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THE GENUS *BETHYLUS* IN NORTH AMERICA (HYMENOPTERA: BETHYLIDAE)

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Bethylid wasps are predominantly tropical and subtropical in distribution, with only a few species of diverse genera penetrating temperate regions and virtually none entering arctic or subarctic regions. The sole exception to this statement, illogically, is the type genus of the family, *Bethylus* Latreille. This rather highly evolved genus is circumpolar in distribution. In North America, specimens have been taken close to the Arctic Circle, but none have been taken south of New York, Illinois, Colorado, and central California. In the Old World there are several species of northerly distribution and several others from the Mediterranean region. The genus is not known from the Southern Hemisphere.

In North America, four species have been described in the genus; these are: *castaneus* Kieffer, *amoenus* Fouts, *brachypterus* Whittaker, and *flavicornis* Whittaker. A fifth species, *decipiens* Provancher, has recently been transferred to the genus by Krombein (1958, U.S. Dept. Agri., Monogr. no. 2, first suppl., p. 98). Examination of types in the U.S. National Museum reveals that two additional species, *Arysepyris californicus* Bridwell and *Perisemus oregonensis* Ashmead, properly belong in the genus. Since the latter species is the type of the genus *Digoniozus* Kieffer (1905, *In* André, Spec. Hymen. Eur. Alger., v. 9, p. 245), this name can be added to the synonymy of *Bethylus*.

One of these seven names can be removed from further consideration here. I have recently had an opportunity to study the type and only known specimen of *Bethylus castaneus* Kieffer (1907, Berlin. Ent. Zeitschr., 51: 295). The wings of this specimen are in poor condition, but enough remains to be sure that this species belongs not to *Bethylus* but to the related genus *Goniozus* (new combination).

Thus there are six specific names available for the North American *Bethylus*, three of them newly assigned to the genus. The question naturally arises as to how much synonymy is involved and how many species, in fact, are there? The present paper is an attempt to answer that question.

ANALYSIS OF THE PROBLEM

Specimens of this genus are not common in collections, but by borrowing material from many sources I was able to obtain about 80 specimens. One's first impression, on scanning this material, is the remarkable uniformity of the specimens in size, color, and structure. The only notable color differences are sexual: the males have yellow mandibles and wholly yellow antennae, while the females have dark mandibles and the antennae more or less infuscated apically. There are no noticeable differences in the structure of the mandibles and clypeus, in the sculpturing of the head or thorax, or in the male genitalia.

There is, however, one character which varies strikingly, and that is wing length. The wings vary all the way from small pads scarcely larger than the tegulae to wings of normal size. This is not unusual in the genus, as several brachypterous species have been described and the European *fuscicornis* is known to exhibit much variation in wing length. In the case of the North American *Bethylus*, it was of interest to know whether wing length varied in a continuous spectrum or whether there were certain wing-length types which might represent different species. Following O. W. Richards (1939, Trans. R. Ent. Soc. London, 89: 185-344) in his revision of the British species, I first determined the relative wing length of each specimen by dividing the length of the fore wing by the length of the hind tibia (which is much easier to measure accurately than total body length). I then plotted the number of individuals exhibiting a given relative wing length (Fig. 1). The males fell into two distinct groups. Those of the first group (Type A) might be termed subapterous, since the wings are exceedingly small, barely surpassing the anterior margin of the propodeum. Males of the second group (Type B) might be termed micropterous, since the wings are still very small, extending about to the beginning of the propodeal declivity. When one plots the females on this same scale he obtains a somewhat different picture (lower half of Fig. 1). The subapterous forms (Type A) tend to have slightly longer wings, the micropterous forms (Type B) slightly shorter wings,

