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THE GENUS *CALOTARSA*,
WITH SPECIAL REFERENCE TO
C. INSIGNIS ALDRICH
(DIPTERA: PLATYPEZIDAE)*

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INTRODUCTION

The flat-footed flies, constituting the family Platypezidae, are of particular interest because of the character which gives these insects both their common and family names. This character consists of the flattened segments of the posterior tarsi as found in the species of certain of the genera, viz., *Clythia* Meigen (= *Platypeza* Meigen), *Protoclythia* Kessel, *Metaclythia* Kessel, and *Calotarsa* Townsend. But of these, *Calotarsa* is unique in the possession of pronounced ornamentation of these hind tarsi in the males (figs. 1, 3, 9).

The genus *Calotarsa* includes only three known species, all of which are confined to North America: *Calotarsa pallipes* (Loew) from the eastern area of the continent; *Calotarsa calceata* (Snow), known only from one locality in New Mexico; and *Calotarsa insignis* Aldrich from western North America.

The calotarsas are the largest platypezids known, specimens occasionally attaining a length of 10 mm. in the male and 8 mm. in the female. On the other hand, individuals half these dimensions are often encountered, these

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smaller flies no doubt coming from larvae which were denied maximum growth by a shortage of food.

To my knowledge, no information regarding the host fungi of these flies has been published previously. The larvae have been mentioned in only one paper (Kessel, 1961). As for the mating activities of calotarsas, Snow (1894) gave some clues, and my wife and I (Kessel and Kessel, 1961, 1962a, 1962b) have published comparative comments in connection with discussions concerned primarily with platypezids belonging to other genera. Except for these few references, practically nothing has appeared in the literature regarding the biology of these flies.

The generic name *Calotarsa* was established by Townsend (1894a) for the reception of his *Calotarsa ornatipes* which he described in the same paper. This species was based on a single specimen, a male collected at Champaign, Illinois, which had been sent to him by S. A. Forbes. Townsend was so impressed by the elaborately decorated hind tarsi of this specimen that both his generic and specific names refer to this character (fig. 1). However, several entomologists had difficulty in accepting these decorations as authentic anatomical structures, and D. W. Coquillett, among the doubters, asked Townsend in a letter if they could be of extraneous vegetable origin. In reply, Townsend (1894b) admitted that he too had been tempted to regard these structures as unnatural until he observed that the right and left sides correspond exactly.

Townsend (1894a) made a serious error in his initial placement of *Calotarsa*, supposing it to be an anomalous member of the family Syrphidae. But his published figure of the wing venation and the text of his description were sufficient for several entomologists to recognize that proper placement should be in Platypezidae. Among these workers were D. W. Coquillett and J. M. Aldrich who wrote letters, and Williston (1894) and Banks (1894). Banks also announced that he had a specimen of this same fly which he had collected in Ithaca, New York, several years before. Thus it was established that Townsend had named a good species, not a "freak" specimen.

It was ultimately discovered, however, that although Townsend had named a good species, the name which he gave it was a synonym. It was Johnson (1908) who concluded from circumstantial evidence that what Townsend had described as *C. ornatipes* was in reality the male of a species which Loew (1865) had named *Platypeza pallipes* and described from a female collected by Osten Sacken in the District of Columbia. Johnson had suspected

PLATE 1

Upper figure. Male of *C. insignis* in full light.

Lower figure. Male of *C. insignis* in dark surroundings. Note the reflections of the flags which are attached to the posterior tarsi. Kodachromes by author.



the synonymy as early at 1897 when on North Mountain (above Stull), Pennsylvania, he "captured almost in the same swing of the net" both *C. ornatipes* and *P. pallipes*. Similarly, Owen Bryant, on September 5, 1903, collected a number of both of these supposed species five miles east of the Isles of Shoals in New Hampshire. Also, Johnson collected six specimens of *P. pallipes* on a window in Boston between September 24 and 28, 1903, and three days later he found a dead specimen of *C. ornatipes* at the same place. Thus it was established that *P. pallipes* with no males and *C. ornatipes* with no females constituted one species, and on the basis of priority the latter trivial name became a synonym of the former. As for the proper generic designation, I prefer to follow Townsend and Aldrich in accepting *Calotarsa* as the proper generic name for this and the other two species which are treated in this paper.

ACKNOWLEDGMENTS

Acknowledgments of assistance in the preparation of a paper of this type must be made to many persons and institutions. Chief among the latter are: Museum of Comparative Zoology, Harvard; Snow Museum, University of Kansas; Canadian National Collections, Ottawa; Oregon State University; United States National Museum; California Insect Survey Collection, University of California, Berkeley; Carnegie Museum, Pittsburgh. Individuals, who in one way or another, have provided specimens for study include: T. G. H. Aitken, P. H. Arnaud, Bruce Barichievich, W. R. Bauer, J. Bedingfield, G. E. Bohart, R. M. Bohart, I. Branson, D. W. Breedlove, G. W. Byers, Leroy Childs, Frank Cole, E. J. Coher, C. H. Curran, J. P. Darlington, R. C. Dickson, R. R. Dreisbach, T. H. Farr, K. M. Fender, J. Hansen, P. D. Hurd, Dean Jamieson, Peter Keyes, Jean Laffoon, J. D. Lattin, G. Lindquist, A. L. Melander, R. T. Orr, E. S. Ross, C. W. Sabrosky, G. E. Shewell, H. W. Smith, Alan Stone, A. H. Sturtevant, K. A. Trexler, W. H. Tyson, G. E. Wallace, J. L. Way, M. R. Wheeler, F. X. Williams, W. W. Wirth, P. W. Wygodzinsky. Berta B. Kessel, my wife, has assisted me throughout the field work, and many of the flies which bear my collector's label were in reality collected by her.

Permission to collect platypezids for specified limited periods and within park boundaries was obtained from the authorities at Yosemite and Sequoia National Parks. The California State Division of Beaches and Parks has provided me with year-round collecting permits for the past several years, covering all State parks and monuments. These were obtained through the kindness of John H. Michael and Burgess W. Heacox, and made possible the collection of much of the material considered in this paper.

I also wish to acknowledge the contributions of those who have helped with the preparation of the paper in special ways: Bernardine B. Engstrom transposed data from labels and typed the manuscript; David Kutty made the wing prints; George E. Johnson made the drawings of the male tarsi of the three *Calotarsa* species; Maurice Giles did the photographic preparation for

the illustrations; and finally, Dr. and Mrs. G Dallas Hanna produced the color plate of *Calotarsa insignis*.

GENERIC RELATIONSHIPS

It seems certain that of known genera, *Calotarsa* is most closely related to *Clythia* (= *Platypeza*). The larvae of *Calotarsa insignis* are essentially like those of *Clythia agarici*. The wing venation (figs. 2, 4, 8) is very similar to that found in *Clythia* and *Protoclythia*. Because of the specialized nature of the posterior tarsi of the males (figs. 1, 3, 9) in *Calotarsa*, we must look to the females (fig. 7) in comparing these structures in *Calotarsa* with those of other genera. In this respect, *Calotarsa* is similar to *Metaclythia* and *Clythia*. From these observations we may conclude that *Calotarsa*, like *Metaclythia*, stemmed from a *Clythia*-like stock.

DISTINGUISHING THE SPECIES

Except for the ornamentation of their posterior tarsi, the males of the three species are very similar in appearance. Negative wing prints, obtained by placing the wing itself in the enlarger and printing from it in place of the usual photographic film, are accurate reproductions of the venation. Such prints, representing the males of the three species, reveal no important differences. In all three species, the posterior branch of the fourth longitudinal vein is clearly short of the wing margin, and the posterior cross vein is separated from the wing margin by a distance which is less than its own length. The most striking difference in the venation of these species is the noticeably shorter posterior branch of the fourth vein in *C. calceata* (fig. 4). In most specimens it extends barely one-third of the distance from the point of branching of the fourth vein to the wing margin. In *C. pallipes* (fig. 2) and *C. insignis* (fig. 8), it extends about half of the distance to the wing border. But these typical dimensions are sometimes modified in individuals and to the degree that the distinctions are not clear-cut and so become untrustworthy. The distance that the posterior cross vein is removed from the wing margin is an even more variable character within each species, and therefore of even less value.

