably identical; and it was pointed out that, if these conjectures proved true, the specific name *locustarum* would supersede both *speciosissima* and *amoena*.

A paper by Mercet published in 1930, however, has apparently cleared up the identity of *locustarum*. In a key to the European species of *Centrodora* he pointed out characters which distinguish *locustarum* from *amoena* and recognized the two as distinct species, this conclusion being based upon a study of paratypes of the former species and upon a specimen which had been compared with the type of the latter species and pronounced identical by Nowicki. Mercet at the same time also pointed out the resemblance between *amoena* and *speciosissima* and remarked that a very careful comparison of the two would be necessary to establish differences between them.

In the light of Mercet's finding regarding *locustarum*, that species need no longer be suspected of being the same as *amoena* or *speciosissima*. On the other hand, Mercet's description and his figures of the antennae of *amoena* agree so closely with specimens of *speciosissima* that the writer is more than ever inclined to believe that they are the same. No European specimens have been examined, however, and it is still deemed inadvisable to synonymize the one with the other without first having the confirmation of such a comparison.

HOSTS AND LIFE HISTORY

The Girault record of this species attacking eggs believed to be those of a species of *Xiphidium* is principally interesting as demonstrating that this species, like all the other species of the genus, normally attacks the eggs of Orthoptera and Homoptera which are inserted in stems and twigs. Its parasitism of the hessian fly, while much more frequently observed, is believed to be either accidental or an acquired habit. In this connection it is interesting to note that, in one instance at least, specimens have been taken under circumstances indicating that the species may at times attack joint-worms, as there are two specimens in the National Museum collection which are said to have been found dead in the gall of *Harmolita tritici* (Fitch) at Sparta, Ill., by F. F. Dicke.

According to McConnell, *Centrodora speciosissima* was first reared in 1915 from hessian-fly puparia collected by P. R. Myers. Since that time it has been reared many times, and it may be said to be a common parasite of that insect.

This *Centrodora* is a primary, internal, gregarious parasite of the hessian fly. McConnell demonstrated that it was a primary parasite by repeatedly getting it to oviposit in puparia known to be free from parasites and rearing it through to the adult. On the other hand, P. R. Myers stated in his unpublished manuscript that it sometimes acts as a secondary parasite, specimens of it having been reared from puparia of the hessian fly which were afterward dissected and found to contain dead remains as well as living adults of *Platygaster*.

According to McConnell, the eggs are deposited in the body cavity of the host after the puparium has been formed, no distinction being made between puparia containing larvae and those containing pupae. In July and August a complete generation of the parasite may develop in 18 to 20 days, indicating the probability of 3 or 4 generations per season. Emergence of the adult is through a hole cut in the side of the host puparium, and as many as 10 adults may mature in a single puparium although the normal number is said by McConnell to be considerably less than 10. The species is said to be capable of reproducing parthenogenetically, unfertilized females producing only males.

DISTRIBUTION

Records of the Bureau of Entomology now show a much wider distribution for this species than that indicated by McConnell in 1916. At that time it was known only from the type locality, Urbana, Ill., and from six localities in Pennsylvania. It is now known to occur in 10 States, viz New York, Pennsylvania, Delaware, Maryland, Virginia, West Virginia, Kentucky, Ohio, Indiana, and Illinois. It has been obtained from numerous localities in Pennsylvania and Maryland, but from relatively few localities in the other States mentioned. This is probably due to the fact that the parasites of the fly have been more extensively studied in these two States than in the others. It is believed that equally careful investigations in the other States would probably show it to be distributed quite as generally there as in Pennsylvania and Maryland.

IMPORTANCE

McConnell pointed out that because of the comparatively short life cycle there is ample time in one season for an enormous multiplication of the species, and he indicated a belief that it might under certain conditions prove to be an important factor in the control of the fly. Investigations carried on at the Carlisle, Pa., laboratory of the Bureau of Entomology covering a period of 10 years, which were published by Hill and Smith in 1928, showed an average annual parasitization of the spring generation of the fly amounting to only 0.11 percent. These figures apparently do not bear out McConnell's hopes, but on the contrary indicate that the species is a nearly negligible factor in the control of the hessian fly.

Family EULOPHIDAE

HORISMENUS TEXANUS (Girault)

(Fig. 29)

Pseudomphale texana Girault, Insecutor Inscitiae Menstruus 4: 120, 1916.

DESCRIPTION

Horismenus texanus differs from all the other parasites of the hessian fly by having a distinct median longitudinal groove running the full length of the scutellum, and by having on the propodeum a narrow, smooth, flat, median area which is bounded on each side by a shallow, slightly depressed, finely punctate area of about the same width as the median area. It differs from other American species of *Horismenus* except *floridanus* Ashmead by having the femora metallic like the thorax. From *floridanus* it differs in that the first tergite (not counting the petiole) constitutes not more than half the length of the abdomen and is quite differently sculptured, while the color of the head and thorax is more metallic.

Female.—Length 2 to 2.4 mm. Head transverse, about as wide as thorax, and about two and one half times as broad as thick antero-posteriorly; ocelli in a nearly equilateral triangle, the posterior ocelli about their own diameter from the eye margins; occiput very slightly concave, finely reticulate-punctate; temples very narrow; eyes ovate, subacute ventrally and conspicuously hairy; vertex and ocellar triangle finely and shallowly reticulated, the area on each side of front ocellus more coarsely and deeply sculptured; front strongly and closely punctate but with the small triangular area above the transverse furrow and a narrow, slightly elevated, triangular, medial area originating between the antennae and extending nearly to the transverse furrow, smooth and polished; face more finely sculptured than the frons; cheeks weakly reticulated; mandibles each with three teeth, the inner tooth a little shorter than the others and more or less notched at apex; labial as well as maxillary palpi 1-jointed. Antennae 10-jointed counting three very minute ring joints, inserted nearly on a line with lower margins of the eyes; scape slender, a little thicker beyond middle; pedicel a little more than twice as long as thick, subequal to the first funicle joint plus ring joints; first funicle joint a little longer than second, the latter a little longer than third which is slightly longer than broad; club 2-jointed, the basal joint a little broader than the funicle joints and approximately one and one half times as long as broad; apical joint much narrower, conical, and ending in a short process. Thorax not twice as long as broad; pronotum short, conical, finely sculptured, its apical border polished and separated from the sculptured portion by a raised line from which a fringe of about six long slender hairs originates; mesonotum

much broader than long, finely reticulate-punctate, the parapsidal grooves complete, the median lobe with 4 long hairs and the scapulae with 2 each; scutellum as long as mesoscutum or a little longer and with similar but slightly weaker sculpture, with one pair of long setae, and with a median longitudinal groove; axillae finely sculptured, broadly separated, and each with one seta; propodeum half as long as scutellum, narrowed into a short and broad neck, smooth except for the two narrow sculptured areas on each side of the neck; propleura, prepectus, and anterior margin of mesepisternum weakly sculptured, remainder of pleura and sternum polished. Legs not thickened, tarsi 4-jointed, the basal joint of hind tarsi not longer than the second joint; hind tibiae with one apical spur. Wings fully developed; fore wing extending to apex of

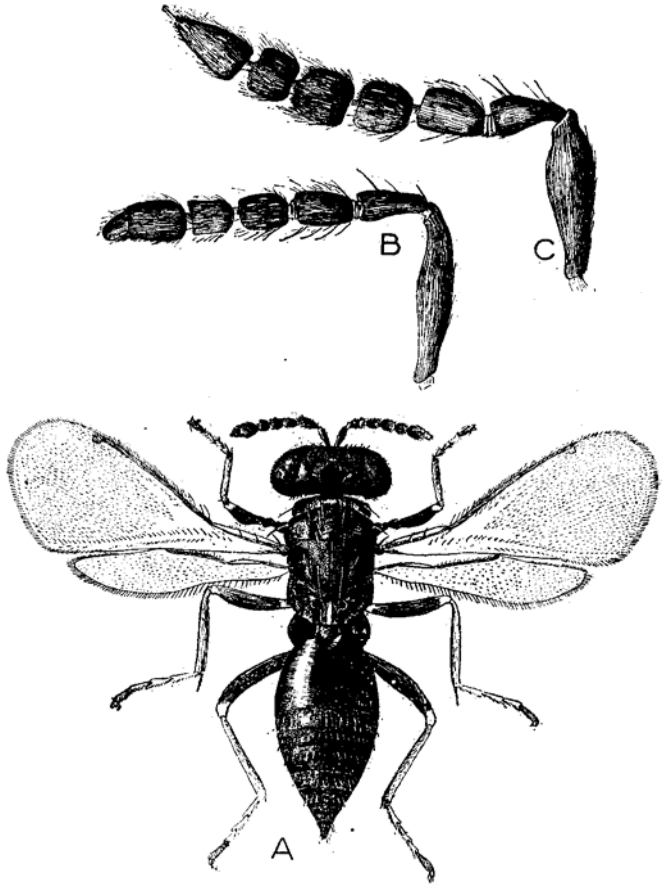


FIGURE 29.—*Horismenus texanus* (Girault): *A*, Adult female; *B*, antenna of female; *C*, antenna of male. *A*, × 24.