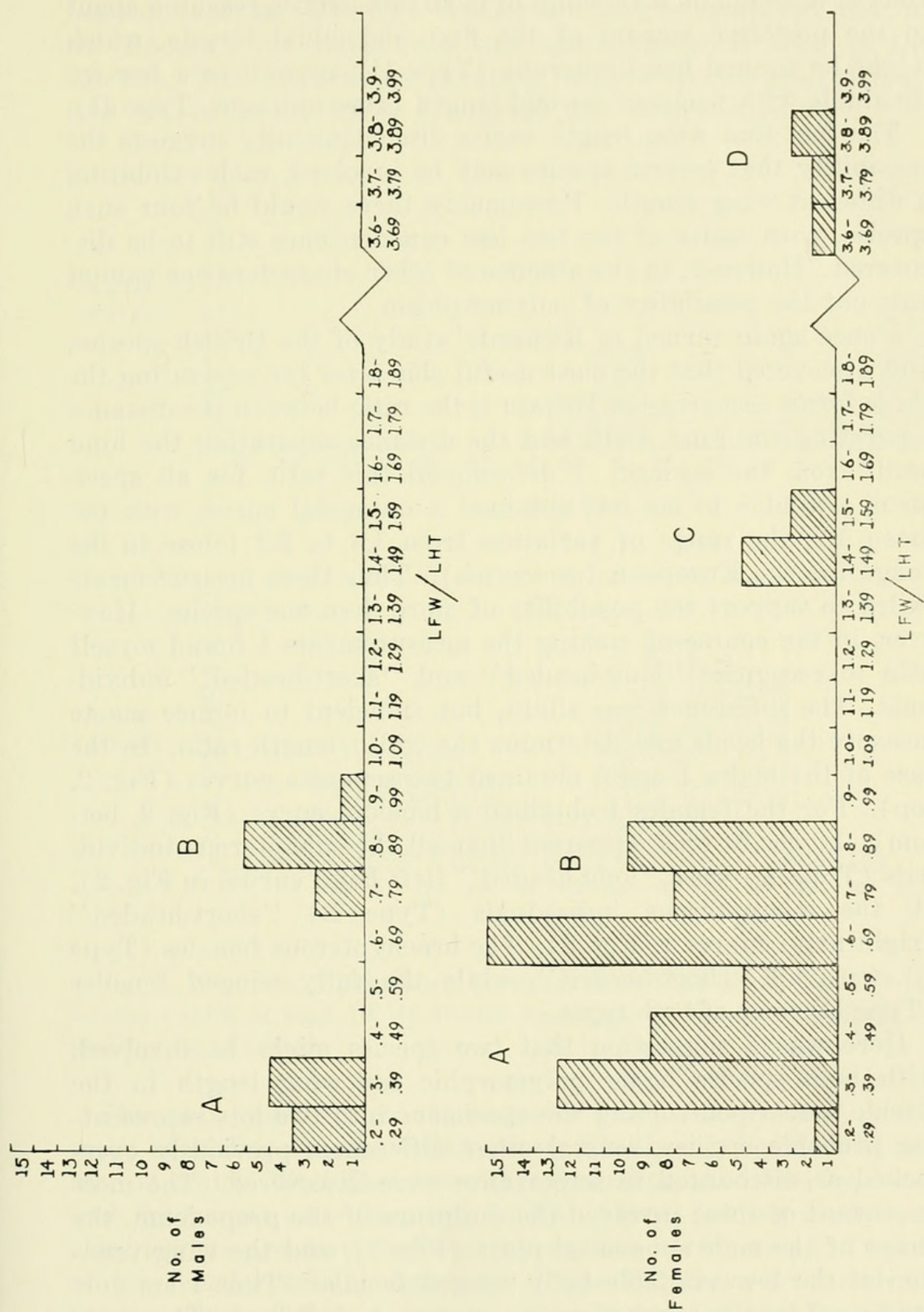


Fig. 1. Numbers of individuals (ordinate) exhibiting given relative wing lengths (length of fore wing [LFW] divided by length of hind tibia [LHT]), males at top, females at bottom.

so that the two curves overlap slightly. Furthermore, there is a class of individuals with wings of moderate length, reaching about to the posterior margin of the first abdominal tergite, which might be termed brachypterous (Type C), as well as a few individuals with wings of normal length (macropterous, Type D).