The species are easily separated in the males, however, by an examination of the posterior tarsi. While all three species have the fifth segment normal, all have the other four segments modified in some important manner. Even *C. pallipes* (fig. 1), which at first glance seems to bear no appendage on the second segment like the others, often shows a rudimentary process which may be regarded as an atrophied filament which once was similar in structure to that which now adorns the first segment. This suggests that the basic *Calotarsa* stock from which our three known and present-day species are descended, had a prominent ornamental appendage on each of the first four segments of the tarsus in the male. Presumably these segments are serially homologous, and the primitive or basic-type form of ornament on each was something like

we now find on the second segment of *C. calceata* (fig. 3) or on the fourth segment of *C. insignis* (fig. 9). Possibly the hoof-like appendage of this fourth segment in *C. insignis* is the more primitive with its maximum development, and the second-segment structure of *C. calceata* is a modification of this plan by reduction and differentiation.

At any rate, one may infer that such structures were derived from the setaceous appendages which are found on the first segment of *C. calceata*, the first segment and the second as well in *C. pallipes* (if the rudiment mentioned above is counted), and the first and second segments of *C. insignis*. Each of these has a flattened wing-like base, and each of them except the rudimentary one, has a terminally expanded portion. The more generalized ornament of the second segment of *C. calceata* could also, by reduction, have produced the silver and black flags which occur on the third segments of the posterior tarsi of the males of *C. pallipes* and *C. insignis*, and from which the latter species gets its name. It must be remembered that all of these hind-tarsal ornaments of male calotarsas are flat and very thin. The one on the second segment of *C. calceata*, although essentially black, possesses numerous semitransparent spots, several of which are quite large. These could have been enlarged still more and fused to produce the silvery flags with black markings of *C. insignis* and *C. pallipes*.

The secondary filament which is attached to the margin of the flag of *C. pallipes* is of particular interest. When Townsend (1894a) described the male of this species as his *C. ornatipes*, he placed and figured this filamentous tassel so that it originates from the proximal margin of the flag. Later (Townsend, 1894b), he commented about receiving from J. M. Aldrich a drawing of the hind tarsus of a male calotarsa which he believed to represent a species similar to but distinct from *C. ornatipes*. This had been captured at Brookings, South Dakota. The principal difference of the proposed new species, as shown by the drawing which Aldrich had made, was that the filamentous appendage was attached to the distal margin of the flag instead of the proximal margin. Townsend proposed that Aldrich describe his fly as a new species. Instead, he sent his drawing to W. A. Snow, who was then specializing on Platypozidae, and asked for his opinion. The type of *C. ornatipes* was deposited in the Snow Museum (named for Snow's father) at the University of Kansas, so was close at hand for Snow to compare with the drawing he had received from Aldrich. Snow (1895) concluded, "I can see no specific differences.... The membranous appendage on the third tarsal joint is on the same side of the leg in both specimens." The only trouble with this decision is that in all of the specimens of *C. pallipes* which I have examined, I have found this filamentous appendage attached to the distal margin of the flag (fig. 1), not the proximal edge as shown in the drawings of Townsend (1894a, fig. 5), Snow (1894a, fig. 2), and even Aldrich (1906, fig. 2). It is strange that all of these men made the same error, especially Aldrich, because he had already figured

it correctly for his South Dakota specimen.

While it is easy to separate the males of the species of *Calotarsa* by means of the ornamentation of their posterior tarsi, one must depend on less obvious characters to distinguish the species in the case of female specimens. Nevertheless, the identifications may be made with a high degree of certainty. In the females of *C. insignis* the abdomen is all yellow above, with, at most, thin, transverse, darker-yellow bands across the posterior margins of some segments. By contrast, the females of *C. pallipes* and *C. calceata* have the abdomen ash colored above, and with obvious transverse bands of black to brown across segments 2 to 5. In both species these bands are gradually widened toward the middle so that they become triangular and pointed toward the front. In *C. calceata* this widening is sufficient to bring the apexes of the triangles to about the anterior margins of their respective segments. In *C. pallipes* this widening is less pronounced so that the apexes of the triangles are clearly short of the anterior margins of their segments.

THE SPECIES

Calotarsa pallipes (Loew).

(Figures 1, 2.)

Platypeza pallipes LOEW (1865, p. 81); ALDRICH (1905, p. 342); JOHNSON (1908, p. 58).

Calotarsa ornatipes TOWNSEND (1894a, pp. 52, 102); ALDRICH (1906, p. 123).

Platypeza ornatipes, BANKS (1894, p. 88); WILLISTON (1894, p. 116); SNOW (1894, p. 143; 1895, p. 207); JOHNSON (1897, p. 254; 1904, p. 19); GREENE (1908, p. 241).

GEOGRAPHICAL DISTRIBUTION. This species is known to range from Quebec, south to North Carolina, and west to South Dakota. Previously published

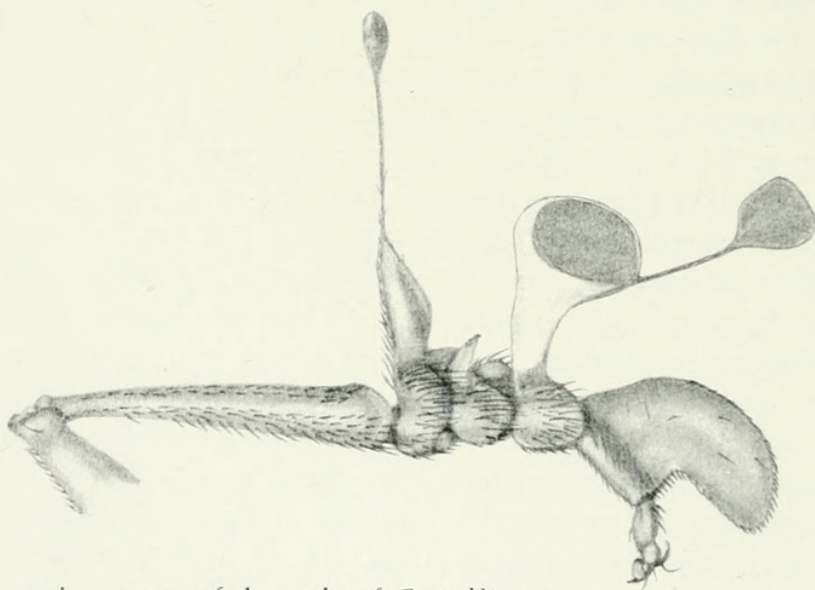


Figure 1. Posterior tarsus of the male of *C. pallipes*.

records gave the District of Columbia, Illinois, New York, Pennsylvania, Massachusetts, New Hampshire, and South Dakota. This list is now more than doubled in number as nine states and provinces have been added as follows: Quebec, Ontario, Maine, Vermont, Connecticut, Michigan, Minnesota, Iowa, and North Carolina.

MATERIAL EXAMINED. In the following list of specimens which I have examined during this study, the initials (H.K.) are used to designate the many flies which bear labels listing Hugo Kahl as the collector. He collected more platypezids of this and other species in eastern United States than any other person, and most of the flies listed here as coming from Pennsylvania were taken by him. The names of the other collectors mentioned in the list are given in full.

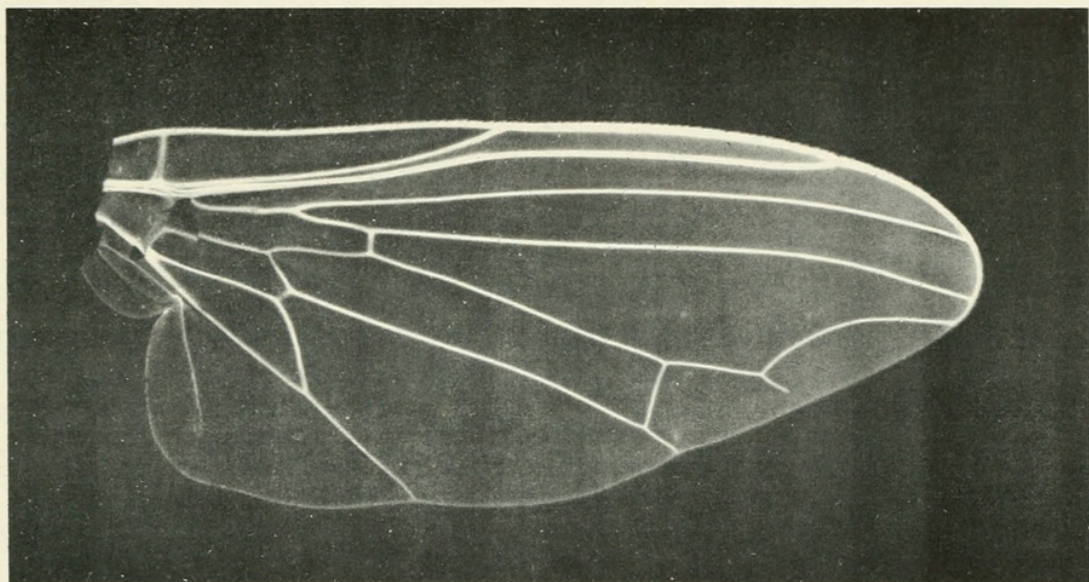


Figure 2. Wing of the male of *C. pallipes*. This print, as well as those shown in figures 4 and 8, was made directly from the wing, mounted on a slide and placed in the enlarger.

