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A Revision of Some Species of *Pero* from the Western United States (Lepidoptera, Geometridae)

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The author recently worked over the collection of the North American species of *Pero* in the American Museum of Natural History, making a number of genitalic preparations of both sexes as an aid in determination. When these slides were studied, it became evident that a number of changes in nomenclature were needed to place properly several of the names currently in use. More material was borrowed from several institutions and individuals to supplement the specimens on hand, so it has become possible to examine several of the species more critically than heretofore.

The basic taxonomic work in this genus for our fauna was done by Grossbeck in his "Studies of the North American geometrid moths of the genus *Pero*" (1910, Proc. U. S. Natl. Mus., vol. 38, pp. 359-377, pls. 13-16). The greater part of his material is in the collection of the American Museum of Natural History, and it forms a substantial part of the material studied for the present paper. However, there were some shortcomings in the Grossbeck paper, and a number of these were noted in McDunnough's "Critical notes on certain *Pero* species (Lepidoptera, Geometridae)" (1949, Amer. Mus. Novitates, no. 1393, pp. 1-11). The present paper is, in part, an amplification of this second article.

The problem of making determinations for the North American

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species of *Pero* is a rather difficult one, because of the general similarity in color and maculation of all the species, and it is further complicated by a rather wide range of individual variation within each species. However, our species can be broken down into two groups on the basis of the male antennae. Most of the species have simple ciliated antennae in the male, while others have dentate antennae. The former belong in *Pero* proper, as Herrich-Schäffer said in his original description, "Antennae marum simpliciter ciliatae. Fühler der Männer einfach gleichmässig gewimpert" (1855-1856, Sammlung . . . Aussereuropäischer Schmetterlinge, p. 28). For the second group, Hulst erected the genus *Marmarea* (1896, Trans. Amer. Ent. Soc., vol. 23, p. 379; type, *occidentalis* Hulst). In his 1910 revision Grossbeck correctly sank this latter as a synonym of *Pero*. As an aid in the classification of our species, it is believed that this antennal character is one of considerable importance.

Owing to the amount of individual variation often found within a given species, and the general similarity of all the species in color and maculation, it is quite often necessary to make genitalic preparations as an aid in determination. That the male genitalia offer good specific characters for determination was recognized by Grossbeck, and he gave illustrations of these structures for all the known species. He placed a good deal of emphasis on the specific importance of what he termed the "clasper." He was followed in this by Cassino and Swett in their descriptions of new species, and they usually figured this structure. It is felt that this character has been overly stressed as a means of specific identification. In some cases it may be possible to place a species by this structure, but more often it is of importance in placing a specimen as to its species group within the genus. As McDunnough pointed out in his 1949 paper, a structure that was apparently overlooked by the earlier workers was the subscaphium, and this often has good specific characters. In addition, the aedeagus often has good characters, as does the ventral plate of the last abdominal segment. Accordingly, in the text, the description of the male genitalia is usually restricted to these three characters and does not include the entire structure. As an aid in studying the ventral plate, the author has modified his usual mounting technique as follows. The entire abdomen is mounted, as usual, but the pleural region on the left side of the last segment is split, as is the intersegmental membrane on the dorsal surface between the last two somites. This allows the dorsal and ventral plates to be separated and placed side by side rather than in the more usual superimposed position, and for this reason it is much easier to study the ventral plate.

Apparently none of the previous workers in this genus has published anything on the female genitalia. Good specific characters are found in these organs, so brief descriptions are included in this paper for the species studied.

While a large number of specimens and dissections have been examined in the preparation of this paper, much work is still needed on the species covered. A knowledge of the early stages is badly needed, not only on the specific level but for the different subspecies of *behrensarius* and *occidentalis*. The food plants are but little known, and it is possible that some of these species feed on more plants than are now known. One interesting aspect of this study is the similarity in geographical distribution of the species. It is intriguing to note that the populations of *behrensarius* and *occidentalis* from the southern Rocky Mountain states appear to be more distinct than are any of the other subspecies. The question is then raised as to whether these populations should be given specific rank or not; more field work and life history work are needed before this matter can finally be settled. It should be noted that one possible explanation for the paucity of several of the species in collections is the fact that the adults are usually on the wing in late spring and early summer, before many collectors are out in the mountainous regions.