The fact that wing length varies discontinuously suggests the possibility that several species may be involved, each exhibiting a different wing length. Presumably there would be four such species, with males of the two less common ones still to be discovered. However, in the absence of other characters one cannot rule out the possibility of polymorphism.

I once again turned to Richards' study of the British species, and discovered that the most useful character for separating the three forms occurring in Britain is the ratio between the distance separating the hind ocelli and the distance separating the hind ocelli from the occiput. I determined this ratio for all specimens available to me but obtained a unimodal curve, with the mean 1.7, the range of variation from 1.3 to 2.2 (close to the range for the European *fuscicornis*). Thus these measurements failed to support the possibility of more than one species. However, in the course of making the measurements I found myself able to recognize "long-headed" and "short-headed" individuals. The difference was slight, but sufficient to induce me to measure the heads and determine the width/length ratio. In the case of the males I again obtained two separate curves (Fig. 2, top). For the females I obtained a bimodal curve (Fig. 2, bottom). It was at once apparent that all the subapterous individuals (Type A) were "long-headed" (left hand curves in Fig. 2), all the micropterous individuals (Type B) "short-headed" (right hand curves in Fig. 2). The brachypterous females (Type C) were all "short-headed", while the fully winged females (Type D) were of both types.

Here was a suggestion that two species might be involved, with both species being polymorphic for wing length in the female sex. Upon sorting the specimens into two lots representing probable species, several other differences previously overlooked or discounted in importance were discovered. The most important of these involved the sculpture of the propodeum, the shape of the male subgenital plate (Fig. 3), and the wing venation of the few available fully winged females. Thus I am now convinced that two polymorphic species are involved. The name *amoenus* Fouts is applicable to the "long-headed" species, while

decipiens (Provancher) is the earliest name for the "short-headed" species. The two species are widely sympatric east of the Rockies, but *amoenus* is not known to occur west of the Rockies. The characters separating the two species are summarized below, as are their synonymy and distribution.