CONNECTICUT: *Storrs:* IX-16-53 (H.W.Smith), 2 males, 2 females; X-4-53 (H.W.Smith), 5 females; X-17-53 (H.W.Smith), 4 females.

IOWA: *Ledges State Park, Boone County:* IX-6-50 (J. Laffoon), 2 females; X-13-50 (J. Laffoon), 1 male.

MAINE: *Nixon:* VIII-31-53 (E. L. Kessel), 1 female.

MASSACHUSETTS: *Amherst:* XI-2-43 (H. Fernald), 1 female. *Leverett:* IX-12-56 (T.H.Farr), 5 males; IX-22-52 (E.J.Coher), 4 females. *Woods Hole:* IX-19-23 (A.H.Sturtevant), 1 male.

MICHIGAN: *Chippewa County:* no date (R.R.Dreisbach), 1 male. *Gogebic County:* VIII-25-47 (R.R.Dreisbach), 1 female.

MINNESOTA: 5 miles s. of *Pequot Lakes*: IX-30-48 (Hicks and J. Laffoon), 1 female.

NEW YORK: *Nyack*: VII-2-84 (no collector), 1 male. *Romapo*: IX-17-10 (no collector), 1 male. *Woodw. Lake*: IX-4-10 (no collector), 1 male.

NEW HAMPSHIRE: *Dolly Copp Camp, White Mountains*: IX-4-40 (J. Hansen), 1 male. *Franconia*: No date (Mrs. A. T. Slosson), 3 females. *Isles of Shoals*: No date (Owen Bryant), 1 male, 1 female. *Kings Ravine, Mt. Adams, White Mountains*: X-12-40 (J. Hansen), 1 female.

PENNSYLVANIA: *North Mountain*: VIII-28-97 (C.W. Johnson), 1 female; IX-1-97 (C.W. Johnson), 1 female; IX-2-97 (C.W. Johnson), 1 male. *Pittsburgh*: IX-4-08 (H.K.), 1 male; IX-5-13 (H.K.), 1 male; IX-9-13 (H.K.), 1 male; IX-9-08 (H.K.), 1 male; IX-9-11 (H.K.), 1 female; IX-10-08 (H.K.), 1 male; IX-10-14 (H.K.), 1 female; IX-11-08 (H.K.), 2 females; IX-12-09 (H.K.), 1 male; IX-14-08 (H.K.), 2 females; IX-15-08 (H.K.), 6 females; IX-16-08 (H.K.), 2 females; IX-17-08 (H.K.), 16 females; IX-18-07 (H.K.), 1 female; IX-19-08 (H.K.), 8 females; IX-19-14 (H.K.), 2 males, 1 female; IX-20-08 (H.K.), 2 females; IX-20-09 (H.K.), 1 female; IX-20-13 (H.K.), 1 female; IX-20-14 (H.K.), 1 male; IX-21-08 (H.K.), 12 females; IX-21-10 (H.K.), 1 female; IX-22-08 (H.K.), 1 female; IX-22-10 (H.K.), 2 males; IX-23-07 (H.K.), 2 males; IX-23-08 (H.K.), 9 males, 4 females; IX-23-10 (H.K.), 1 male, 1 female; IX-23-14 (H.K.), 2 females; IX-24-13 (H.K.), 1 male, 1 female; IX-25-08 (H.K.), 1 male; IX-25-13 (H.K.), 1 female; IX-25-14 (H.K.), 2 females; IX-26-09 (H.K.), 2 males, 1 female; IX-27-13 (H.K.), 1 male; IX-28-11 (H.K.), 1 female; IX-28-13 (H.K.), 6 males; IX-28-14 (H.K.), 1 female; IX-29-07 (H.K.), 1 male; IX-29-14 (H.K.), 4 females; X-1-03 (H.K.), 1 female; X-1-10 (H.K.), 1 male; X-1-14 (H.K.), 1 female; X-2-07 (H.K.), 1 female; X-2-13 (H.K.), 2 females; X-2-14 (H.K.), 1 female; X-3-13 (H.K.), 2 females; X-3-14 (H.K.), 6 males, 5 females; X-4-08 (H.K.), 4 females; X-4-11 (H.K.), 1 male; X-4-13 (H.K.), 1 female; X-5-11 (H.K.), 1 male; X-5-14 (H.K.), 2 females; X-8-14 (H.K.), 1 female; X-10-09 (H.K.), 2 females; X-12-14 (H.K.), 2 females; X-26-14 (H.K.), 1 female; XI-13-12 (H.K.), 1 female.

ONTARIO: *Jordan*: IX-7-19 (C.H. Curran), 1 male. *Ottawa*: X-5-23 (C.H. Curran), 3 females; X-12-45 (J. Bedingfield), 1 female.

QUEBEC: *Abbotsford*: VIII-30-36 (G.E. Shewell), 2 females; IX-2-36 (G.E. Shewell), 1 male. *Mt. Orford*: IX-9-37 (G.E. Shewell), 2 females. *St. Annes*: VIII-5-38 (no collector), 1 male.

VERMONT: *Balboa Mountain*: IX-10-22 (no collector), 1 female. *Bolton Mountain*: IX-1-22 (O. Bryant), 3 males.

SEASONAL DISTRIBUTION. The earliest record for this species is for Nyack, New York, July 2, 1 male. I am inclined to doubt this date, but because no collector was given, it is impossible to check on it. The next earliest record, also for a male, is for August 5, from St. Annes, Quebec. The earliest record for a female is August 25, from Gogebic County, Michigan. It has been my experience with *C. insignis*, and numerous other platypezids, that the males begin to appear at the beginning of the season with some females, but not seven weeks in advance of them as the first record would suggest. In general, the season for platypezids in our Northern Hemisphere begins in the north and progresses southward. If the July 2 date were for a fly taken in Ontario or Quebec, I would be more inclined to accept it. I suspect that an error of a month is involved, particularly in view of the fact that the earliest female, taken on August 25, is from the northern state of Michigan. While more collecting is needed to make certain, I believe the season for *C. pallipes* begins in early August, not July.

The latest date that I know of for the collection of a male of this species is October 5. This record is from Pittsburgh, Pennsylvania. The latest date for a female, also from Pittsburgh, is November 13. We may conclude, therefore, that the season for the adults of *C. pallipes* is from early August to middle November, the males disappearing by the middle of October.

FUNGUS HOSTS. I know of no data which indicate what fungi the larvae of this species use for food. To my knowledge, the immature stages have not been observed.

MATING HABITS. These seem to be unknown for *C. pallipes*, but it is presumed that they are similar to those of the other two species of the genus which are discussed below.

Calotarsa calceata (Snow).

(Figures 3, 4.)

Platypeza calceata SNOW (1894, pp. 146-148).

Calotarsa calceata, ALDRICH (1905, p. 341; 1906, pp. 123-124); KESSEL and KESSEL (1961, p. 295; 1962a, p. 57; 1962b, p. 290).

This species is known only from the type series of 75 males and 1 female, all taken at Hop Canyon, Magdalena Mountains, Socorro County, New Mexico. These flies were captured by W. A. Snow, August 19-21, 1894. In an attempt to obtain more of them, my wife and I visited this locality on August 19, 1951 (Kessel, 1952), but were unsuccessful.

Snow's observations on *C. calceata* were particularly significant, for he seems to have been the first to describe the swarming of males among platypezids. This phenomenon, and the mating activities which are related to it,

will be considered in some detail under the next species, *C. insignis*.

Snow learned nothing of the food plants and immature stages of his species.