MATERIALS STUDIED: During the preparation of this paper, 1240 specimens and 159 genitalic dissections were studied, including all the type specimens except *occidentalis* Hulst; Dr. E. L. Todd kindly compared this specimen for the author. This material has been made available to the author through the kindness of the authorities of several museums and the cooperation of private collectors, who are referred to specifically below. The genitalic preparations have been made largely by the author, mainly from specimens in the collections of the American Museum of Natural History, William R. Bauer, and the author. Additional slides have been studied from the collection of the Museum of Comparative Zoölogy, Harvard College.

Upon the completion of this paper, identification or type labels were placed on all specimens studied by the author at the American Museum of Natural History. In this way, future workers will know what specimens were studied.

ACKNOWLEDGEMENTS: Without the assistance of two men this study could not have been done. The late John L. Sperry of Riverside, California, whose magnificent collection of North American Geometridae is now incorporated in the collection of the American Museum of Natural History, collected very many of the specimens used in this paper. To Mr. James H. Baker, of Baker, Oregon, go sincere thanks

for 'several summers' work in capturing material from his area in series, without which it would have been impossible to do this revision. The author also wishes to acknowledge with thanks the cooperation and aid of the following men who have examined types at his request or who have allowed him to study specimens in their charge: Dr. E. L. Todd of the United States National Museum, Mr. Lloyd M. Martin of the Los Angeles County Museum, and Dr. P. J. Darlington, Jr., of the Museum of Comparative Zoölogy, Harvard College. A similar word of thanks goes to Mr. William R. Bauer of Petaluma, California, and to Mr. Carl W. Kirkwood of Summerland, California, for the privilege of studying specimens from their private collections.

THE *giganteus* GROUP

The species in this group are among the largest that occur in our fauna, and the males have simple antennae. The adults show sexual dimorphism in coloration, as the males are usually gray to gray-brown, while the females are brown. They may be distinguished by the genitalia as follows: the males have a very large subscaphium with an elongate, beak-like, terminal process, and the aedeagus has a narrow, terminal, transverse, sclerotized band with a tail-like extension; the females have the ductus bursae very heavily sclerotized, the surface of the elongate bursa compulatrix with a great many tiny, stellate indentations, and between these two structures is a fairly large, lightly sclerotized, median chamber, from whence the ductus seminalis arises.

Pero giganteus Grossbeck

Figures 4, 9, 16

Pero giganteus GROSSBECK, 1910, Proc. U. S. Natl. Mus., vol. 38, p. 366 (*partim*), pl. 13, fig. 3 (cotype female), pl. 15, fig. 3 (male genitalia). McDUNNOUGH, 1949, Amer. Mus. Novitates, no. 1393, p. 3 (*partim*). RINDGE, 1955, Bull. Amer. Mus. Nat. Hist., vol. 106, p. 144.

Pero provoensis CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 136. McDUNNOUGH, 1945, Canadian Ent., vol. 77, p. 67. (New synonymy.)

Unfortunately, it is difficult to separate this species by maculation from the closely allied northern species of this complex. These two entities have the largest wing expanse of our North American species, and they have been confused ever since the appearance of Grossbeck's description of *giganteus*, as he included both species in his type series. Subsequent workers have naturally followed the Grossbeck revision, so the error has been perpetuated. Not until the male genitalia are carefully studied can the true limits of this species be ascertained. Once the material is sorted on the basis of genitalic characters, it

becomes obvious that the true *giganteus* is restricted in range to the southern Rocky Mountains.

Both Grossbeck and McDunnough (1949) have given descriptions of the pattern and color of this species, and it has been illustrated by the former. On the basis of our present material it is not possible to decide whether or not this species can be divided into subspecies. Specimens from the southern part of the range appear to be somewhat more contrastingly marked, which could be owing to the much more recent date of capture as compared with the type series. More material is needed before this problem can be settled.

MALE GENITALIA: Subscaphium (fig. 4) very large, with a very prominent, elongate, beak-like structure apically, with pronounced longitudinal keel-like swelling medially extending almost entire length of subscaphium below the beak-like structure, being most prominent at the latter location; aedeagus (fig. 9) with terminal transverse sclerotized band extending about three-quarters of width of apex of aedeagus, having a low, sclerotized, finely dentate ridge beginning on left side, and usually with a short thickened tooth to the right, the transverse sclerotization continued caudally as a narrow, sclerotized, tail-like structure, the latter being slightly shorter than the former; vesica with a few extremely fine spiculations. Ventral plate (fig. 16) elongate, narrowed posteriorly, with two broad, semitruncate, terminal lobes, the dorsal surface of each with a small sclerotized ridge extending medioposteriorly but not exceeding the length of the lobes.