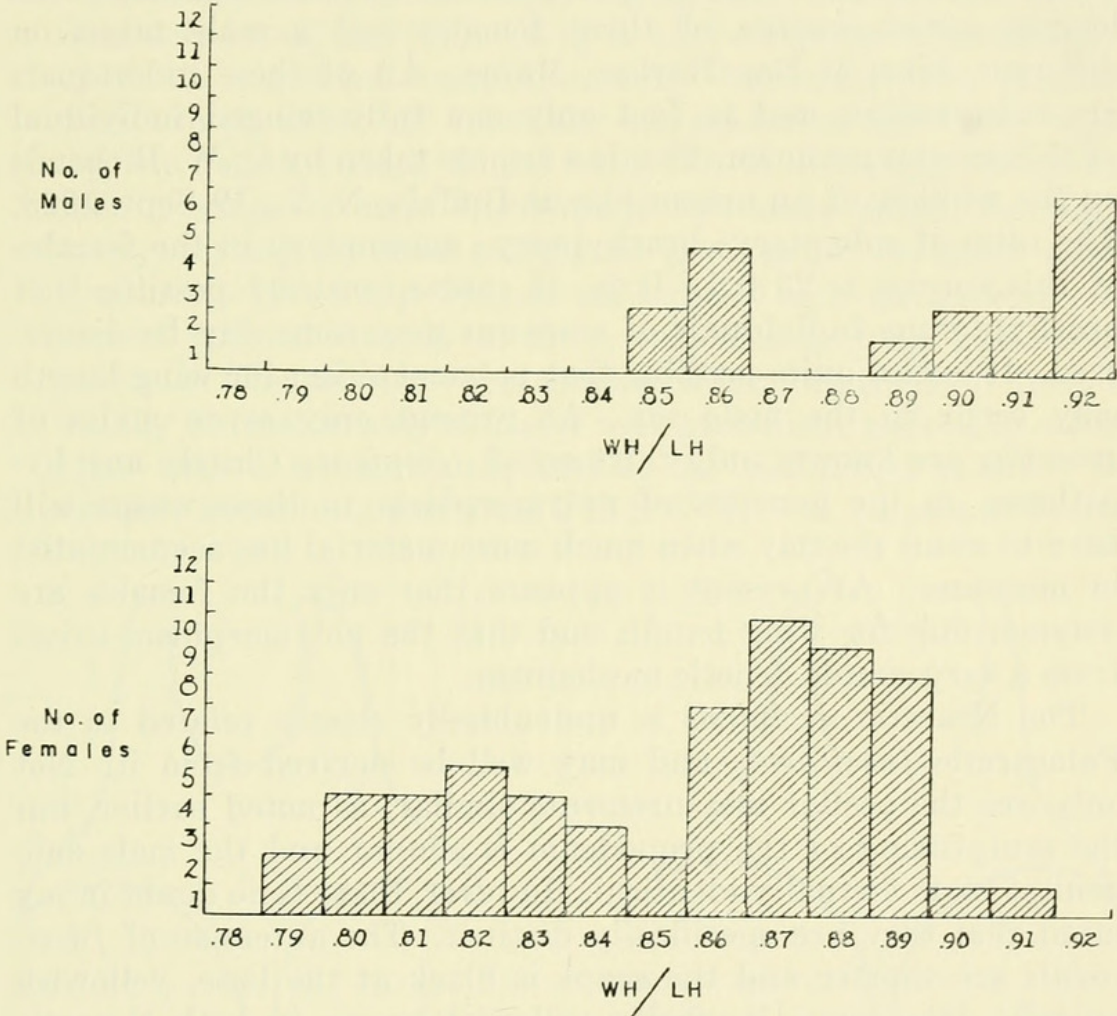


Fig. 2. Numbers of individuals (ordinate) exhibiting given relative head lengths (width of head [WH] divided by length of head [LH]), males at top, females at bottom.

The only good series of *decipiens* from one locality is the series of 16 females and 4 males from Chilliwack, British Columbia, on which Whittaker based his descriptions of *brachypterus* and *flavicornis*. As discussed further below, I have studied or obtained the necessary information on this entire series. Twelve of the females are micropterous (Type B), three are brachypterous (Type C), and one is macropterous (Type D). This 12:3:1 ratio, obtained in a series from one locality, is approached rather closely by the ratio for the species throughout its range,

which is 41:9:4. Unfortunately, only one reared series of this species is available. That is a series of five females and three males in the U.S. National Museum reared from *Vicia angustifolia* at the Lummi Indian Reservation, Washington. All individuals in this series are micropterous.

Unfortunately, no good series of *amoenus* is available; the longest series consists of three females and a male taken on different dates at Bar Harbor, Maine. All of these individuals are subapterous, and in fact only one fully winged individual of this species is known. This is a female taken by O. W. Richards on the window of an automobile at Buffalo, N. Y., 19 Sept. 1928. The ratio of subaptery: brachyptery: macroptery in the females of this species is 23:0:1. It is, of course, entirely possible that brachypterous individuals of *amoenus* may some day be discovered. It is also quite possible that polymorphism for wing length may occur in the male sex. At present only seven males of *amoenus* are known, only thirteen of *decipiens*. Clearly any hypotheses on the genetics of polymorphism in these wasps will have to await the day when much more material has accumulated in museums. At present it appears that only the females are polymorphic for wing length and that the polymorphism arises from a very simple genetic mechanism.

The Nearctic *decipiens* is undoubtedly closely related to the Palaearctic *fuscicornis* and may well be derived from it. Not only are the ocellar measurements similar, as noted earlier, but the sculpturing of the propodeum is similar and the male subgenital plate virtually identical. However, there is no doubt in my mind that they are specifically distinct. The antennae of *fuscicornis* are shorter and the scape is black at the base, yellowish apically (the scape is wholly yellowish-brown in both Nearctic species). Richards has found that the frequency distribution of relative wing length in *fuscicornis* is more or less trimodal or quadrimodal, but less distinctly so than in *decipiens* and with a much larger proportion of longer-winged individuals. Furthermore, the males of *fuscicornis* are typically macropterous rather than micropterous as in *decipiens*.