abdomen, a little less than two and one half times as long as broad; submarginal vein half as long as marginal; stigmal vein sessile and very short; postmarginal vein rarely a little longer than stigmal; marginal cilia short; submarginal vein dorsally with two setae. Abdomen ovate, as broad as thorax and about as long as head and thorax or a little shorter, distinctly petiolate, the petiole about as long as broad, and finely punctate, with a smooth median longitudinal carina dorsally; first tergite beyond the petiole smooth and polished except for a finely reticulated transverse band between the middle and apex,

this band as broad as the smooth area between it and the apex; following tergites all finely reticulated but with a narrow apical border smooth; first tergite bare dorsally, sparsely hairy laterally, the other tergites hairy; ovipositor not exserted. General color obscure metallic green, the occiput and usually a spot on each side of front ocellus black or bronzy black, the abdomen shining black except that the petiole and the sculptured portions of the tergites are tinted with bronze; antennae black tinged with metallic; all coxae, all trochanters, and all femora metallic like the thorax; narrow apices of femora and all tibiae and tarsi pale yellow; wings hyaline, venation dark brown.

Male.—Length 1.7 to 1.9 mm. Antennae a little longer than in the female, not thickened apically; scape distinctly but not greatly swollen; pedicel twice as long as broad at apex; three ring joints which are very minute; flagellar joints a little thicker than pedicel, joints 1 to 4 successively decreasing very slightly in length, the first about one and one half times as long as thick, the fourth quadrate; last flagellar joint distinctly conical, nearly as long as the two preceding joints combined and terminating in a short spine. Abdomen short, the apical tergites retracted; petiole distinctly longer than broad, opaquely sculptured, with a weak median carina; reticulated band on first tergite less distinct than in the female. Otherwise like the female.

Redescribed from the badly mutilated type specimen and seven additional specimens in the National Museum collection.

REVIEW OF LITERATURE

This species was described from a single female specimen collected by Nathan Banks at College Station, Tex., and the original description apparently constitutes the only reference to it in literature. It was placed by Girault in the genus *Pseudomphale* Schrottky, but this genus is now known to be a synonym of *Horismenus* Walker.

HOSTS AND LIFE HISTORY

Horismenus texanus has been reared from the hessian fly in only a single instance so far as is known, one female having been reared August 24, 1922, from a puparium of that insect collected at Berryville, Va., by H. D. Smith. The record has not been previously published.

The species seems to be a more common parasite of *Meromyza americana* Fitch. It has been reared from that host by P. R. Myers at Hagerstown and Funkstown, Md.; by C. N. Ainslie at Mesilla Park, N.Mex., and by A. F. Satterthwait at Charleston, Mo. V. L. Wildermuth reared it at Sacaton, Ariz., from what was believed to be *M. americana* infesting salt grass (*Distichlis spicata*), and it has been reared from unknown hosts in wheat by J. R. Horton at Charleston, Mo., and by W. J. Phillips at Huntsville, Ala. Three specimens are in the National Museum collection also, which are said to have been reared from *Eumetopiella rufipes* Macquart at Sioux City, Iowa, by C. N. Ainslie.

The species is believed to be a primary parasite of the hosts mentioned. It emerges from the host puparium. Nothing further can be said of its life history.

DISTRIBUTION

Comparatively few records are thus far available for this species, but these indicate a rather wide distribution. These records have already been enumerated. They show the species to have been taken in Maryland, Virginia, Alabama, Missouri, Iowa, Texas, New Mexico, and Arizona, thus indicating a general distribution throughout

the southern part of the United States from the Atlantic nearly to the Pacific. It is apparently absent from a large part of the principal wheat-growing area of the country.

IMPORTANCE

Horismenus texanus is of no importance as a parasite of the hessian fly. Its value in the control of *Meromyza* is not known.

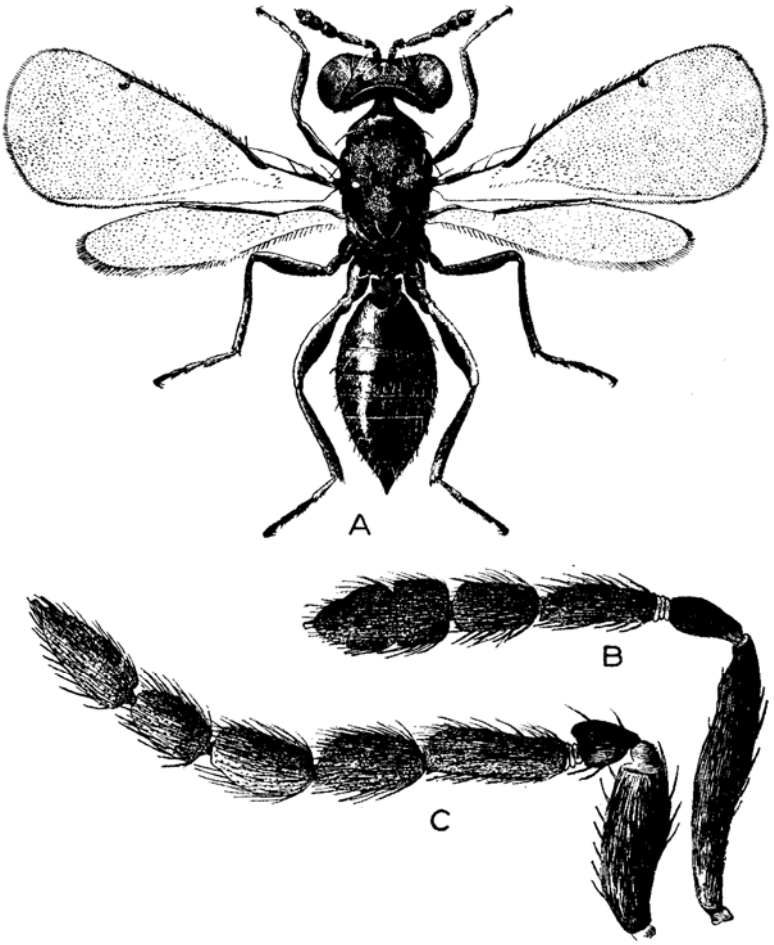


FIGURE 30.—*Pleurotropis benefica* Gahan: *A*, Adult female; *B*, antenna of female; *C*, antenna of male. *A*, × 20.

PLEUROTROPIS BENEFICA Gahan

(Fig. 30)

Pleurotropis sp. Gahan, U.S. Dept. Agr. Bul. 834: 12, 1920.

Pleurotropis benefica Gahan, Ent. Soc. Wash. Proc. 23: 117, fig. 2, 1921; Ries, Jour. Agr. Research 32: 293, 1926; Thompson, Empire Marketing Bd. Pub. 29: 101, 1930; Salt, Bul. Ent. Research 22: 541, 1931; Smith, Bul. Ent. Research 22: 548, 1931; Gahan, Ann. Ent. Soc. Amer. 25: 751, 1932.