FEMALE GENITALIA: Ductus bursae heavily sclerotized, tapering anteriorly to junction with median chamber, which is lightly sclerotized; ductus seminalis arising from left side of median chamber adjacent to junction with ductus bursae; bursa copulatrix globular, approximately one and one-half times as long as ductus bursae, the surface with very many minute, stellate indentations.

EARLY STAGES: Unknown.

FOOD PLANT: Unknown.

TYPES: Of *giganteus*, in the American Museum of Natural History; of *provoensis*, in Museum of Comparative Zoölogy, Harvard College.

TYPE LOCALITIES: Provo, Utah (*giganteus*); Deer Creek, Provo Canyon, Utah (*provoensis*).

RANGE: The southern Rocky Mountain states of Utah, Colorado, New Mexico, and Arizona. (See fig. 1.) On the wing from late June through August. The localities suggest that the species may be restricted to higher elevations throughout its range.

REMARKS: Seventy-nine specimens and 14 genitalic dissections were examined. It should be noted that since McDunnough's 1949 paper,

the slide of Grossbeck's that served as the basis for his plate 15, figure 3, has been found. Grossbeck originally labeled it *occidentalis*, but this name was later crossed out and *giganteus* substituted by Grossbeck. He apparently used an entire specimen for his slides, as there are two sets of venational slides for all four wings, and another slide of all the legs, antennae, and palpi, in addition to one of the male genitalia. The only locality label on these slides is Utah. McDunnough apparently overlooked the allotype specimen also, as it is in the American Museum collection; this female is labeled Provo, Utah, July 9, 1908 (T. Spalding).

It is possible that some misunderstanding could arise concerning the designation of the type of this species, as Grossbeck states in his original description that the type is listed as catalogue number 13124 in the United States National Museum. However, this statement alone does not constitute a valid designation of the type specimen, as neither an exact type locality nor any single specimen is so designated in the original description. This situation applies to all four species (*giganteus*, *modestus*, *colorado*, and *marmoratus*) described in the Grossbeck revision. The specimens under the above number in the collection of that institution are one male and two females from Kaslo, British Columbia, labeled as cotypes. In the collection of the American Museum are two specimens labeled by Grossbeck as "male type" and "female type" from Provo, Utah, plus a number of cotypes from Utah, Colorado, British Columbia, Washington, and Oregon, as McDunnough has already pointed out. It will be shown that this assemblage of material is not conspecific, so it becomes necessary to try to determine just what Grossbeck regarded as being typical for his species. It quickly becomes evident that he must have regarded the specimens from Utah as actually representing this species, because (1) he so labeled a male and a female from material in his own collection as being the two types; (2) the specimen illustrated on plate 13, figure 3, is from Provo, Utah, the same locality as for these two types; and (3) the genitalia illustrated on plate 15, figure 3, are also from another Utah specimen. In addition, there are nine Utah specimens labeled as cotypes from the Grossbeck collection, while there is only a total of seven other cotypes from all the other localities in the collection. It should be noted, too, that all the specimens and genitalic preparations illustrated in Grossbeck's revision are in the Grossbeck collection, which is now incorporated in the American Museum collection, and that he must have considered these as being typical of the species concerned. He made this doubly clear by labeling specimens described by him in his revision as "male type," "female type," or "cotypes." Accordingly,

there can be no doubt of his intent to have the Utah specimens as the types of *giganteus*, so the specimen labeled by Grossbeck as "male type" becomes the holotype of this species.

The type of *provoensis* is a somewhat aberrant male, with the median area of the forewings above greatly reduced in width. Except for this difference, it fits in very well with the other members of this species.

Pero mizon, new species

Figures 5, 10, 17

Azelina ancetaria occidentalis DYAR (*nec* Hulst), 1904, Proc. U. S. Natl. Mus., vol. 27, p. 913.