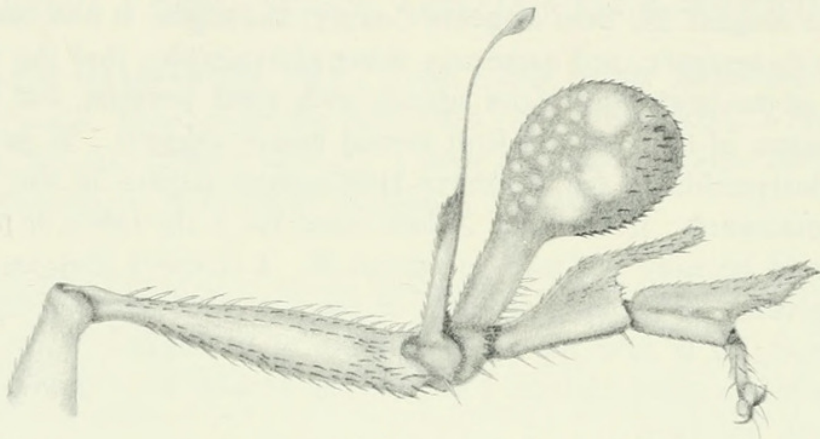


Figure 3. Posterior tarsus of the male of *C. calceata*.

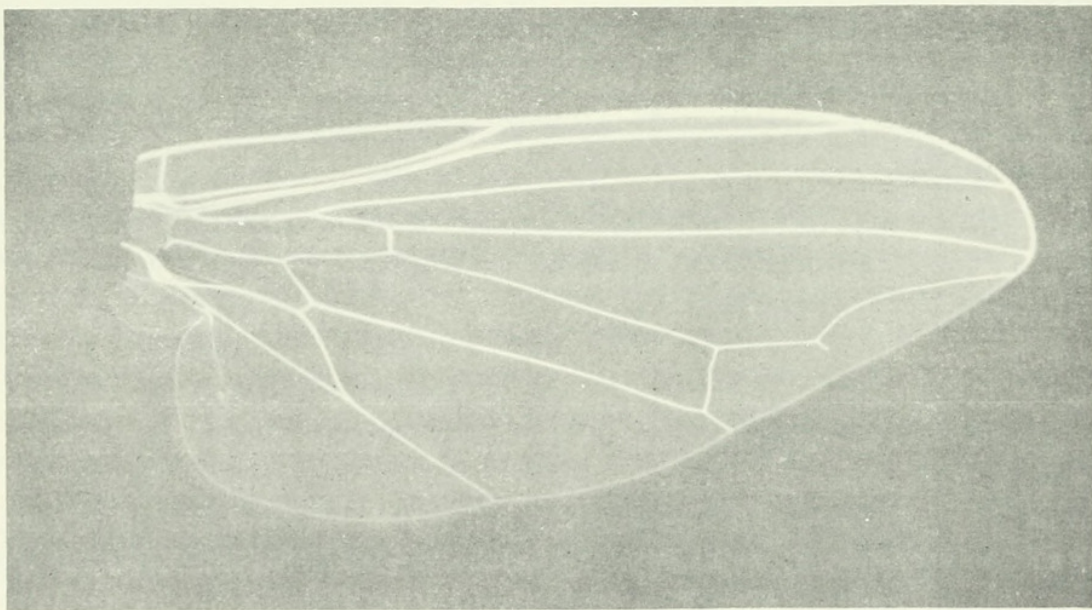


Figure 4. Wing of the male of *C. calceata*.

Calotarsa insignis Aldrich.

(Figures 5, 6, 7, 8, 9, and plate 1.)

Calotarsa insignis ALDRICH (1906, p. 126); KESSEL (1961, p. 9); KESSEL and KESSEL (1961, p. 296; 1962a, pp. 60, 61, 64; 1962b, p. 289).

GEOGRAPHICAL DISTRIBUTION. *Calotarsa insignis* is known from southern British Columbia (Vancouver Island and Cultus Lake), western Oregon, much of California, and a single record from western Montana. Presumably it also occurs in Washington, Idaho, and perhaps southern Alberta, but I have looked in vain for it in each of these areas. Likewise, A. L. Melander, who was well acquainted with platypezids and collected them at every opportunity, did not collect *C. insignis* in Washington and Idaho, although he was located at Washington State College for some time and did much collecting in both of these states. Similarly, J. M. Aldrich, who named this species and certainly would not overlook it, was a member of the faculty at the University of Idaho and did much collecting in the area, but did not find it. There is no question, however, about the Montana record. I captured the fly (a male) myself, 9 miles east of Paradise, Sanders County, August 31, 1962.

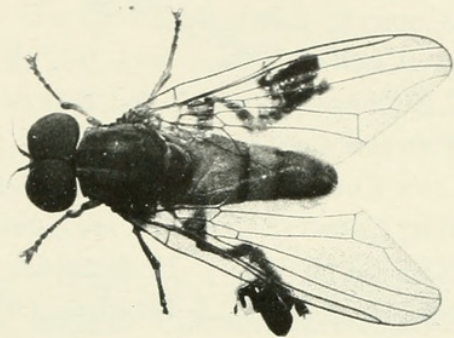


Figure 5. Dorsal view of the male of *C. insignis*.

MATERIAL EXAMINED. In the following list of specimens which I have examined during this study, I have used my initials (E.L.K.) to designate those flies which bear labels listing E.L.Kessel as the collector. Actually, much of this material was collected by Berta B. Kessel, my wife, who has been my constant companion in the field work. The names of the other collectors are given in full.

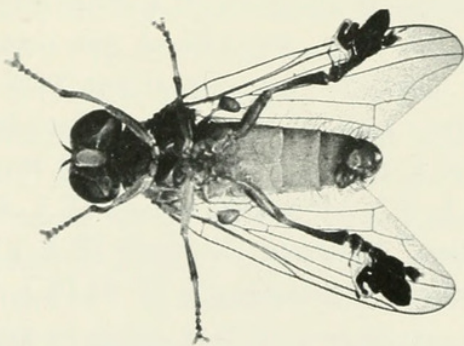


Figure 6. Ventral view of the male of *C. insignis*.

BRITISH COLUMBIA: *Cultus Lake Provincial Camp*: X-19-38 (J.K. Jacob); 1 male. *Goldstream Provincial Camp, Vancouver Island*: X-16-61 (E.L.K.), 3 females; X-17-61 (E.L.K.), 3 females. *Miracle Beach Provincial Park, Vancouver Island*: X-14-61 (E.L.K.), 1 female. *Stamp Falls Provincial Park, Vancouver Island*: X-13-61 (E.L.K.), 2 females. *Victoria*: X-16-61 (E.L.K.), 1 female.