DESCRIPTION

Pleurotropis benefica is like *P. metallicus* except in the following particulars:

Female.—Length 3 mm. Postocellar line not quite twice the ocellocular; temples strongly punctate without a smooth border along the eye margin; fovea on each side of clypeus very small and indistinct; occiput clothed with rather coarse, curved hairs along its margin, these hairs densest and most conspicuous opposite narrowest part of temples; antennae weakly clavate; first flagellar joint about three times as long as thick, second joint distinctly shorter than fifth and distinctly longer than third, the latter subquadrate; fourth flagellar joint subquadrate or a little broader than long, fifth much smaller than the fourth, more or less conical and terminating in a process which is much shorter than the body of the segment; mesoscutum usually a little less than twice as wide as long, the depressions terminating parapsidal grooves posteriorly shallow and sculptured like rest of mesoscutum; propodeum entirely impunctate, the median carina and lateral folds strongly developed, the former not double basally but forking at or near the middle of propodeum, the two branches diverging; mesosternum smooth posteriorly; abdomen ovate, about as long as head and thorax combined, the petiole about twice as broad as long, broader at base than at apex, opaquely punctate, carinately margined laterally above and below and often with a weak median longitudinal carina above; first tergite beyond the petiole finely reticulately sculptured on the apical one third, bare except at extreme lateral margins; following tergites hairy, finely reticulated, and dull, except a very narrow apical border on each which is somewhat shining. General color green or bluish green, the face and front somewhat darker and the occiput and more or less of the vertex behind the ocelli dull black; antennae black, the scape slightly metallic; legs all metallic like the thorax, their tarsi all black or very dark fuscous; abdominal petiole dull black, following segment bright metallic green basally, its apical one third and all the remaining segments dull purplish black; wings hyaline, venation blackish.

Male.—Length 2.2 mm. Antennae much longer than that of female, not clavate; the scape slightly thickened, about 4 times as long as broad; pedicel a little longer than broad; ring joints small and transverse; first flagellar joint 3 to 4 times as long as thick, second 2 to 2½ times and the third about twice as long as thick; fourth either as long as third or a little shorter than third; fifth more slender and usually longer than preceding joint and terminating in a short spine; all flagellar joints hairy, distinctly sculptured, and without elongate sensoria. Abdomen short, the segments beyond the fourth usually retracted and concealed; petiole a little longer than broad, about as long as hind coxae, without distinct lateral carinae; apex of first segment beyond petiole very weakly sculptured and sculpture of following segments much less dull than in the female; the lateral margins of tergites form a distinct longitudinal fold on each side of the venter. Color as in the female except that the face is bluish green like the rest of the head and the abdominal tergites beyond the second are more metallic and not so dull as in the female.

Redescribed from the 16 specimens forming the type series which were reared from *Trachelus tabidus* (Fabricius) at Mount Holly Springs and Carlisle, Pa.; 1 specimen reared from the same host in Maryland by the writer, and 3 specimens reared from *Cephus pygmaeus* Linnaeus in the vicinity of Cambridge, England, by George Salt. A single specimen reared from the hessian fly was examined but subsequently lost before this description was drawn.

REVIEW OF LITERATURE

This insect was first mentioned in 1920, when the present author recorded an apparently undescribed species of *Pleurotropis* as attacking the black grain-stem sawfly, *Trachelus tabidus*, in Pennsylvania. The following year a description of the species was published

and the name *Pleurotropis benefica* given to it. Ries recorded the species in 1926 as a parasite of *Cephus pygmaeus* in New York, and in 1930 Thompson listed it as having been reared from the same host in England. In connection with an exhaustive study of the parasites of *C. pygmaeus* in England, undertaken with the view of introducing the more effective ones into western Canada for the purpose of controlling *Cephus cinctus* Norton in that region, George Salt, of the Imperial Institute of Entomology, in 1931 gave an excellent account of *P. benefica* in its relationship to *C. pygmaeus* in England, including descriptions and figures of adult, larva, and pupa. Smith also mentioned the rearing of *P. benefica* from *C. pygmaeus* material obtained in England and shipped to Canada in connection with the same project. A recent paper by the present author mentions the occurrence of the species in England and suggests the possibility that it may have been previously described there. Its similarity to several European described forms is discussed, and the characters by which it seems to differ from these are pointed out.

HOSTS AND LIFE HISTORY

While this species is without doubt primarily a parasite of the grain-stem sawflies, *Trachelus tabidus* and *Cephus pygmaeus*, it is interesting to record the rearing of a single specimen of it from *Phytophaga destructor*. According to Myers' unpublished manuscript, this specimen was reared March 31, 1919, from an isolated puparium of the hessian fly collected at Carlisle, Pa. The specimen was identified by the present author after comparison with the type of *benefica*, but was later lost while being returned to the collector.

Little can be said regarding the life history of this species as a parasite of the hessian fly except that it emerges from the host puparium. Salt has definitely established, however, that it is a primary, solitary, internal parasite of *Cephus pygmaeus*, the parasite larva developing in the body cavity of the host larva, overwintering as a full-grown larva in the cocoon of the host, and emerging as an adult in the spring. No doubt its development as a parasite of the fly is similar.

DISTRIBUTION

Pleurotropis benefica is not known to occur in Europe outside of England. In North America it is at present known only from Maryland, Virginia, Pennsylvania, West Virginia, and New York.

IMPORTANCE

The species is at present of no importance as a parasite of the hessian fly.

PLEUROTROPIS METALLICUS (Nees)

(Fig. 31)

Eulophus metallicus Nees von Esenbeck, Hymenopterorum ichneumonibus affinium monographiae . . . , v. 2, 176, 1834.

Entedon epigonus Walker, Monographia chalciditum, p. 112, 1839; Forbes, U.S.Dept.Agr., Div. Ent., Insect Life 5:72, 1892; Riley, U.S.Dept.Agr., Div. Ent., Insect Life 6:133, 1893; Howard, U.S.Dept.Agr., Div.Ent., Insect Life 6:375, 1893; 7:356, fig. 36, and 414, 1895; Marlatt, U.S.Dept.Agr., Div. Ent. Circ. (2nd ser. rev.) 12:3, 1895; Marchal, Ann. Soc. Ent. France 66:81,

1897; Pospjelov, Illus. Ztschr. Ent. 5:263, fig. 6, 1900; Marlatt, U.S. Dept. Agr. Farmers' Bul. 132:19, 1901; Felt, N.Y. State Ent. Rpt. 17 (Mus. Bul. 53):722, fig. 5, 1902; Pospjelov, Choziajstva [Kiev] 2:152, 1907; Bachmetjev, Ztschr. Wiss. Insektenbiol. 4:350, 1908; Webster, U.S.Dept.Agr., Bur. Ent. Circ. 70:11, 1906; Howard and Fiske, U.S.Dept.Agr., Bur. Ent. Bul. 91:30, 1911; Webster, U.S. Dept. Agr. Farmers' Bul. 640:14, 1915; Miller, New Zeal. Jour. Agr. 19:205, 1919; Znamenski, Poltava Agr. Expt. Sta., Ent. Dept. Bul. 2:1925 (abstract in Rev. Appl. Ent. (A) 12:291, 1924).

Entedon metallicus Walker, List of specimens of hymenopterous insects in the collection of the British Museum, pt. 2, p. 136, 1848; Dalla Torre, Catalogus hymenopterorum . . . , v. 5, p. 40, 1898; Schmiedeknecht, Hymenoptera,

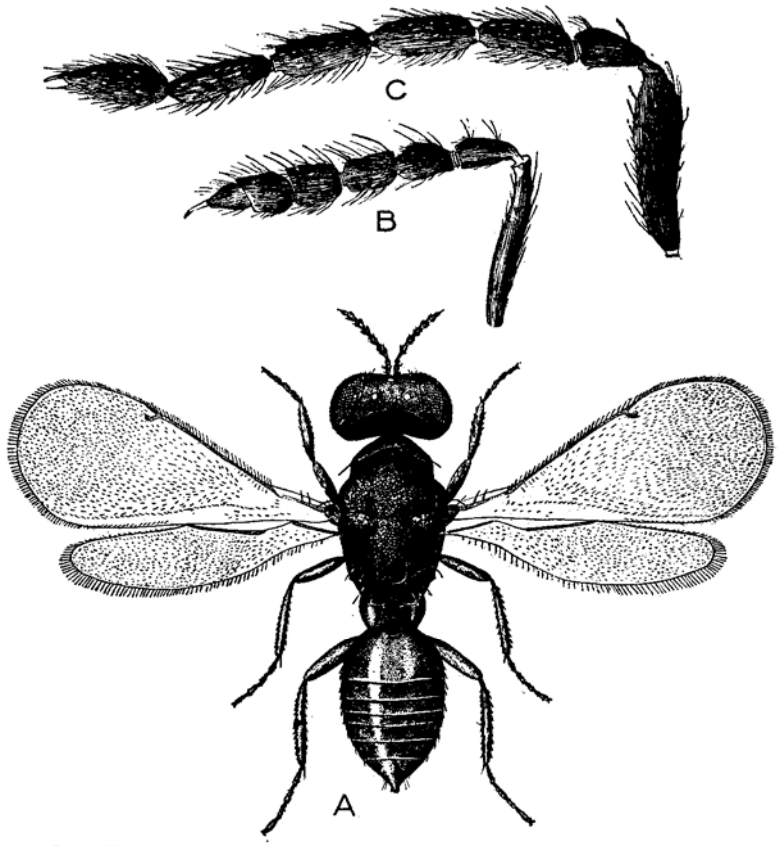


FIGURE 31.—*Pleurotropis metallicus* (Nees): *A*, Adult female; *B*, antenna of female; *C*, antenna of male. *A*, × 28.