TAXONOMIC TREATMENT

Key to North American Species of BETHYLUS

Propodeum with a median polished ridge, remainder of disc contrastingly alutaceous; head rather short (width/length ratio

.85-.91 in female, .89-.92 in male); wings of micropterous individuals reaching at least nearly to middle of propodeal disc (relative wing length .57-.91); fully winged individuals with radial vein curved upward sharply apically, vein arising from basal vein barely indicated; fore tibiae clear yellow; male subgenital plate strongly emarginate, but the side-pieces relatively broad and blunt (Fig. 3, a) . . . *decipiens* (Provancher)

Propodeum somewhat convex dorsally but without a median ridge which is set off from the remainder of the disc; head slightly longer (width/length ratio .79-.84 in female, .85-.86 in male); wings of most individuals extremely small, reaching barely beyond anterior margin of propodeum (relative wing length .26-.54); fully winged individuals with radial vein not curved upward sharply at apex, vein arising from basal vein nearly as long as transverse median vein; fore tibiae of female usually at least weakly suffused with brownish; male subgenital plate with a strong emargination, the side-pieces reduced to slender, acuminate processes (Fig. 3, b) *amoenus* Fouts

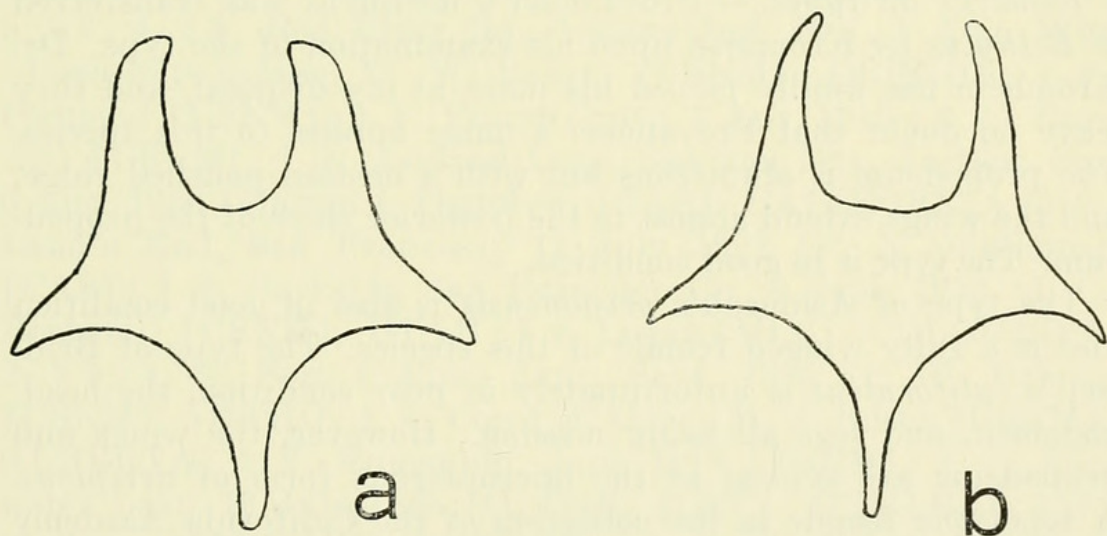


Fig. 3. Subgenital plates of (a) *Bethylus decipiens* and (b) *Bethylus amoenus*.

BETHYLUS DECIPIENS (Provancher)

Gonatopus decipiens Provancher, 1887, Add. Corr. Faune Ent. Canada, Hymen., p. 179 [Type: ♀, Cap Rouge, Quebec (Que. Prov. Mus., yellow label no. 1332)]. — Muesebeck and Walkley, 1951, U. S. Dept. Agri. Monogr. 2, p. 1038.

Perisemus oregonensis Ashmead, 1893, Bull. U. S. Nat. Mus., 45: 70 [Type: ♀, Portland, Oregon (U. S. Nat. Mus. no. 40422)]. New synonymy.