Pero giganteus auct., *nec* Grossbeck, GROSSBECK, 1910, Proc. U. S. Natl. Mus., vol. 38, p. 366 (*partim*). BARNES AND McDUNNOUGH, 1912, Contributions to the natural history of the Lepidoptera of North America, vol. 1, pt. 4, p. 45, pl. 21, fig. 16 (cotype of *giganteus*). BLACKMORE, 1918, Proc. Ent. Soc. British Columbia, vol. 8, p. 8. CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 139. McDUNNOUGH, 1927, Canadian Ent., vol. 69, p. 266; 1949, Amer. Mus. Novitates, no. 1393, p. 3 (*partim*). J. R. J. L. JONES, 1951, Occas. Paper Ent. Soc. British Columbia, no. 1, p. 136. CARL, GUIGUET, AND HARDY, 1952, Occas. Paper British Columbia Prov. Mus., vol. 9, p. 119.

MALE: Forewings above light grayish brown, with scattered darker scales in basal portion of wing, and with the veins tending to be marked with yellow-brown, especially in median area of wing; t. a. line rather poorly defined, being slightly more prominent in the cell; median area brown, becoming darker brown distally, where the t. p. line is formed; discal dot small, whitish, preceded by faint yellow-brown area; subterminal and terminal areas light gray, dusted with gray-brown scales below the radial veins, with a narrow shade line of grayish white at outer border of t. p. line and a second line of the same color curving across wing from below the apex to the outer angle, and with three small white subterminal spots in cells R_5 , M_1 , and M_3 , and a small black spot in cell Cu_1 . Hind wings above light gray, becoming more heavily suffused outwardly with brownish scales, and with anal angle shaded with black scales; extradiscal line grayish white, extending straight across wing, but with inwardly pointing teeth in cells; a series of small black terminal dots in the cells below the radial vein. Under surface light gray, shaded with brown scales, especially on hind wings.

Length of forewing: 18 to 24 mm.; holotype, 22 mm.

FEMALE: Similar to male, but forewings above ochre, shaded with brown and dark orange-brown scales, the median area being mainly this latter color.

Length of forewing: 21 to 25 mm.; allotype, 23 mm.

MALE GENITALIA: Subscaphium (fig. 5) very elongate, with median

shelf-like projection extending approximately one-half to two-thirds of the length of the terminal beak-like projection; aedeagus (fig. 10) with terminal transverse sclerotized band extending about two-thirds of width of apex of aedeagus, having a low, sclerotized, finely dentate ridge beginning on left side and usually extending the length of the band, and with a short, toothed protuberance on the right side, the transverse sclerotization continued caudally as a narrow, sclerotized, tail-like structure, the latter being slightly longer than the former; vesica with a few fine spiculations. Ventral plate (fig. 17) elongate, narrowed posteriorly, with two broad, rounded, terminal lobes, the dorsal surface of each with a sclerotized pointed projection extending beyond apex of lobes.

FEMALE GENITALIA: Similar to those of *giganteus*, but with median chamber lightly sclerotized and with several longitudinal folds or creases, and with bursa copulatrix very long, being at least twice as long as the sclerotized ductus bursae, the surface with a large number of very fine stellate indentations.

EARLY STAGES: Undescribed.

FOOD PLANTS: *Ribes sanguineum* Pursh, *Alnus rubra* Bong., *Spiraea discolor* (Jones, 1951); a male in the author's collection from Westley, Stanislaus County, California, was reared on alfalfa and clover by W. Allan.

TYPES: Holotype, male, Spring Creek, near Baker, Baker County, Oregon, July 29, 1949 (J. H. Baker), and allotype, female, Baker, Baker County, Oregon, July 21, 1938 (J. H. Baker); both in the American Museum of Natural History. Paratypes, 186 males and 56 females: *California*: Alameda County, June (Hy. Edwards), one male; Trinidad, Humboldt County, July 12, 1909, one male; Davis Creek, Modoc County, July 17, 1922, one male; Big Trees, Calaveras County, August 5, 1953 (W. J. and J. W. Gertsch), one male; Meeks Bay, Lake Tahoe, July 23, 1941 (G. H. and J. L. Sperry), one male; Clarksburg, Sacramento County, July 14, 1931, one male; Cazadero, Sonoma County, August 18, one female; Sonoma County, one female; Laytonville, Mendocino County, June 17, 1949, August 18, 1949, September 1, 7, 26, 1949 (R. F. Sternitzky), five males and one female; Point Reyes, Marin County, June 4, 12, 1947 (R. F. Sternitzky), two males; Petaluma, Sonoma County, April 27, 1940, May 12, 20, 24, 1940, May 28, 1938, June 2, 25, 1940, June 28, 1941, September 10, 16, 18, 1939, September 13, 16, 23, 1946, October 21, 1938 (W. R. Bauer), September 20, 1936, October 15, 1935 (E. C. Johnston), 12 males and eight females; Anderson Springs, Lake County, August 17, 1947, September 1, 1947 (W. R. Bauer), three males; Spring Mountain,