Fam. Chalcididae, *in* Genera insectorum, fasc. 97, p. 440, 1909; Treherne, Ontario Ent. Soc. Rpt. 46:189, 1916; Meyer, Rpt. Appl. Ent. Leningrad 4:241, 1929; Gourlay, New Zeal. Dept. Sci. Indus. Research Bul. 22:6, 1930; Blunck, Ztschr. Angew. Ent. 18:588, 1931.

Semiotellus nigripes Lindeman, Bul. Soc. Nat. Moscou (2) 1:179, 185, 192, 1887; Ormerod, Entomologist 20:317, 1887; Enock, Entomologist 21:203, 1888; Riley, U.S.Dept.Agr., Div. Ent., Insect Life 1:132, 1888; Enock, Ent. Soc. London, Trans. 1891:359; Forbes, U.S.Dept.Agr., Div. Ent., Insect Life 4:179, 1891; Riley, U.S. Dept. Agr. Rpt. Ent. 1891:235, 1892; 1892:158, 1893; 1893:211, 1894; Dalla Torre, Catalogus hymenopterorum . . . , v. 5, p. 212, 1898; Collin, Ann. Appl. Biol. 5:90, 1918; Meyer, Ztschr. Angew. Ent. 9:116, 1923; Imms, Parasitology 22:33, 1930.

Pleurotropis epigonus McConnell, Jour. Econ. Ent. 9: 145–147, 1916; Myers, U.S. Natl. Mus. Proc. 53: 255, 1917; Wade and Myers, Ent. Soc. Wash. Proc. 23: 202, 1921; Howard, Natl. Acad. Sci. Proc. 10: 18, 1924; Hill and Smith, Jour. Agr. Research 36: 153, 1928.

DESCRIPTION

Pleurotropis metallicus may be distinguished from all other hessian-fly parasites, except *P. benefica*, by the fact that the inner margins of the eyes are broadly emarginate, the eyes are closer together below the antennae than at the vertex, the propodeum medially has two very delicate, parallel, and very narrowly separated longitudinal carinae which diverge posteriorly, the lateral folds of the propodeum are distinctly carinate, and the color of head and thorax is highly metallic blue-green. It can be distinguished from *benefica* by the fact that the abdominal petiole in the female is as long as broad, the first tergite beyond the petiole is perfectly smooth and polished, and the median propodeal carina is double for its whole length.

Female.—Length 1.8 to 2.2 mm. Head transverse, a little broader than thorax and about three times as broad as thick antero-posteriorly at the middle, broadly concave behind, the occiput perpendicular to the vertex, the latter carinately margined behind; ocelli in an obtuse triangle, postocellar line more than twice the ocellocular line, the latter about equal to diameter of an ocellus; temples very narrow above, broader below, not receding; eyes moderately large, pyriform, with short but distinct pile, distinctly closer together below the antennae than at vertex, the inner eye margins broadly emarginate near middle, the posterior margin also slightly concave; malar space very short; frons with a curved transverse groove near middle, rather strongly depressed medially, with a low ridge extending upward between the antennae to the transverse groove; clypeus not separated from face, its anterior margin practically straight, with a round shallow fovea at each anterior lateral angle; mandibles bidentate; maxillary palpi 1-jointed, with a long terminal seta and also a lateral seta which is attached basad of the middle and extends beyond the apex; labial palpi also 1-jointed, with a long terminal seta and a shorter lateral one; vertex and frons strongly reticulate-punctate, shining; face and clypeus more finely sculptured than frons; temples strongly punctate but with a narrow orbital strip more weakly sculptured; occiput finely reticulate-punctate, not conspicuously hairy. Antennae 10-jointed, inserted well below middle of face but above lower extremities of eyes, not distinctly clavate; scape slender, slightly curved, reaching to the level of front ocellus, reticulately sculptured on inner side, smooth outwardly, about as long as combined pedicel, ring joints, and two basal joints of funicle; pedicel about twice as long as thick at apex; three very small transverse ring joints; flagellar joints hairy, without elongate sensoria; the first joint the longest, about twice as long as thick, a little broader than pedicel; second joint a little shorter than the first and a little longer than the third, the latter usually subquadrate or only slightly longer than broad; fourth joint also subquadrate and equal to the third; fifth joint much narrower at base than the preceding joint, conical, terminating in a slender process which is usually about half as long as the body of the segment. Thorax about twice as long as broad; pronotum short, conical, on a much lower plane than mesonotum, reticulate-punctate except a narrow transverse smooth area at the posterior margin, this smooth area separated from the sculptured declivous anterior portion by a delicate carinate line and with a few long hairs springing from this line; mesoscutum about twice as broad as long, convex, strongly reticulate-punctate, the parapsidal grooves complete but delicately impressed, except posteriorly where each groove terminates in a broad depression that is sculptured within like the remainder of mesocutum, the median lobe of mesoscutum with 4, and the lateral lobes each with 2, long setae; scutellum uniformly sculptured like mesoscutum and with a single pair of long hairs a little behind the middle; axillae widely separated, sculptured like scutellum; propodeum about half as long as scutellum, mostly smooth but more or less distinctly punctate posteriorly, especially toward the middle, with two very delicate and narrowly separated carinae at the middle which are parallel anteriorly but diverge somewhat posteriorly, the lateral folds carinate and nearly straight,

spiracular sulci deep and nearly straight, spiracles small and round; mesopleura mostly reticulated but with a smooth area medially and another posteriorly; mesosternum mostly smooth; metapleurum very small, nearly smooth, and with a short projecting tooth or tubercle posteriorly. Legs slender; tarsi 4-jointed; hind coxae weakly reticulated. Wings fully developed, the fore wing extending beyond apex of abdomen; submarginal vein with two erect bristles dorsally; marginal vein more than twice the submarginal, stigmal and postmarginal veins subequal, both short; base of wing mostly bare. Abdomen ovate, about as long as thorax, distinctly petiolate; petiole about as long as broad, finely and closely punctate, the anterior dorsal margin produced slightly forward so that it overlaps the apex of propodeum; first tergite (not counting the petiole) comprising approximately one third to one half the total length of abdomen, perfectly smooth, and highly polished; following tergites distinctly reticulated basally, smooth at apex, the sixth and seventh almost entirely sculptured; ovipositor not exserted. General color bright green or bluish green, the frons and face with a bronzy cast and the occiput dull black; antennae black, the scape slightly metallic; legs all metallic green, their tarsi black or blackish; petiole black; first tergite bright metallic green, following tergites and the sternites bronzy black; wings hyaline, venation blackish.

Male.—Length 1.2 to 1.6 mm. Antennae 10-jointed, much longer than in the female; scape slightly and nearly uniformly thickened throughout its length, about four times as long as thick, reticulated on its inner side, smooth on its outer side; pedicel about one and one half times as long as thick; three transverse ring joints (distinct only when slide-mounted); flagellum not thicker at apex than at base, 5-jointed, the joints subequal and rather distinctly separated, the first four each approximately three times as long as thick, the apical joint elongate oval and ending in a distinct process or spine which is not over one fourth the length of body of segment; the whole flagellum moderately hairy, the joints without any elongate sensoria. Abdomen short, the apical segments usually retracted, the abdomen thus appearing squarely truncate at apex; petiole a little longer than broad, opaquely punctate; first segment beyond the petiole smooth and polished. Otherwise like the female except that the face and frons are not tinted with bronze.