CALIFORNIA: ALAMEDA COUNTY: *Berkeley*: X-31-47 (W.W.Wirth), 5 males; XI-9-36 (E.I.Schlinger), 1 female; XI-20-38 (T.G.H.Aitken), 34 females; XI-no day-36 (T.G.H.Aitken), 1 female; XI-no day-36 (G.E. Bohart and R.M. Bohart), 3 females; XII-4-36 (R.C.Dickson), 1 female; XII-9-36 (R.C. Dickson), 1 female. *Niles*: I-4-62 (W.H.Tyson), larvae. *Oakland*: XI-8-57 (B.Barichievich), 2 females; XI-10-57 (B.Barichievich), 1 female; XI-23-57 (B.Barichievich), 2 females. AMADOR COUNTY: *4 miles E. of Volcano*: X-2-60 (E.L.K.), 9 males, 3 females. BUTTE COUNTY: *Curry-Bidwell State Park*: XI-20-62 (E.L.K.), 2 females. CONTRA COSTA COUNTY: *Danville*: I-7-52 (F.X.Williams), 11 female. *No locality*: X-29-36 (G.E.Bohart), 1 male. DEL NORTE COUNTY: *Klamath*: X-30-61 (E.L.K.), 1 female. *Patrick Creek*: XI-11-61 (E.L.K.), 3 females; XI-14-59 (E.L.K.), 5 females. GLENN COUNTY: *2 miles N. of Red Bridge*: XI-19-60 (E.L.K.), 18 females. HUMBOLDT COUNTY: *Grizzly Creek Redwoods State Park*: IX-23-60 (E.L.K.), 2 males; XI-5-60 (E.L.K.), 19 females; XI-8-59, (E.L.K.), 10 females. *Myers Flat*: XI-1-59 (E.L.K.), 5 females. *Orleans*: X-25-59 (E.L.K.), 5 females. *Prairie Creek State Park*: XI-4-60 (E.L.K.), 3 females. *Van Duzen Forest Campground*: XI-7-59 (E.L.K.), 1 male, 9 females. *Willow Creek (East Ford) Forest Campground*: X-25-59 (E.L.K.), 8 females; X-31-59 (E.L.K.), 3 females. KERN COUNTY: *Kern River (15 miles S. Miracle Springs)*: XII-2-60 (E.L.K.), 13 females. *Kernville*: XII-3-60 (E.L.K.), 1 female. LAKE COUNTY: *Adams Springs*: IX-22-59 (E.L.K.), 1 male. *Anderson Springs*: IX-30-50 (W.R.Bauer), 1 male; XI-22-59 (E.L.K.), 5 females. LOS ANGELES COUNTY: *Arcadia*: X-15-49 (M.R.Wheeler), 7 females; XI-18-49 (M.R.Wheeler), 1 female. *Glendale*: XI-24-62 (E.I.Schlinger), 5 females; XI-25-50 (E.I.Schlinger), 1 female; XII-21-50 (E.I.Schlinger), 2 females. *Pasadena*: XI-16-49 (M.R.Wheeler), 2 females; XI-21-49 (M.R.Wheeler); 1 female; XI-25-49 (M.R.Wheeler), 1 female. *South Pasadena*: XI-8-55 (J.L.Way), 1 male. *West Ford, San Gabriel Canyon*: XI-18-49, 1 female. MADERA COUNTY: *Westfall Ranger Station*: X-16-60 (E.L.K.), 1 female. MARIN COUNTY: *Mill Valley*: I-12-46 (E.L.K.), 3 females; I-19-46 (E.L.K.), 2 females; IX-22-46 (E.L.K.), 2 males; IX-22-51 (E.S.Ross); 1 male; X-4-45 (E.L.K.), 1 male; X-7-45 (E.L.K.), 3 females; X-7-48 (E.L.K.), 4 males, 7 females; X-12-47 (E.L.K.), 2 males, 1 female; X-16-47 (E.L.K.), 3 males, 7 females; X-18-47 (E.L.K.), 10 males, 67 females; X-20-45 (E.L.K.), 3 females; X-21-45 (E.L.K.), 43 females; X-21-48 (E.L.K.), 2 males, 1 female; X-24-45 (E.L.K.), 14 males, 21 females; X-25-47 (E.L.K.), 2 males, 29 females; X-26-47 (E.L.K.), 1 female; XI-1-45 (E.L.K.), 65 females; XI-9-47 (E.L.K.), 1 male, 30 females;

XI-20-47 (E.L.K.), 1 female; X-21-45 (E.L.K.), 13 males, 6 females; XI-27-47 (E.L.K.), 8 males, 5 females; XII-29-45 (E.L.K.), 3 females. *Navato*: X-24-51 (E.L.K.), 17 males; XI-21-48 (E.L.K.), 1 male, 1 female. MARIPOSA COUNTY: *Wowona Campground, Yosemite National Park*, X-22-60 (E.L.K.), 3 females. *Yosemite Valley, Yosemite National Park*: X-15-60 (E.L.K.), 2 males, 10 females; X-22-60 (E.L.K.), 1 male, 10 females. MENDOCINO COUNTY: *2 miles up Navarro River*: XII-5-59 (E.L.K.), larvae. *Mouth of Pieta Creek*: X-29-61 (E.L.K.), 2 females; X-13-61 (E.L.K.), 6 females; XI-18-60 (E.L.K.), 14 females.

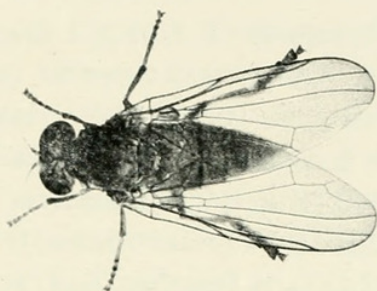


Figure 7. Female of *C. insignis*.

Standish Hickey State Park: X-29-61 (E.L.K.), 2 females. *3 miles N. of Willets*: X-29-61 (E.L.K.), 1 female. MERCED COUNTY: *McConnell State Park*: XI-16-60 (E.L.K.), larvae. MONTEREY COUNTY: *Pfeiffer-Big Sur State Park*: I-3-60 (E.L.K.), larvae; X-8-60 (E.L.K.), 2 males, 2 females; XI-28-59 (E.L.K.), 7 males, 16 females; XII-19-59 (E.L.K.), 17 females. *Nacimiento Canyon Forest Campground*: X-8-60 (E.L.K.), 2 males, 4 females. *Plaskett Creek Forest Campground*: XII-20-59 (E.L.K.), 2 females. NAPA COUNTY: *Bothe-Napa Valley State Park*: XI-8-62 (E.L.K.), 1 female, XI-16-62 (E.L.K.), 1 male, 3 females. NEVADA COUNTY: *Nevada City*: X-19-62 (E.L.K.), 2 females. *Rough and Ready*: XII-28-60 (I. Branson), larvae. *Washington*: X-19-62 (E.L.K.), 3 females. *White Cloud Forest Campground*: X-19-62 (E.L.K.), 1 female. ORANGE COUNTY: *Lower San Juan Forest Campground*: XI-16-61 (E.L.K.), 5 females; XII-29-59 (E.L.K.), 1 female. *Trabuco Forest Campground*: XI-15-61 (E.L.K.), 10 females. PLUMAS COUNTY: *Greenville*: IX-27-59 (E.L.K.), 1 male; X-2-59 (E.L.K.), 1 male; X-9-59 (E.L.K.), 1 female. RIVERSIDE COUNTY: *Upper San Juan Forest Campground*: XII-6-61 (E.L.K.), larvae. SAN BENITO COUNTY: *San Juan Canyon*: X-10-60 (E.L.K.), larvae; XII-10-60 (E.L.K.), larvae. SAN BERNARDINO COUNTY: *Mill Creek Forest Campground*: XII-27-60 (E.L.K.), 2 females. SAN DIEGO COUNTY: *De Luz*: XII-7-61 (E.L.K.), 1 male, 12 females. *Fallbrook*: XII-7-61 (E.L.K.), 1 female; XII-26-59 (E.L.K.), 4 females. *San Luis Rey Forest Campground (near Lake Henshaw)*: XII-12-61 (E.L.K.), larvae. *Pauma*: XII-27-59 (E.L.K.), 2 females. SAN FRANCISCO COUNTY: *Golden Gate Park*: X-12-47 (E.L.K.), 1 male, 1 female; X-14-57 (B. Barichievich), 1 male; X-17-47 (E.L.K.), 1 male;

X-17-62 (R.T.Orr), larvae; X-18-57 (B. Barichievich), 1 male; X-20-47 (E.L.K.), 1 male, 2 females; X-24-59 (E.L.K.), 1 female; X-30-57 (B. Barichievich), 4 males, 4 females; XI-1-47 (E.L.K.), 5 males, 3 females; XI-4-47 (E.L.K.), 2 males, 8 females; XI-4-57 (B. Barichievich), 1 male; XI-7-47 (E.L.K.), 1 male, 1 female; XI-8-57 (B. Barichievich), 1 female; XI-9-47 (E.L.K.), 1 male, 1 female; XI-11-47 (E.L.K.), 8 females; XI-11-57 (B. Barichievich), 2 males, 6 females; XI-14-47 (E.L.K.), 1 female; XI-15-57 (B. Barichievich), 3 females; XI-26-47 (E.L.K.), 1 female; XI-27-61 (E.L.K.), 1 female; XII-1-47 (E.L.K.), 1 female; XII-3-47 (E.L.K.), 1 female; XII-8-59 (E.L.K.), 1 male, 1 female; XII-12-47 (E.L.K.), 3 females; XII-29-47 (E.L.K.), 1 female. *Yerba Buena Island*: X-5-58 (G.Lindquist), 1 male. *SAN JOAQUIN COUNTY: Caswell State Park*: XI-24-60 (E.L.K.), 12 females. *SAN LUIS-OBISPO COUNTY: Cerro Alto Forest Campground*: XII-23-61 (E.L.K.), 4 females. *Marquart Park*: XII-24-61 (E.L.K.), 1 female. *Routzahn Park*: XII-23-61 (E.K.K.), 10 females. *SAN MATEO COUNTY: Corte de Madera Creek, Portola*: XII-10-59 (Paul Arnaud), 55 males, 1 female. *Portola State Park*: XI-27-59 (L.L.K.), 4 females. *SANTA BARBARA COUNTY: Miguelito Park*: XII-22-61 (E.L.K.) 2 females. *Paradise Park*: XII-21-61 (E.L.K.), 3 females. *Santa Barbara*: XII-12-59 (D.E.Breedlove), 13 females; XII-15-59 (D. E. Breedlove), 1 male, 7 females. *Santa Rosa Park*: XII-22-61 (E.L.K.), 1 female. *SANTA CLARA COUNTY: Los Altos*: IX-27-61 (Dean Jamieson), 1 male. *Mt. Madonna County Park*: XII-18-59 (E.L.K.), 2 females. *Stanford University: Ino day-16* (Isabel McCracken), 2 males, 1 female; X-7-00 (J.M.Aldrich), 1 male (type series); X-28-05 (J.M.Aldrich), 1 female (type series); X-28-07 (J.M.Aldrich), 1 female; XI-25-53 (Paul Arnaud), 1 female. *SANTA CRUZ COUNTY: Big Basin Redwoods State Park*: XII-12-59 (E.L.K.), 6 females, larvae. *Wildwood*