Napa County, April 24, 1939, May 20, 1947, June 3, 1940, June 18, 1947 (W. R. Bauer), four males; Inverness, Marin County, May 26, 1941 (W. R. Bauer), one female; Grizzly Flats, Eldorado County, September 12, 1938 (E. P. Chace), one male; Santa Rosa, May 12, 1936 (E. C. Johnston), May 17, 1940 (J. A. Comstock), five males; Crescent City, Humboldt County, July 19, 1937 (E. P. Chace), one male; Mohawk, Plumas County, 1939 (B. Winter), one male; Nelson Creek, Plumas County, July 26, 1940, August 16, 23, 1940 (W. R. Bauer), two males and one female; Johnsville, Plumas County, August 6, 1946 (H. Pini), one female; Colusa, Colusa County, August 21, 1936 (W. R. Bauer), one male; Guerneville, Sonoma County, May 15, 1925 (E. Guédet), one female; San Anselmo, Marin County, June 7, 1946 (F. H. Rindge), one female; Miami Ranger Station, Mariposa County, June 30, July 5, 1946 (F. H. Rindge), two males; Grass Valley, Nevada County, May 18, 1946 (F. H. Rindge), one male; Hat Creek Ranger Station, Shasta County, July 13, 1947 (F. H. Rindge), one male; Alturas, Modoc County, July 26–29, 1948 (F. H. Rindge), one male; Hornbrook, Siskiyou County, August 29, 1948 (R. Coleman), one male; Walker River, Mono County, July 21, 1939 (M. L. Walton), one male; Westley, Stanislaus County, emerged April 19, 1948 (W. Allen), one male. *Nevada*: Holbrook, August 4, 1938 (G. H. and J. L. Sperry), one male and two females. *Oregon*: The Dalles (Hy. Edwards) (cotypes of *giganteus*), two males; Chief Joseph Mountain, Joseph, August 20, 25, 1950 (G. H. and J. L. Sperry), two males; Wallowa Lake, Wallowa National Forest, July 23, 1940 (J. H. Baker), one male; Wallowa Lake, July 4, 1949 (G. H. and J. L. Sperry), one male; Spring Creek, near Baker, Baker County, July 24, 30, 31, 1953, July 22, 1954, August 1, 1953 (J. H. Baker), nine males; Baker, August 3, 1939 (J. H. Baker), one female; Gresham, July 30, August 8, 1947 (J. Schuh), three males. *Washington*: Tacoma (cotype of *giganteus*), one female; Rosemary Inn, Lake Crescent, July 19, 21, 23, 29, 1941 (G. H. and J. L. Sperry), two males and five females; Walla Walla, various dates in May, June, August, and September, 1947–1949 (W. C. Cook), 85 males and seven females. *British Columbia*: Duncans, Vancouver Island, July 16–23 (Hanham) (cotypes of *giganteus*), one male and one female; Vancouver Island, one male and one female; British Columbia Biological Station, Departure Bay, July 9, 1909, one male and one female; Quamichan District, Vancouver Island, June 22–30, July 1–7, 8–14 (A. W. Hanham), two males and one female; Wellington, August 9, 1946 (D. C. Ferguson), June 18, 1949, July 2, 1949 (R. Guppy), two males and one female; Victoria, one female; Kaslo, August 22 (cotype of *giganteus*), one female; New Westminster, July 6,

1938 (J. K. Cooper), two males; Kaslo, August 22, one male; no locality, July 7, 1902, one male. *Montana*: Trout Valley, near Deborgia, Sanders County, August 5, 1941 (G. H. and J. L. Sperry), one female. *Idaho*: Wallace, various dates in May, July, August, and September, 1926–1946 (O. Huellemann), 15 males and 15 females; Boise, August 25, 1941 (A. H. and S. K. Rindge), four males. Paratypes in the collections of the American Museum of Natural History, Los Angeles County Museum, W. R. Bauer, J. H. Baker, C. W. Kirkwood, and the author.