Described from the following material: 6 specimens bearing the label *Semiotellus nigripes* Lindeman in Lindeman's own handwriting, received by Riley or Howard from the author of the species and probably constituting a part of the type material; 14 mounted and many unmounted specimens received in 1890, 10 received in 1891, and 5 others in 1894, all reared from puparia of the hessian fly collected by Fred Enock in England; 2 specimens reared from the fly by W. D. Taylor at Daleally, Errol, New Brunswick; and 66 specimens reared from the fly in various localities in the eastern part of the United States.

REVIEW OF LITERATURE

Nees described *Eulophus metallicus* in 1834 from specimens of both sexes taken on oak at Sickershausen, Germany. Five years later Walker described *Entedon epigonus* from specimens collected near London, England, on the Isle of Jersey, and in Ireland. In 1848 he synonymized his species with *metallicus* Nees, which he transferred to the genus *Entedon*. In 1887 Lindeman characterized as *Semiotellus nigripes* a parasite reared by him from the hessian fly in Russia, and Miss Ormerod, who was at the time investigating the recent appearance of the hessian fly in England, reared parasites from it in that country which were identified for her by Lindeman as *S. nigripes*. The occurrence of this parasite in England was confirmed by Riley, and also by Enock, the following year. In 1891 Enock wrote of having sent to Riley a large number of fly puparia containing *S. nigripes* with a view to the establishment of the para-

site in North America, and Forbes, as well as Riley, published brief accounts of the receipt of the material and its distribution in Illinois, Indiana, Michigan, and Canada. The following year Forbes again mentioned the introduction, stating that he had not succeeded in recovering the parasite from the areas in Illinois where it had been released. In this paper Forbes stated incidentally that Riley had compared specimens of *S. nigripes* Lindeman with the types of *Entedon epigonus* Walker in the British Museum and found them to be the same. This seems to have been the first recognition of Lindeman's species as a synonym. The statement by Forbes was confirmed by Riley in his annual report for 1891.

Many other references to the species occur in the literature of both Europe and North America, but few of these are of much interest. Howard recorded in 1894 a second attempt at introduction of it into North America, specimens received from England having been released in Maryland. The first recovery of the parasite was announced the following year, also by Howard, who stated that a single specimen had been captured in a field at Cecilton, Md., where a part of the imported material had previously been released. In 1916 McConnell published a short review of its introduction into this country and cited six localities in Maryland and Pennsylvania where it had been recovered. At the writer's suggestion, McConnell treated the species under the name *Pleurotropis epigonus*, this being the first recognition of it as belonging in the genus *Pleurotropis*. In 1918 Collin recorded *S. nigripes* as a parasite of *Oscinella frit* in England, and the following year Miller discussed it as a factor in the control of the hessian fly in New Zealand. The facts regarding its introduction into North America were again reviewed by Wade and Myers in 1921, and a list was given of 150 localities scattered through 13 States where it had been found up to that time.

Hans Blunck has recently recorded as *Entedon metallicus* Nees a parasite reared by him in Pomerania from *Mayetiola phalaris* Barnes, the identification having been made by L. Bïro.

Most writers have treated this species under the specific name *epigonus* despite the early synonymizing by Walker of that name with *metallicus* Nees and despite the fact, also, that the Walker synonymy was accepted as correct by both Dalla Torre and Schmiedeknecht in their catalogs of the Chalcidoidea. No one seems to have given any reason for rejecting the synonymy, even though it has been generally ignored. The writer has been unable to find anything in the description by Nees to indicate that *metallicus* is different from *epigonus;* and since Walker had specimens from Prussia, which he presumably compared with his own types and declared to be the same, there appears to be no good reason why this synonymy should not be accepted and the specific name *metallicus* be applied to this common parasite of the hessian fly.

Generically this species conforms much more closely to *Pleurotropis* than it does to *Entedon*. The propodeum, in having the median carina double as well as in having the lateral folds strongly carinate, agrees with *Pleurotropis* but differs markedly from *Entedon*. In all other characters, too, it seems to coincide with *Pleurotropis*, and in the writer's opinion that is where it should be placed.

HOSTS AND LIFE HISTORY

Besides the hessian fly, the only other known hosts for *Pleurotropis metallicus* are *Oscinella frit* (Linnaeus), first recorded by Collin, and later mentioned by Meyer and Imms, and *Mayetiola phalaris* Barnes recently recorded by Blunck.

Little is known of the life history, but it is believed to be a primary, solitary, internal parasite. McConnell states that he obtained emergence of adults in cages from April to June, inclusive, and from September to December, inclusive. Emergence is from the puparium of the fly.

DISTRIBUTION

Apparently this species is widely distributed in Europe, having been recorded from various parts of Russia, from Germany, and from the British Isles.

In North America, as has already been stated, Wade and Myers listed 13 States in which it had been found up to 1921. These States were Virginia, Maryland, Delaware, New Jersey, Pennsylvania, New York, Ohio, West Virginia, Indiana, Michigan, Illinois, Oregon, and Washington. Fletcher in 1900 and Treherne in 1916 recorded what was probably this species from Prince Edward Island, Canada. So far as the writer is aware, no additional records have been secured that would extend this known distribution.

The presence of the species in most of the area indicated can perhaps be accounted for by the supposition of natural spread from the original points of introduction. Its presence in Oregon and Washington, however, can hardly have come about in this way. There is apparently no record of its intentional introduction into that area, and a wide area in which the species is not known to occur intervenes between these far Western States and the nearest point of intentional release of it. Its presence in these States apparently must be accounted for on the basis of accidental introduction, probably through the agency of commerce.

IMPORTANCE

According to Hill and Smith this species ranks fifth in importance as a parasite of the fly in the Middle Atlantic States. Over a period of 10 years it showed an average of only 1.13 percent parasitization of the fly, however, with a maximum in any one year of 3.59 percent. These percentages are not sufficiently high to indicate that the species is more than a rather minor factor in the control of the fly.

TETRASTICHUS CARINATUS Forbes

(Fig. 32)

Tetrastichus carinatus Forbes, Ill. State Ent. Rpt. (1884) 14: 48, 1885; Riley, U.S. Natl. Mus. Proc. (1885) 8: 421, 1886; Amer. Nat. 19: 1105, 1885; Amer. Assoc. Adv. Sci. Proc. (1885) 34: 334, 1886; Lindeman, Bul. Soc. Nat. Moscou (2) 1: 185, 1887; Cresson, Synopsis of the families and genera of the Hymenoptera of America, north of Mexico . . . , p. 245, 1887; Osborn, U.S.Dept.Agr., Div. Ent. Bul. (n.s.) 16: 28, 37, 1898; Dalla Torre, Catalogus hymenopterorum . . ., v. 5, p. 12, 1898; Sanderson, Del. Agr. Expt. Sta. Rpt. 12: 207, 1901; Ainslie, Ent. Soc. Wash. Proc. 10: 15, 1908; Folsom, Ill. Agr. Expt. Sta. Bul. 134: 122, 1909; Headlee and Parker, Kans. Agr. Expt. Sta. Bull. 188: 109, 1913; Felt, N.Y. State Ent. Rpt. 28 (Mus. Bul. 165): 39, 1913; Hill and Smith,

Jour. Agr. Research 36: 153, 1928; Wehrle, N.Y. (Cornell) Agr. Expt. Sta. Bul. 481: 29, 1929.

Tetrastichus rileyi Lindeman, Bul. Soc. Nat. Moscou (2) 1: 183, 1887; Ormerod, Entomologist 20: 317, 1887; Riley, U.S.Dept.Agr., Div. Ent., Insect Life 1: 132, 1888; Meyer, Rpt. Appl. Ent. Leningrad 4: 241, 1929; Blunck, Ztschr. Angew. Ent. 18: 589, 1931.

Tetrastichus sp. Washburn, Minn. State Ent. Bul. 77: 7, 1902; Ainslie, Ent. Soc. Wash. Proc. 10: 15, 1908.