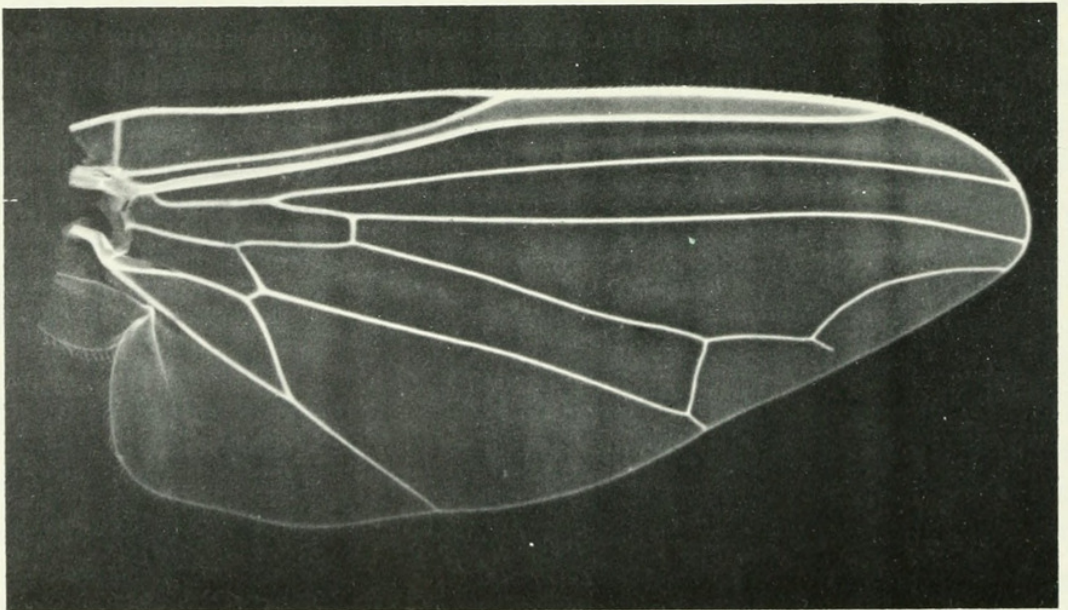


Figure 8. Wing of the male of *C. insignis*.

(3 miles N. of Boulder Creek): XI-24-62 (Peter Keyes), 1 female. SHASTA COUNTY: *Castle Creek*: X-18-59 (E.L.K.), 2 males, 7 females. *Pit River, below Burney Falls*: X-17-59 (E.L.K.), 1 female. SIERRA COUNTY: 3 miles N. of *Downieville*: X-25-62 (E.L.K.), 2 females. *Ramshorn Forest Campground*, 6 miles W. of *Downieville*: X-21-62 (E.L.K.), 1 female. *Wild Plum Forest Campground*, 5 miles N. of *Sierra City*: X-26-62 (E.L.K.), 1 female. SISKIYOU COUNTY: *Fowler Forest Campground*: X-17-59 (E.L.K.), 4 females. *Hamburg*: X-23-59 (E.L.K.), 10 females. *Happy Camp*: X-24-59 (E.L.K.), 39 females. SONOMA COUNTY: 2 miles S. of *Glen Ellen*: XI-8-62 (E.L.K.), 6 females. *Monte Rio*: XII-6-59 (E.L.K.), 1 female. STANISLAUS COUNTY: *Turlock Lake State Park*: XI-11-60 (E.L.K.), 2 males, 10 females. TEHAMA COUNTY: *Potato Patch Forest Campground*: XI-16-59 (E.L.K.), 1 female. TRINITY COUNTY: *Rush Creek Forest Campground*: X-30-59 (E.L.K.), 5 females; XI-6-69 (E.L.K.), 5 females. TULARE COUNTY: *Sequoia National Park, Generals' Highway, elevation 5400 feet*: X-29-60 (E.L.K.), 8 females. 5 miles SE. of *Three Rivers, elevation 1000 feet*: X-30-60 (E.L.K.), 2 males, 6 females; XI-25-60 (E.L.K.), 5 males, 26 females; XII-17-60 (E.L.K.), 6 females. TUOLUMNE COUNTY: *Crane Creek, Yosemite National Park*: X-23-60 (E.L.K.), 5 females. VENTURA COUNTY: *Camp Comfort*: XI-30-61 (E.L.K.), 2 females. *Matilija Springs*: X-30-49 (M.R.Wheeler), 1 male. *Steckel Park*: XI-28-52 (E.L.K.), 1 female; XII-19-61 (E.L.K.); 1 female. *Wheeler Gorge Forest Campground*: XII-1-61 (E.L.K.), 2 females; XII-19-61 (E.L.K.), 1 female.

MONTANA: SANDERS COUNTY: 9 miles E. of *Paradise*: VIII-31-62 (E.L.K.), 1 male.

OREGON: BENTON COUNTY: *Corvallis*: I-5-15 (L.Childs), 2 females; I-15-15 (L. Childs), 1 female; XII-25-14 (L.Childs), 1 female. CURRY COUNTY: *Azalea State Park*: X-30-61 (E.L.K.), 2 females. *Humbog Mountain State Park*: X-31-61 (E.L.K.), 11 females. *McGribble Forest Campground*: X-31-61 (E.L.K.), 10 females. HOOD RIVER COUNTY: *Hood River*: X-11-17 (A.L.Melander), 1 female. JACKSON COUNTY: *Goldhill*: XI-10-61 (E.L.K.), 6 females. LANE COUNTY: *Hendricks Bridge State Park*: XI-9-61 (E.L.K.), 1 female. LINN COUNTY: *Cascadia State Park*: XI-7-61 (E.L.K.), 1 female. MARION COUNTY: *Champoeg State Park*: XI-24-61 (E.L.K.), 1 male, 2 females; XI-5-61 (E.L.K.), 10 females. YAMHILL COUNTY: *Peavine Ridge, McMinnville*: X-22-46 (K.M.Fender), 1 male.

SEASONAL DISTRIBUTION. The male from Sanders County, Montana, mentioned immediately above, represents not only the most eastern record for the species, but the earliest seasonal one as well. This is some three weeks earlier than the next earliest record which is from Mill Valley, Marin County, California. This difference may be accounted for by the more northern latitude of Montana, and perhaps its higher elevation as well. Early emergence seems to be associated with both higher latitude and higher elevation, which, in turn,

are associated with more severe climate. In general, the more severe and longer the winter, the earlier the platypezid season begins. This early beginning of the season makes up for its earlier termination in such climates.

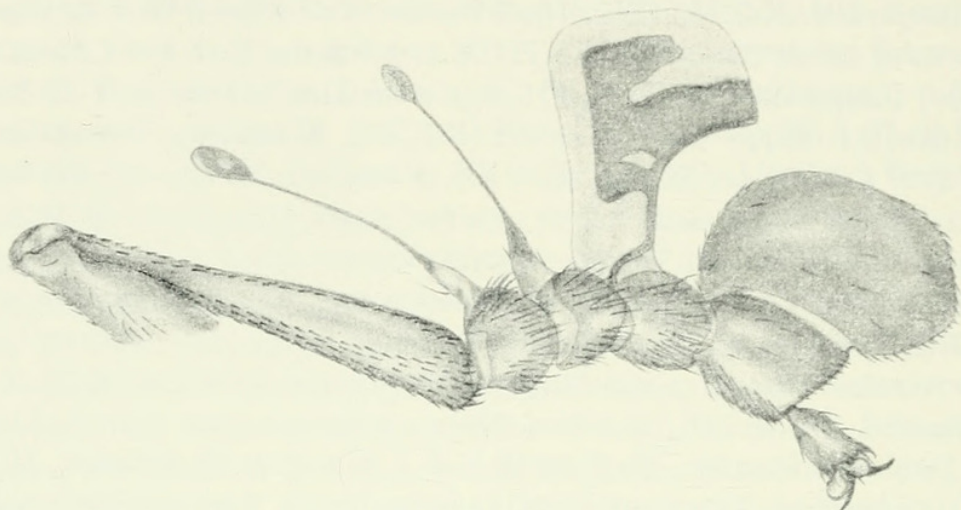


Figure 9. Posterior tarsus of the male of *C. insignis*.