RANGE: From central California north to at least southern British Columbia, and into Idaho. (See fig. 1.) On the wing from May through August. In the Museum of Comparative Zoölogy there is a specimen labeled Volga, South Dakota, but this locality needs to be verified.

REMARKS: Two hundred and sixty-nine specimens and 30 genitalic dissections were examined. While having the same type of maculation as *macdunnoughi*, the males of this species lack the decided gray cast of that species, and both sexes are considerably larger. The male genitalia are distinct in having a larger subscaphium, with the median shelf-like protuberance being not so long as the terminal beak-like process. The female genitalia are larger than in *macdunnoughi*, and the bursa copulatrix is more heavily covered with the stellate indentations.

Pero macdunnoughi Cassino and Swett

Figures 7, 11, 18

Pero peplarioides auct., nec Hulst, GROSSBECK, 1910, Proc. U. S. Natl. Mus., vol. 38, p. 368 (*partim*), pl. 13, figs. 4, 5 (male and female), pl. 15, fig. 2 (male genitalia). J. A. COMSTOCK, 1930, Bull. Southern California Acad. Sci., vol. 29, p. 29, pls. 13–15 (life history).

Pero macdunnoughi CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 141. McDUNNOUGH, 1945, Canadian Ent., vol. 77, p. 67; 1949, Amer. Mus. Novitates, no. 1393, p. 4.

Pero peplarioides macdunnoughi, McDUNNOUGH, 1938, Check list, p. 170.

The actual status of this species was definitely settled by McDunnough in two papers (1945, 1949). It occurs in southern California, where it is fairly common, and extends as far north as the San Francisco Bay area. It is much smaller than *giganteus* and *mizon*, as the length of each forewing in both sexes is about 3 mm. less than in those species. The forewings of the males above tend to be grayer than in *giganteus* and *mizon*, and in both sexes the t. a. line tends to be less sharply delimited, as the basal area is more heavily dusted with dark scales. In contrast to the grayish colored males, the females above