DESCRIPTION

Tetrastichus carinatus differs from all other parasites said to attack the hessian fly except *T. productus* Riley and *ainsliei* Gahan, by the

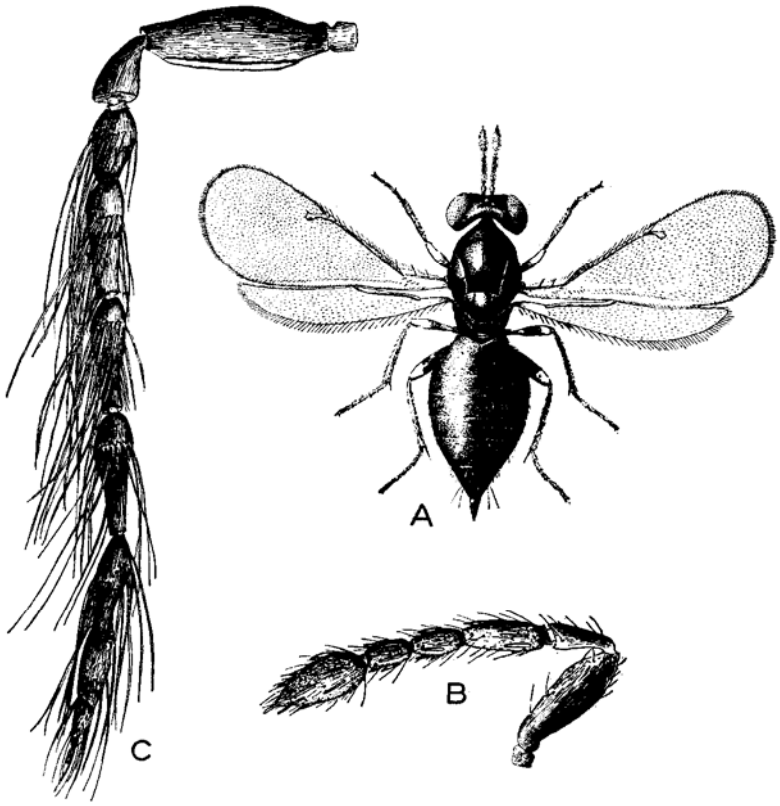


FIGURE 32.—*Tetrastichus carinatus* Forbes: *A*, Adult female; *B*, antenna of female; *C*, antenna of male. *A*, × 24.

two parallel grooved lines running from the base to the apex of the scutellum. From *T. productus* it may be distinguished by the broader, shorter, and less conical abdomen, by the less strongly sculptured propodeum, and by the usually paler femora.

Female.—Length 0.8 to 2 mm. Head transverse, concave in front (frequently collapsed); occiput slightly concave; ocelli in a low triangle, lateral ocellus about twice its own diameter from the eye margin; eyes very nearly bare, extending to the back of head, the temples absent; malar space equal to nearly half the eye height; frons deeply and broadly depressed, with a median

carina at bottom of the depression; mandibles each with 3 teeth, the outer tooth slightly longer and more acute than the other 2; maxillary palpi composed of a single joint, about 5 times as long as wide at base, blunt at apex, with 3 apical setae, and another long seta located a little before the middle of joint; labial palpi also 1-jointed, about twice as long as broad and with about 3 unequal spines at apex; whole head with rather fine weak sculpture. Antennae 9-jointed, weakly clavate, inserted a little above the lower extremities of the eyes, and clothed with brownish hairs; scape about as long as pedicel, ring joint, and first funicle joint, slightly compressed and a little curved; pedicel a little more than twice as long as thick at apex; 1 transverse and very short ring joint; funicle 3-jointed, the first joint nearly 1½ times the length of pedicel and of about the same thickness as pedicel; second funicle joint about equal to pedicel, third a little shorter than second; club pointed ovate, 3-jointed, not longer than the 2 preceding joints together, distinctly a little thicker than the funicle joints and terminating in a short spine; elongate sensoria unusually prominent, occurring in a single more or less irregular series on each of the funicle and club joints and appearing as low carinalike processes the apices of which project somewhat from the surface of the segment. Thorax finely lineolate or reticulate; prothorax short, obconic, sparsely hairy posteriorly; mesoscutum broader at the tegulae than long down the middle, the parapsidal grooves deep and complete, the middle lobe (prescutum) with a very fine but distinct median longitudinal suture and bare except for a distinct row of hairs along each side near the parapsidal grooves; lateral lobes (scapulae) sparsely hairy; scutellum strongly convex, rounded posteriorly, with 2 distinct longitudinal grooves dorsally, bare except for 2 moderately long hairs on each of the dorsolateral sclerites; axillae widely separated, advanced forward along the parapsidal groove for nearly half the length of the groove; propodeum very short medially, longer laterally, with a weak median carina but without lateral folds or spiracular sulci and weakly reticulately sculptured; pleura reticulated. Legs normal; tarsi 4-jointed; hind coxae faintly reticulated; hind tibia with 1 spur which is very slightly shorter than the first tarsal joint; middle tibial spur a little longer than first tarsal joint. Wings well developed; fore wing extending well beyond apex of abdomen, a little more than twice as long as broad, bare basally behind the submarginal vein, except for a transverse row of hairs running obliquely proximad from the base of marginal vein and joining a longitudinal row which parallels the posterior margin of wing; marginal cilia short; marginal vein longer than submarginal, about 4 times as long as stigmal; postmarginal vein absent or represented by a very short stub; submarginal vein with 2 to 4 erect short hairs dorsally. Abdomen as broad or somewhat broader than thorax, about as long as head and thorax together, broadly ovate with the apex acute; weakly reticulately sculptured, the tergites except the first sparsely hairy; ovipositor not exserted. Head and thorax metallic blue or green, often more or less aeneous; oral margins, mandibles, and other mouth parts yellowish; antennae, including scape, brownish black; coxae concolorous with pleura; femora often wholly pale yellow but frequently all 3 pairs marked with a broad fuscous or blackish patch or band which, in some cases, embraces half or more than half the segment; tibiae and tarsi, except apical tarsal joint, pale yellow; abdomen aeneous black; wings hyaline, venation dark brown.

Male.—Length 1.5 mm. Antennae nearly two thirds as long as body, not clavate, 10-jointed with one ring joint; scape compressed, about two and one half times as long as broad; pedicel one and one half times as long as thick; funicle 4-jointed, the joints narrower at apex than at base, somewhat vase shaped, each with a whorl of very long hairs which extend to or beyond the apex of the following segment; first joint the shortest, about equal to pedicel; second, third, and fourth joints subequal, each about three times as long as their greatest breadth; club 3-jointed, the joints not so distinctly separated as those of funicle; the first and second joints each with a whorl of long hairs, subequal in length, shorter than the funicle joints; apical joint a little shorter than preceding, with a few shorter hairs, and terminating in a blunt spine or process at apex. Abdomen not longer than thorax, convex above, not acute at apex. Color and other characters as in the female.

Described from 84 specimens reared in America and 9 reared in Europe from the hessian fly. Details regarding this material are given in the discussion under the review of literature.

REVIEW OF LITERATURE

Tetrastichus carinatus was described by Forbes in 1885 from specimens reared by him from wheat stems infested with the hessian fly collected at Anna, Ill. At nearly the same time Riley published the description of *T. productus* Riley. In connection with his description, Riley mentioned the fact that he had received from Forbes a single specimen of *T. carinatus*, and he pointed out several differences between his own species and the one of Forbes. Riley's remarks were reviewed later in the same year in the American Naturalist and in the Proceedings of the American Association for the Advancement of Science. Osborn reproduced Forbes' description in his bulletin on the hessian fly in 1898. In 1901 Sanderson recorded *T. carinatus* as a parasite of *Dasyneura leguminicola* (Lintner) in Delaware. Ainslie published a short note in 1908, in which he figured a puparium of the hessian fly parasitized by a *Platygaster* with one of the *Platygaster* pupation cells occupied by an unidentified species of *Tetrastichus*. This *Tetrastichus* is now believed to have been *T. carinatus*. In 1909 Folsom recorded the rearing of two unidentified species of *Tetrastichus* from *Dasyneura leguminicola*, the clover seed midge, in Illinois and incidentally mentioned that Sanderson had reared *T. carinatus* in Delaware in 1900 from the same midge. In 1913 Felt stated that *T. carinatus* was abundant as a parasite of the hessian fly in New York, and in 1928 Hill and Smith discussed the species in their paper on the relative abundance of hessian-fly parasites in the eastern part of the United States.