As discussed under *C. pallipes*, the males of platypezids, like those of many other insects, begin to emerge early in the season. It is not surprising, therefore, that these first two records are for males. The earliest record for females of *C. insignis* is for September 24, at Champoeg State Park, Oregon. For this species the season for adults lasts past the middle of January in its southern ranges, the latest specimen taken being a female captured at Mill Valley, Marin County, California, January 19. The latest record for the capture of a male is for December 8, at San Francisco, California. The adult season for *C. insignis*, therefore, is from the last of August past the middle of January, the males disappearing by the middle of December.

HOST FUNGUS. Although I know of no published records which give the host fungus of *C. insignis*, or of either of the other species of *Calotarsa*, it is now abundantly clear that the larvae of *C. insignis* commonly feed on *Armillaria mellea*, known popularly as the oak-root fungus or honey mushroom. My own discovery of this fact dates back to 1959 when I reared adults of *C. insignis* from honey mushrooms which I had collected near the Navarro River in Mendocino County, California. Since that time I have repeatedly obtained these flies from larvae infesting *Armillaria mellea* collected from several other localities in California, including Pfeiffer-Big Sur State Park, Monterey County; Big Basin Redwoods State Park, Santa Cruz County; San Luis Rey Forest Campground, Riverside County; McConnell State Park, Merced County; Rough and Ready, Nevada County; and Golden Gate Park, San Francisco County.

Later, while studying material collected by others in the preparation of this paper, it was found that this species had been reared from *Armillaria* at Berkeley, Alameda County, as long ago as 1936. A specimen from the E. I. Schlinger collection, dates November 9 of that year, bears this information, as do flies reared by R. C. Dickson (XII-4-36 and XII-9-36), T.G.H. Aitken (XI-no day-36), and G.E. and R. M. Bohart (XI-no day-36). Presumably Aitken and the Boharts collected their larvae together. Very recently I received five females from E. I. Schlinger which he had reared from *Armillaria* taken at Glendale, Los Angeles County, November 24, 1962.

EMERGENCE TIMES. Much of interest, in addition to the fact that *C. insignis* utilizes *Armillaris mellea* as its host fungus, was revealed by the rearing experiments. Table I tabulates the data of these rearing records.

These cultures gave surprising results on two counts. In the first place, the adults did not wait until the following fall to emerge, yet none of the extensive field-collected material that I have examined consists of anything but flies which have been taken during the autumn and early winter. In the closely related genus *Clythia* we have species (e.g. *C. agarici* and *C. polypori*) which may develop without a long diapause and may therefore have several broods a year, but although the flies of *C. insignis* are large and conspicuous enough to attract attention at any season, no one seems to have captured any of them during the spring and summer. It seems necessary, therefore, to conclude that the emergence dates given in the table are abnormal ones, resulting from an abnormal environment during pupation. Under ordinary field conditions, the adults of *C. insignis* do not emerge until after a diapause of many months, but it is evident that in the artificial environment of uncontrolled laboratory conditions this diapause may be omitted. It is as though the entire culture had been physiologically alerted by the adverse conditions of the abnormal environment not to wait until the usual emergence time in the autumn, but rather to start sampling the environment at once on a trial-and-error basis. In this way some of the individuals of the species may be able to survive and reproduce. The culture from Pfeiffer-Big Sur is particularly interesting in this respect. It straggled its emergences over a period of almost six months and to the normal season.

It might be argued that because the larvae of the Pfeiffer-Big Sur culture were collected on December 19, and the first adults did not emerge until February 9, that the diapause had not been dispensed with, but only shortened. An attempt had been made to determine the time of pupation for this and the Big Basin Redwoods cultures. In both cases, the full-grown larvae were slow in pupating and for several weeks attempted to disperse. It would seem that this interval between the attainment of full growth for the larvae and the time of their pupation may be an important period of dispersal in nature as well.

TABLE 1. *Rearing records for C. insignis, all from California localities and from Armillaria mellea. The identifications of the fungus specimens were made by Robert T. Orr and Berta B. Kessel.*

| COUNTY | LOCALITY | LARVAE COLLECTED | ADULTS EMERGED | NUMBER & SEX | COLLECTOR |
|------------|-------------------------------------|---------------------|-------------------|---------------------|------------|
| Mendocino | 2 miles up Navarro R. | XII-5-59 | I-27-60 | 3 females | E.L.Kessel |
| | | | II-8-60 | 1 male | |
| | | | II-18-60 | 1 female | |
| | | | III-1-60 | 1 female | |
| | | | III-3-60 | 1 female | |
| | | | III-20-60 | 1 male 1 female | |
| Santa Cruz | Big Basin Redwoods State Park | XI-12-59 | IV-5-60 | 4 males 3 females | E.L.Kessel |
| | | | IV-6-60 | 7 males 5 females | |
| | | | IV-21-60 | 4 males 3 females | |
| Monterey | Pfeiffer- Big Sur State Park | XII-19-59 | II-9-60 | 2 females | E.L.Kessel |
| | | | II-10-60 | 1 male 3 females | |
| | | | II-11-60 | 6 females | |
| | | | II-16-60 | 4 males 25 females | |
| | | | II-18-60 | 1 male 2 females | |
| | | | II-23-60 | 4 males 33 females | |
| | | | II-25-60 | 15 males 28 females | |
| | | | II-26-60 | 9 males 12 females | |
| | | | III-1-60 | 15 males 30 females | |
| | | | III-3-60 | 16 males 19 females | |
| | | | III-8-60 | 16 males 29 females | |
| | | | III-10-60 | 22 males 26 females | |
| | | | III-15-60 | 19 males 17 females | |
| | | | III-11-60 | 11 males 6 females | |
| | | | III-17-60 | 7 males 6 females | |
| | | | III-19-60 | 12 males 13 females | |
| | | | III-23-60 | 26 males 25 females | |
| | | | III-26-60 | 43 males 23 females | |
| | | | III-30-60 | 34 males 13 females | |
| | | | IV-6-60 | 23 males 18 females | |
| | | | IV-7-60 | 21 males 29 females | |
| | | | IV-11-60 | 24 males 18 females | |
| | | | IV-15-60 | 10 males 5 females | |
| | | | IV-20-60 | 28 males 24 females | |
| | | | IV-24-60 | 18 males 20 females | |
| | | | IV-29-60 | 10 males 3 females | |
| | | | IV-2-60 | 5 males 3 females | |
| | | | V-4-60 | 5 males 2 females | |
| | | | V-6-60 | 1 male 3 females | |
| | | | V-10-60 | 30 males 18 females | |
| | | | V-13-60 | 26 males 38 females | |
| | | | V-19-60 | 3 males 13 females | |
| | | | V-21-60 | 20 males 24 females | |
| | | | V-28-60 | 5 males 29 females | |