- Digoniozus oregonensis* Kieffer, 1905, Spec. Hymen. Eur. Alger., 9: 245 [Made type of new genus *Digoniozus*]. — Muesebeck and Walkley, 1951, U. S. Dept. Agri. Monogr. 2, p. 732.
- Arysepyris californicus* Bridwell, 1919, Proc. Hawaiian Ent. Soc., 4: 34 [Type: ♀, Parkside, San Francisco Co., Calif. (U. S. Nat. Mus. no. 64124)]. New synonymy.
- Bethylus brachypterus* Whittaker, 1929, Trans. R. Ent. Soc. London, 76: 385 [Type: ♀ (not ♂ as stated), Chilliwick, Br. Col. (British Museum)]. — Muesebeck and Walkley, 1951, U. S. Dept. Agri. Monogr. 2, p. 732. New synonymy.
- Bethylus flavicornis* Whittaker, 1929, Trans. R. Ent. Soc. London, 76: 386 [Type: ♂, Chilliwick, Br. Col. (British Museum)]. — Muesebeck and Walkley, 1951, U. S. Dept. Agri. Monogr. 2, p. 732. New synonymy.
- Glenosema californicus* Muesebeck and Walkley, 1951, U. S. Dept. Agri. Monogr. 2, p. 727.
- Bethylus decipiens* Krombein, 1958, U. S. Dept. Agri. Monogr. 2, First Suppl., p. 98.

Remarks on types. — Provancher's *decipiens* was transferred to *Bethylus* by Krombein upon his examination of the type. Dr. Krombein has kindly placed his notes at my disposal, and they leave no doubt that Provancher's name applies to this species. The propodeum is alutaceous but with a median polished ridge, and the wings extend almost to the posterior slope of the propodeum. The type is in good condition.

The type of Ashmead's *oregonensis* is also in good condition and is a fully winged female of this species. The type of Bridwell's *californicus* is unfortunately in poor condition, the head, abdomen, and legs all being missing. However, the wings and propodeum are typical of the micropterous form of *decipiens*. A topotypic female in the collection of the California Academy of Sciences is very similar to the type and is in good condition.

Whittaker's two names require special discussion. The types and most of the paratypes are in the British Museum and I have not seen them. However, Mr. G. E. J. Nixon has been good enough to examine these specimens and send me the critical information on them. I have studied one paratype of *brachypterus* in the collection of Cornell University as well as two of this species and one of *flavicornis* in the collection of Robert M. Fouts of Laredo, Texas. The characters Whittaker used for separating the two species are color characters which happen to be those which separate the sexes, and it happens that all the specimens

of *brachypterus* are females and all of *flavicornis* are males — Whittaker's statements to the contrary notwithstanding. The entire series is from Chilliwack, British Columbia; the type of *brachypterus* is a fully winged female, that of *flavicornis* a micropterous male. As indicated earlier, three of the paratypes of *brachypterus* are brachypterous, the remaining twelve micropterous.