Two years after the description of *T. carinatus* and *T. productus*, there appeared the description of *Tetrastichus rileyi* Lindeman, based upon specimens reared from the hessian fly in Russia. Lindeman compared this species with *productus* Riley, pointing out certain distinguishing characteristics. He did not separate it from *carinatus*, although he mentioned that species in a footnote. Miss Ormerod submitted to Lindeman specimens which she had reared from the fly in England, and he identified them as *T. rileyi*. At nearly the same time, Riley also studied material reared from the fly in England, and in it he, too, found specimens which he identified as *T. rileyi*. Blunck has recently recorded *T. rileyi* as a parasite of *Mayetiola phalaris* in Pomerania, Germany.

In the National Museum collection are the remains of five specimens mounted with minuten pins on a single piece of cork and bearing the label "*Tetrastichus rileyi* Ldm." in what is believed to be Lindeman's own handwriting. These specimens bear no locality or other label except the name label, but L. O. Howard has assured the writer that they were received from Lindeman and that in all probability they represent a part of the type material. Only parts of these specimens now remain, but enough to permit the positive statement that *T. rileyi* is identical with *T. carinatus*. This opinion is confirmed by a single well-preserved specimen reared from the hessian fly in Russia by T. Cheviroff, apparently at St. Petersburg (now Leningrad), which is not only identical with what remains of the Lindeman specimens of *T. rileyi* but is also in every respect a typical representative of *T. carinatus*. Three additional specimens in the collection which belong to the species *carinatus* are from England, dated May 23, 1894.

The American material studied includes one female sent to Riley by Forbes and believed to be a paratype, another specimen which was compared with the actual type by both J. C. Crawford and the writer and pronounced a homotype, and many additional specimens reared from the hessian fly by Webster, McConnell, Myers, Larrimer, Reeher, and others.

HOSTS AND LIFE HISTORY

Hosts thus far recorded for *T. carinatus* are *Phytophaga destructor* (Say), *Dasyneura leguminicola* (Lintner), *Mayetiola phalaris* Barnes, and *Platygaster* sp. Myers states in his unpublished manuscript that at least 9 instances have been observed in which minute female specimens of *T. carinatus* emerged from hessian-fly puparia containing *Platygaster* cocoons and in 5 of these instances the *Platygaster* has been identified as *P. vernalis* Myers=*zosine* Walker.

Early authors, such as Riley, Lindeman, and Osborn, regarded this species as a true secondary parasite, but more recent investigations by McConnell, Myers, Hill, and others have shown it to be normally a primary, internal, solitary parasite of hessian-fly larvae of the spring generation, becoming secondary only occasionally when by accident the female oviposits in a larva that is already occupied by *Platygaster*.

Details of its life history are unknown to the writer. Emergence takes place from the fly puparium.

DISTRIBUTION

European literature, so far as known, records the species from England, Germany, and Russia. European material seen by the writer is limited to England and Russia. It is highly improbable, however, that its distribution in Europe is so limited as the few available records indicate.

In North America *T. carinatus* appears to be distributed throughout the wheat-growing area east of the Mississippi River, but it has not, to the writer's knowledge, been taken west of that river except in the far Northwestern State of Washington. Definite records of its occurrence have been obtained from New York, New Jersey, Pennsylvania, Maryland, Delaware, Virginia, North Carolina, West Virginia, Kentucky, Ohio, Michigan, Indiana, Illinois, Washington, and the Province of Ontario, Canada. It seems highly improbable that the species, which was first found in Illinois nearly 50 years ago, does not occur in the neighboring States of Iowa, Missouri, and Minnesota. Future investigations will very likely disclose its presence in all three of these States and possibly farther west, although the dry climate and higher temperatures of Kansas and Nebraska may account for its absence there.

IMPORTANCE

According to Hill and Smith, *T. carinatus* ranks seventh in importance among parasites of the fly in the Eastern States. Myers' manuscript states that the maximum percentage of parasitization by this species obtained in a single collection of puparia was 12 percent, while Smith and Hill found an average parasitization by it over a 10-year period of only 0.57 percent, with a maximum for any one season of 2.07 percent.

TETRASTICHUS PRODUCTUS Riley

Tetrastichus productus Riley, U.S. Natl. Mus. Proc. (1885) 8: 419, 421, 1886; Amer. Nat. 19: 1104, 1885; Amer. Assoc. Adv. Sci. Proc. (1885) 34: 333, 1886; Cresson, Synopsis of the families and genera of Hymenoptera of America, north of Mexico . . ., p. 246, 1887; Lindeman, Bul. Soc. Nat. Moscou (2) 1: 183, 1887; Marchal, Ann. Soc. Ent. France 66: 81, 1897; Osborn, U.S.Dept.Agr., Div. Ent. Bul. (n.s.) 16: 28, 37, 1898; Dalla Torre, Catalogus hymenopterorum . . ., v. 5, p. 21, 1898; Ainslie, Ent. Soc. Wash. Proc. 10: 14, 1908; Viereck, *in* Smith, Insects of New Jersey . . ., p. 639, 1910; Viereck, Conn. State Geol. and Nat. Hist. Survey Bul. 32: 454, 1916; Headlee and Parker, Kans. Agr. Expt. Sta. Bul. 188: 109, 1913.

DESCRIPTION

As already indicated, *Tetrastichus productus*, like *T. carinatus*, may be distinguished from other parasites of the hessian fly by the presence of two parallel grooves on the dorsum of the scutellum. The foregoing description of *carinatus* will apply to *productus* except in the following respects:

Female.—Length 1.75 to 2 mm. There is no distinct carina at the bottom of the frontal depression and the sculpture of the head is a little less distinct than in *carinatus*. The antennal pedicel is narrower and much shorter than the first funicle joint, about one and one half times as long as thick; funicle joints subequal or successively diminishing very slightly in length, each about twice as long as thick and distinctly longer than the pedicel; club not thicker than the funicle joints, distinctly 3-jointed, the apical joint terminating in a short spine. Thorax as in *carinatus*, except that it is a little narrower and the sculpture of the mesoscutum is a little less distinct. The propodeum is a little longer than in *carinatus*, with a distinct median carina, and with the sculpture consisting of fine deep reticulate punctures, the whole surface dull. Hind coxae outwardly on basal half sculptured like propodeum; middle spur not quite equal to first tarsal joint. Wings extending barely to apex of abdomen; submarginal vein with only one erect bristle dorsally; marginal vein about three times as long as stigmal. Abdomen elongated, distinctly longer than head and thorax, conical, not broader than thorax, the apex acute. Color shining black, the mesoscutum sometimes with a greenish cast; the abdomen usually more or less metallic; trochanters, apices of all femora, all tibiae, and all tarsi pale yellow; all coxae and femora, except apices of latter, black. Wings hyaline, venation brown; antennal flagellum brownish, scape brownish testaceous.

Male.—Length 1.5 mm. Antennae nearly two thirds as long as the body, 10-jointed with one ring joint; scape slightly compressed, about as in *carinatus*; funicle 4-jointed, the joints cylindrical, not vase shaped; the first funicle joint the shortest, about twice as long as broad; three following joints subequal and about three times as long as broad; each of the four funicle joints with numerous coarse hairs, the first three with a part whorl of suberect curved setae on the dorsal side at base, none of these hairs, however, being much longer than the joints from which they spring; the fourth funicle joint apparently without such a whorl of setae, or if present it is less distinct than on the other segments; club distinctly 3-jointed, not broader than funicle, distinctly hairy, but the hairs apparently not arranged in whorls and not much longer than the segment, the three club joints together not quite so long as the two preceding funicle joints. Abdomen not longer than the thorax, slightly compressed from the sides, blunt at apex. Color as in the female.

Described from the type series in the United States National Museum comprising 7 females and 5 males.

REVIEW OF LITERATURE

Tetrastichus productus was originally described by Riley in 1885 from specimens said to have been reared from overwintering coarctate larvae of the hessian fly collected at Cadet, Mo. The species has been mentioned frequently by subsequent writers dealing with

parasites of the fly, but in every instance these references appear to be merely citations to, or repetitions of, the original record. In none of them is it stated that the species has been again reared or collected.