TABLE I.
(Continued)

| COUNTY | LOCALITY | LARVAE COLLECTED | ADULTS EMERGED | NUMBER & SEX | COLLECTOR |
|---------------|----------------------------|---------------------|-------------------|--------------------|------------|
| | | | V-31-60 | 5 males 26 females | |
| | | | VI-2-60 | 1 male 11 females | |
| | | | VI-7-60 | 1 male 8 females | |
| | | | VI-9-60 | 2 females | |
| | | | VI-13-60 | 3 males 13 females | |
| | | | VI-20-60 | 14 females | |
| | | | VI-24-60 | 1 female | |
| | | | VI-28-60 | 1 male 4 females | |
| | | | VII-5-60 | 1 male 5 females | |
| | | | VII-8-60 | 2 females | |
| | | | VII-11-60 | 3 females | |
| | | | VII-14-60 | 1 male 4 females | |
| | | | VII-15-60 | 2 females | |
| | | | VII-21-60 | 1 female | |
| | | | VII-22-60 | 2 females | |
| | | | VII-26-60 | 1 female | |
| Nevada | Rough and Ready | XII-28-60 | 1-17-61 | 1 female | I.Branson |
| Riverside | Upper San Juan Forest C.G. | XII-6-61 | VI-31-62 | 2 males | E.L.Kessel |
| San Benito | San Juan Canyon | X-10-60 | IV-20-61 | 1 female | E.L.Kessel |
| | | | V-18-61 | 2 females | |
| | | | V-24-61 | 1 male | |
| | | | V-26-61 | 3 males | |
| | | | V-27-61 | 1 male | |
| | | | V-28-61 | 1 male | |
| San Francisco | Golden Gate | X-17-62 | XI-20-62 | 1 female | R.T.Orr |
| Merced | McConnell State Park | XI-16-60 | III-29-61 | 2 males | E.L.Kessel |

At any rate, pupation of the two cultures in question did not take place until approximately January 20 which, for the Pfeiffer-Big Sur brood, left only about nineteen days before the first flies emerged. The Golden Gate Park culture should also be noted in this connection. It produced its lone fly barely a month after the larvae were collected, certainly leaving no time for a diapause.

The second way in which the cultures produced surprising results was that the sequence of emergence did not bear out our impression, gained from field work, that the first flies to emerge are males. In all of the cultures considered in table I, and from which both males and females emerged, females

appeared on the first day of emergence, and in the Navarro River, Pfeiffer-Big Sur, and San Juan Canyon cultures, only females emerged the first day. Possibly this discrepancy from the expected, like the abnormal times of emergence, may be attributed to the artificial laboratory environment in which the cultures were kept. Nevertheless, a second impression gained from field work, viz., that the females predominate or occur alone during the last part of the season, is definitely supported by the rearing evidence. The Pfeiffer-Big Sur culture, with its large numbers and its emergences over a six-month period, indicates clearly that mostly females are produced toward the end of the season and that the last flies to emerge are exclusively females. During the last two months of the six months emergence period, the sex ratio of the emerging flies consisted of 73 females to 8 males, and the last two weeks yielded 6 females to no males. In view of these data, it seems proper to amend our field impressions as follows: the first flies to emerge are likely to represent both sexes, but the males complete their emergences earlier, so that the last individuals to appear are females. Some of the males live long enough to fertilize these late-emerging females, whose youth at the time permits them to live on for several weeks and therefore to oviposit on those host fungi which appear very late in the season.

OVIPOSITION. Egg laying by females of *C. insignis* has been observed by Peter Keyes, one of my students at the University of San Francisco. While collecting at Wildwood, 3 miles north of Boulder Creek, Santa Cruz County, California, on November 24, 1962, he came upon a rotten oak stump on which many honey mushrooms were growing. Removing some of these fungi and turning them upside-down, Keyes found the flies engaged in laying eggs. They were not easily disturbed, and some of them continued to oviposit with the mushrooms in the reversed position.

In all respects these flies behaved in the manner I have described for *Clythia agarici* (Kessel, 1960). The females wandered about over the gill surface, stopping frequently to oviposit. Each fly backed into the egg-laying position, moving backward into the slit between two gills and sinking so deeply that her abdomen was hidden and her wing bases were pressed against the gill surface. In this position her wings were flattened out over the surface of the pileus, and her hind legs projected more or less beneath them. Each fly remained in this ovipositing position for a few moments, long enough to lay an egg, and then neatly eased herself out of the slot. The mushrooms were mature, but not in a state of decomposition.

In the case of *C. agarici*, oviposition on a particular fungus occurs only for a period of one day, but Keyes had no opportunity to verify this observation for *C. insignis* because he could not return to visit the site the next day.

MATING ACTIVITIES. Actual mating pairs of *C. insignis* have not yet been observed to my knowledge, but the swarming activities of the males have been noted repeatedly. I first came across these swarms on October 22, 1945, at Mill Valley, Marin County, California. They appeared in the late morning and lasted until late afternoon, and were invariably found in "chimneys" open to the sky above and formed by irregular rings of trees, usually redwoods.

The swarms often consisted of several hundred flies, all males as evidenced by repeated sampling with a long-handled net. The insects flew slowly, moving to and fro in rather parallel formation, although rising and falling in altitude all the while. Such swarms were in evidence every day that I visited the area for a period of two weeks. Then came a series of heavy rains which continued for about three weeks. While individual males were still to be found on the bushes with the females after the rains, no more swarms of them were seen for the duration of the season, and some of the "chimney" sites which they had previously occupied had now been taken over for swarming purposes by *Platyppezina pacifica*. It seemed that the storm had greatly reduced the population of males, but the females were as plentiful as ever. This result is not unexpected when one considered the amount of energy which the males must expend as they continue in flight many hours each day within the swarm. It is probable that the males formed smaller swarms after the storm, but if this was the case they went unobserved.

I encountered similar swarms at Mill Valley during succeeding years, and again at Novato, also in Marin County, when I moved to that location. According to his collection labels, W. W. Wirth observed the male swarms of this species at Berkeley, Alameda County, California, October 31, 1947. Such swarming of the males is preliminary to mating in all the species of platypezids that have been studied adequately (Kessel and Kessel, 1961; 1962a; 1962b).

As noted under the discussion of *C. calceata*, Snow (1894a) was probably the first to observe this swarming of the males in platypezids. In fact, he obtained all but two of his specimens from such an aggregation, the exceptions constituting a mating pair which he captured in the air below the swarm. Snow was not aware of it, but it is now evident from observations on the mating habits of flat-footed flies which my wife and I have made during the past few years, that the pair which he caught in his net were descending from the swarm where they had first embraced.

Our observations on *P. pacifica* and *Protoclythia californica* indicate that the events leading up to mating are basically the same for platypezids in general, the swarming of the males differing only in regard to such matters as the height off the ground and the nature of the "chimney." In the two species here mentioned, the males wait in the swarm for the approach of individual fe-

males and, as each receptive female comes close enough, she is grabbed by the nearest male. Copulation is initiated at once, and then the female takes the initiative to tow the male backwards as they descend to the lower-story vegetation to complete their nuptial activities. Undoubtedly it was such a descending pair that Snow captured, for we must presume that the mating habits of platypezids as a family correspond as well as does their preliminary epigamic behavior.

In platypezids, the mating swarm is to be regarded as a device which serves as a recognition symbol and erotropic stimulus for the species. In all of the cases which I have observed, the legs of the "dancing" males are pendant, and in the species of *Calotarsa* the striking ornamentation of the posterior tarsi would appear to provide additional signals of this type. The ultimate in this ornamentation is achieved in the flat-footed flies, *C. pallipes* and *C. insignis*, and in the latter particularly, with its great hoof-like appendages attached to the fourth segments and the more spectacular banners flying from the third segments.

A female of *C. insignis*, passing a swarm of her males "dancing" in the darkened woods, could hardly fail to see the display of scintillating flashes which are emitted as the silvered surfaces of the flags reflect what light is present to broadcast the species' message of invitation. Plate 1, figure 2 illustrates how these flags, even those of a resting fly, reflect light in dark surroundings. On a leaf, a female will sit in close proximity to her males and ignore them completely. Only in the air, activated by the recognition of her own species' pattern of sexual stimulation, will she respond.

SUMMARY

The genus *Calotarsa* is known from three species, all recorded only from North America. *Calotarsa pallipes* (Loew) is an eastern species, found thus far from Quebec to North Carolina and westward as far as South Dakota. The season for this species is from early August to middle November. *Calotarsa calceata* (Snow) is known only from one locality in New Mexico and has been collected only in August. *Calotarsa insignis* Aldrich has a known distribution from southern British Columbia to southern California and, although it has not been collected in Washington and Idaho, a specimen was captured in Montana. The observed season for this species is from late August to middle January.

Calotarsa insignis is the only species of the genus for which the host fungus is known, having been reared repeatedly from *Armillaria mellea*. Under field conditions the adults do not emerge until after a diapause of many months, but under uncontrolled laboratory conditions this diapause may be abbreviated or omitted. In one culture, emergences straggled over a period of almost six



Kessel, Edward L. 1963. "The genus *Calotarsa*, with special reference to *C. insignis* Aldrich (Diptera: Platypezidae)." *Occasional papers of the California Academy of Sciences* 39, 1–24.

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