Specimens examined. — 40 ♀♀, 10 ♂♂. ALASKA: 1 ♀, Fairbanks, 25 June 1948 [USNM]; 1 ♀, Circle, 2 July 1958 (C. Lindroth) [CNC]; 1 ♀, Nenana, 17 June 1953 (R. I. Sailer) [USNM]; 1 ♀, 2 ♂♂, Mile 1476, Alaska Highway (C. Lindroth) [CNC]. BRITISH COLUMBIA: 1 ♀, Mile 290, Alaska Highway, 19 June 1951 (W. Mason) [CNC]; 1 ♀, Smithers, 12 June 1958 (C. Lindroth) [CNC]; 1 ♀, Cranbrook, 12 May 1922 (C. Garrett) [CNC]; 1 ♀, Victoria, 28 Aug. 1923 (K. F. Auden) [CNC]; 3 ♀♀, 1 ♂, Chilliwack, May-June, Sept. 1927 (O. Whittaker) [CU, Coll. R. M. Fouts]; 1 ♂, Galiano, 2 Aug. 1929 [Coll. Fouts]; 1 ♀, Kaslo (A. N. Caudell) [USNM]; 2 ♀♀, Terrace [MCZ]. WASHINGTON: 1 ♀, Olympia [USNM]; 5 ♀♀, 4 ♂♂, Red River Rd., Lummi Ind. Res., 1 Aug. 1944 (*Vicia angustifolia*, W. W. Baker) [USNM]. OREGON: 1 ♀, Portland [USNM]; 1 ♀, Forest Grove, 1 Apr. 1919 (A. C. Burrell) [USNM]; 1 ♀, Ashland Loop, Siskiyou Mts., Jackson Co., 6 Aug. 1950 (Malkin & Thatcher) [CAS]. CALIFORNIA: 1 ♀, Land's End, San Francisco, 11 July 1922 (F. X. Williams) [CAS]; 1 ♀, Parkside, San Francisco Co., 8 Sept. 1910 (J. C. Bridwell) [USNM]. UTAH: 1 ♀, Logan [MCZ]. COLORADO: 2 ♀♀, 1 ♂, Fort Collins, June, Sept. 1895 (C. F. Baker) [USNM]. IDAHO: 1 ♀, Coeur d'Alene (H. J. Rust) [USNM]. ALBERTA: 1 ♀, Edmonton, June 1917 [USNM]; 1 ♂, Elkwater Lake, 19 July 1956 (O. Peck) [CNC]. ONTARIO: 1 ♀, Sudbury, 1892 [CNC]. QUEBEC: 1 ♀, Anticosti Island, 9 Sept. [MCZ]. NEW BRUNSWICK: 1 ♀, Penobsquis, Dec. 1927 (C. A. Frost) [MCZ]. NOVA SCOTIA: 1 ♀, Portapique, 23 July 1929 (C. A. Frost) [MCZ]. MAINE: 4 ♀♀, Bar Harbor, July-Oct. (A. E. Brower) [USNM]. NEW YORK: 1 ♀, Grand Island, 11 Oct 1922 [USNM]; 1 ♀, North Fairhaven, 1 Sept. 1918 [CU].¹

¹ The following abbreviations have been employed for the museums involved: CAS, California Academy of Sciences, San Francisco; CNC, Canadian National Collections, Ottawa; CU, Cornell University, Ithaca; MCZ, Museum of Comparative Zoology, Cambridge; USNM, U. S. National Museum, Washington.



Map showing distribution of North American *Bethylus*. Solid triangles: *Bethylus amoenus*, subapterous form; hollow triangle: macropterous form of *amoenus*. Solid circles: *B. decipiens*, micropterous form; half-solid circles: brachypterous form of *decipiens*; hollow circles: macropterous form of *decipiens*.

BETHYLUS AMOENUS Fouts

Bethylus amoenus Fouts, 1928, Proc. Ent. Soc. Wash., 30: 127 [Type: ♀, Slaterville-Caroline, Tompkins Co., N.Y., 14 June 1904 (Cornell Univ. no. 934)]. — Muesebeck and Walkley, 1951, U. S. Dept. Agri. Monogr. 2, p. 732.

Remarks on types. — The type is in good condition. I have also studied a male allotype, bearing the same data, in the collection of Robert M. Fouts.

Specimens examined. — 24 ♀♀, 7 ♂♂. NORTHWEST TERRITORIES: 2 ♀♀, Norman Wells, 3-13 July 1949 (W. Mason) [CNC]. ALBERTA: 1 ♀, Aspen Beach, 23 Aug. 1944 (O. Peck) [CNC]; 1 ♀, Elkwater Lake, 19 July 1956 (O. Peck) [CNC]. SASKATCHEWAN: 1 ♂, White Fox, 10 July 1944 (O. Peck) [CNC]; 1 ♂, Holdfast, June 1946 (W. A. Nelson) [CNC]; 1 ♀,