Furthermore, despite the fact that the fly has been under almost continuous observation and study for many years, during which time numerous investigators of the Bureau of Entomology, as well as other individuals, have carried on extensive and intensive studies of the parasites, literally thousands of all stages of the fly having been collected and many thousands of parasites reared, apparently no one has ever again reared or collected *Tetrastichus productus*. If the species was actually reared from the fly originally, it is hard to account for its failure to reappear upon that host over a period of nearly 50 years. Although Riley definitely asserts that the type material was reared from coarctate larvae of the hessian fly, statements elsewhere in the same paper indicate that infested straws may have been placed in cages for emergence of the parasites, in which case there is a distinct chance that some insect or insects other than the hessian fly may have been introduced and may have served as host to this *Tetrastichus*. Color is lent to this assumption by the further statement of Riley that a *Microgaster* was also reared from wheat straw infested with the fly. In this case it is certain that the host was not the hessian fly but some accidentally introduced species, and there is at least a possibility that the same may be true of the host of the *Tetrastichus*.

Nothing is known of the real hosts or of the life history of *T. productus*. Riley believed it to be a secondary parasite, basing this belief on the assumption that, since some species of the genus were secondary, all others must be likewise, a theory now thoroughly exploded insofar as the Chalcidoidea are concerned.

TETRASTICHUS AINSLIEI Gahan

Tetrastichus ainsliei Gahan, U.S.Natl. Mus. Proc. 53: 214, 1917.

DESCRIPTION

Tetrastichus ainsliei is similar in most structural characters to *T. carinatus* and *T. productus*, but distinguishable at once by the broad whitish band at the base of the abdomen in both sexes. It further differs from *carinatus* by being more slender, by lacking metallic coloration on the head and thorax, by being less distinctly sculptured, and by having the first and second funicle joints subequal. It differs from *productus* principally by having the abdomen of the female short ovate, about as long as the thorax, and the femora and tibiae all pale.

Both sexes are deep shining black; the flagellum brownish black; scape, basal third of abdomen, and all legs pale yellow, the front coxae mostly and the median and hind coxae basally black; mandibles reddish; wings hyaline, venation pale. The propodeum is distinctly very finely punctate and has a weak median carina. The submarginal vein has only one erect bristle.

Redescribed from the types and 11 additional specimens in the United States National Museum.

REVIEW OF LITERATURE

This species has not been mentioned in the literature since the original description. It was described from specimens reared at Elk Point, S.Dak., by C. N. Ainslie from *Mordellistena* sp.

HOSTS AND LIFE HISTORY

Besides the original record from *Mordellistena* sp., there are specimens in the collection reared from an unidentified coleopterous larva at Renwick near Ithaca, N.Y., by Emma Avins, in May 1922, and two specimens said to have been reared from *Phytophaga destructor* by C. N. Ainslie at Dickinson, N.Dak., under Webster no. 23393.

Nothing is known regarding the life history of the species.

DISTRIBUTION

Three localities in which this species have been taken have been already mentioned, viz Ithaca, N.Y., Elk Point, S.Dak., and Dickinson, N.Dak. The only other record is of four specimens taken by A. F. Satterthwait at Hinsdale, Ill., October 10, 1929, on *Helianthus tuberosus*, and recorded under Webster Grove no. 293085. These localities indicate that the species may be distributed over most of the northern part of the United States.

IMPORTANCE

Since but two specimens have thus far been reared from the hessian fly, the species is evidently of no importance in controlling that insect.

OTHER SPECIES RECORDED IN LITERATURE AS PARASITIZING THE HESSIAN FLY

Several records in the literature of species parasitizing the hessian fly, or possibly parasitizing that host, are believed to be either incorrect or in need of confirmation. One of these records refers to a species of Pteromalidae, one to a species of Scelionidae, another to a species which has been placed doubtfully in Calliceratidae, and still another to a species of Alysiidae.

COELOPISTHIA FORBESII (Dalla Torre)

Pteromalus pallipes Forbes, Ill. State Ent. Rpt. 14: 46, pl. 4, fig. 1, 1885 (name preoccupied by *pallipes* Spinola); Osborn, U.S.Dept.Agr., Bur. Ent. Bul. (n.s.) 16: 28, 33, 1898.

Pteromalus forbesii Dalla Torre, Catalogus hymenopterorum . . ., v. 5, p. 125, 1898 (for *pallipes* Forbes, not *pallipes* Spinola).

No description of this pteromalid is given here because it is almost certainly not a parasite of *Phytophaga destructor*, although so recorded by Forbes.

Forbes' types have been seen by the writer, and they are apparently congeneric with species at present placed in the genus *Coelopisthia*. A series of specimens in the collection which seem to agree in every way with Forbes' types is said to have been reared from

Catocala sp. on hickory, November 2, 1883. Another series of specimens is labeled as having been reared June 19, 1882, from (*Arctia*) *Apantesis nais* (Drury). The locality is not indicated in either case.

The species has not been reared from the hessian fly since the original record by Forbes in 1884; and since it is apparently normally parasitic upon large lepidopterous larvae, it is not believed likely that it would attack the hessian fly. The Forbes record must have been a mistake.

HOPLOGRYON KANSASENSIS Gahan

Hoplogryon kansasensis Gahan, Ent. Soc. Wash. Proc. 14: 7, 1912.

The unique specimen from which this scelionid was described was taken at Manhattan, Kans., from a field cage in which hessian flies were breeding, according to the data given the writer by T. J. Headlee, from whom the specimen was received. Nothing like it has since been reared from *Phytophaga destructor*, and the species is belived not to be a parasite of that insect.

LYGOCERUS TRITICUM (Taylor)

Ceraphron triticum Taylor. Amer. Agr. 1860: 300, fig. 1.
Lygocerus triticum Riley and Howard, U.S.Dept.Agr., Div. Ent., Insect Life 4: 123, 1891; Ashmead, U.S. Natl. Mus. Bul. 45: 110, 1893.

The identity of *Lygocerus triticum* is unknown, and it will probably remain so, as the description is very unsatisfactory. It was recorded by Miss Taylor as ovipositing in puparia of the hessian fly, but nothing has since been reared from that host which could be identified as representing the species.

SYNALDIS INCISA Gahan

Synaldis incisa Gahan, Ent. Soc. Wash. Proc. 14: 4, 1912.

The original description of this alysiid was based upon specimens taken at Manhattan, Kans., from field cages in which hessian flies were breeding. These specimens were not known definitely to have been attacking the hessian fly, and the species has not been reared subsequently from that insect. The true host of this parasite is unknown, but it is probably some dipterous insect other than the hessian fly.

UNPUBLISHED RECORDS THAT ARE CONSIDERED DOUBTFUL

There are a number of specimens representing several different species in the National Museum collection, ostensibly reared from *Phytophaga destructor* by various members of the Bureau of Entomology staff, which have not been treated in the preceding pages. The material of each of these species consists of not over 1 or 2 specimens.

In some instances these specimens are in too poor condition for positive identification or description. In 1 or 2 instances the identity of the species is known, but their known biology is such as to render it extremely unlikely that they would attack the hessian fly, and it is deemed inadvisable to publish the records until they have

been verified by additional rearings. One of the identified species belongs to a group, Alysiidae, which is outside the author's present field of activity but will be mentioned here because of the probability that the record is correct and in order to make this list of hessian-fly parasites as nearly complete as practicable.

The alysiid *Coelinidea meromyzae* Forbes is represented by one specimen said to have been reared from *Phytophaga destructor* at Wellington, Kans., by E. G. Kelly, under Webster no. 4087, Expt. no. 152273, and another is said to have been reared from the same host by the same collector at Watenga, Okla., under Webster no. 17319, Expt. no. 152415. This species is a well-known parasite of *Meromyza americana* Fitch, the wheat stem maggot. The fact that this species normally attacks a dipteron infesting the stems of wheat, even though it is a species belonging to an entirely different family from that to which the hessian fly belongs, makes it appear reasonable to believe that the records may be correct. Nevertheless, considering the great amount of rearing of hessian-fly parasites that has been done and the abundance of *Coelinidea meromyzae*, it is difficult to understand why it has not been reared by others from this host.