Assiniboia, June 1955 (J. R. Vockeroth) [CNC]; 1 ♂, Saskatoon, 15 Sept. 1924 (K. M. King) [CNC]. MINNESOTA: 1 ♀, Eaglesnest, 26 Aug. 1959 (W. V. Balduf) [USNM]. WISCONSIN: 1 ♀, Cranmoor, 20 May 1910 (C. W. Hooker) [USNM]. ILLINOIS: 1 ♀, Palos Park, 17 March 1933 (Frison & Mohr) [Ill. Nat. Hist. Survey]. MICHIGAN: 1 ♀, Wexford Co., 4 July 1952 (R. R. Dreisbach) [Coll. Dreisbach]; 1 ♀, Presque Isle Co., 28 July 1952 (P. B. Kanno) [Coll. Dreisbach]; 1 ♀, Midland Co., 20 June 1945 (R. R. Dreisbach) [Coll. Dreisbach]. ONTARIO: 1 ♀, Jordan, 25 Sept. 1916 (W. A. Ross) [CNC]; 1 ♀, Rondeau Park, Kent Co., 28 June 1936 (G. Steyskal) [Coll. Dreisbach]; 1 ♀, Prince Edward Co., 10 July 1950 (J. F. Brimley) [CNC]; 1 ♀, Belleville, 2 Oct. 1956 (J. M. Smith) [CNC]. NEW YORK: 1 ♀, Buffalo, 19 Aug. 1928 (O. W. Richards) [MCZ]; 2 ♀♀, Ithaca, 28 May, 23 June (Babiy, Evans) [CU, MCZ]; 1 ♀, 1 ♂, Slaterville-Caroline, 14 June 1904 [CU, Coll. R. M. Fouts]; 1 ♂, Caroline-Harford, Tompkins Co., 15 June 1904 [CU]; 1 ♂, Gannett Hill, 30 Aug. 1925, 2000 feet [CU]. MAINE: 3 ♀♀, 1 ♂, Bar Harbor, July, Sept., Oct. (A. E. Brower) [USNM]; 1 ♀, Southwest Harbor, 6 Sept. 1922 [CU]. NOVA SCOTIA: 1 ♀, Portapique, 22 July 1929 (C. A. Frost) [MCZ].

BIOLOGY OF THE GENUS

The only specimen of this genus which I have collected was taken walking over the ground in a small sand pit. Several specimens in collections are labeled as having been taken sweeping, one while "sweeping *Carex*," another "while beating for ants." Several specimens of both species were taken by A. E. Brower at Bar Harbor, Maine, on "Great Heath," one of the female *decipiens* "on flowers of *Ilex verticillata*." A female *amoenus* from Palos Park, Illinois, is labeled "in wet peat sample," while a series of *decipiens* from the Lummi Indian Reservation, Washington, is labeled "Rd *Vicia angustifolia*." Apparently these insects occur in a variety of situations. *B. amoenus* has been collected in every month from March to October, *decipiens* from April to October and also in December.

Two specimens of *amoenus* bear host data. One is the female listed above from Cranmoor, Wisconsin, which is indicated as a probable parasite of *Eudemis vacciniana*. This name is now regarded as a synonym of *Rhopobata naevana* (Hbn.), an oleuthreutid moth known as the black-headed fireworm. The other

specimen is the female listed from Belleville, Ontario, which is labeled as a parasite of *Brachypterolus pulicarius* L. This is a nitidulid beetle introduced from Europe to the United States about 1918.

If the latter record is correct, it is the only known instance of a *Bethylus* attacking a beetle. The European *cephalotes* Förster and *fuscicornis* (Jurine) attack various caterpillars, chiefly Microlepidoptera but occasionally Noctuidae. The female wasps sting and malaxate their rather large prey, then drag it to a place of concealment, such as a hollow stem. Several eggs are laid on the prey and several larvae develop on a single host. Further details regarding the biology of these two species may be found in the papers of Richards (1932, Trans. Ent. Soc. So. England, 8: 35-40; 1939, Trans. R. Ent. Soc. London, 89: 185-344).



Evans, Howard E. 1962. "The genus *Bethylus* in North America (Hymenoptera: Bethyridae)." *Breviora* 150, 1–12.

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