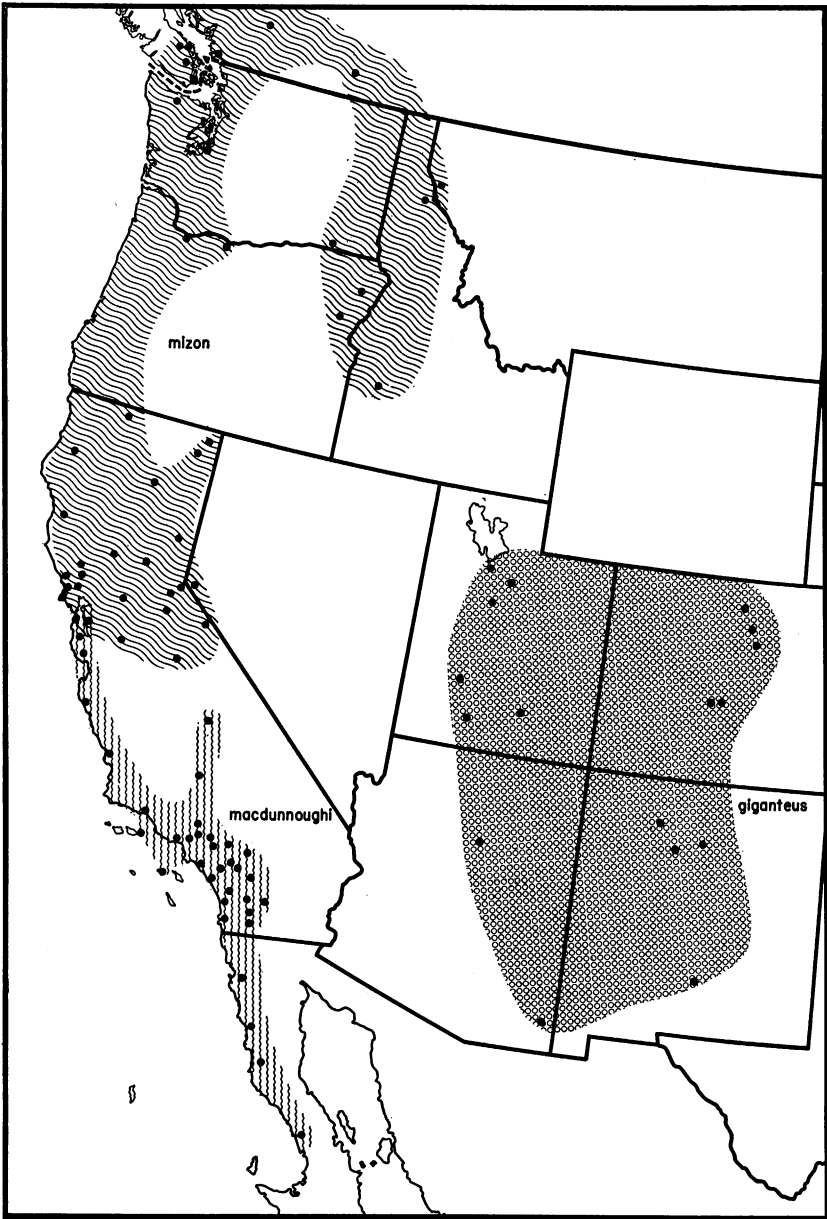


FIG. 1. Distribution of *Pero giganteus* Grossbeck, *mizon* Rindge, and *macdunnoughi* Cassino and Swett.

are a reddish brown, and they have a tendency to have more dark scaling outside the t. p. line than does *giganteus*.

MALE GENITALIA: Subscaphium (fig. 7) very large, with a very prominent, elongate, beak-like structure apically, with a broad, elongate, shelf-like projection below this, extending as far as the tip of the beak-like structure, then continued caudally as a longitudinal, keel-like, medial swelling; aedeagus (fig. 11) with a narrow, terminal, transverse, sclerotized band extending about one-half of width of aedeagus on the left side, continued caudally as a narrow tail-like structure, the latter as long as or slightly longer than the former; vesica with a few extremely fine spiculations. Ventral plate (fig. 18) elongate, narrowed posteriorly, with two broad, semitruncate or bluntly rounded, terminal lobes, the dorsal surface of each with a small sclerotized ridge extending medioposteriorly to the tip of the terminal lobes.

FEMALE GENITALIA: Similar to those of *giganteus*, but with median chamber tending to be less heavily sclerotized, and with surface of bursa copulatrix with fewer stellate indentations.

EARLY STAGES: Described and illustrated by Comstock.

FOOD PLANTS: Privet (Comstock, 1930).

TYPE: In Museum of Comparative Zoölogy, Harvard College.

TYPE LOCALITY: San Diego, San Diego County, California.

RANGE: From northern Baja California and southern California, north as far as the San Francisco Bay area in central California. (See fig. 1.) On the wing in every month of the year.

REMARKS: Two hundred and fifty-five specimens and 25 genitalic dissections examined. The male genitalia can easily be separated from those of *giganteus* by the large, median, shelf-like projection of the subscaphium. The female genitalia of these two species are similar, but the stellate indentations of the bursa copulatrix are fewer in number than in *giganteus*.

DISCUSSION OF THE *giganteus* GROUP

All three species are closely allied and similar in appearance, yet are apparently morphologically distinct and geographically isolated. Of the three species involved, *giganteus* has the best-defined maculation and is the largest. In table 1 is summarized a series of wing measurements for the three species concerned. While there is some overlapping in the size range for the three species, the averages show that a good difference is present. When the genitalia are studied, good constant morphological differences are observed, particularly in the structure of the subscaphium and aedeagus. Of the former, *macdun-*

noughi has the smallest, *mizon* the largest; these two species have the median shelf-like projection, which is lacking in *giganteus*. In *macdunnoughi*, the point of origin of this latter structure is nearly in the center of the subscaphium, and it is as long as that process; in *mizon* the shelf-like projection is much shorter than the beak-like terminal process, and the point of origin is just beyond one-third of the distance

TABLE 1
MEASUREMENTS OF LENGTH OF RIGHT FOREWING

		Number	Range	Average
<i>giganteus</i>	♂	51	20-24 mm.	21.8 mm.
	♀	22	21-25	23.3
<i>mizon</i>	♂	153	18-24	21.3
	♀	54	21-25	22.9
<i>macdunnoughi</i>	♂	126	14-20	18.7
	♀	55	16-22	20.3

from the end instead of in the middle. With regard to the terminal armature of the aedeagus, *macdunnoughi* has the smallest sclerotized band, while the other two species have a larger band with a dentate ridge and usually a tooth or projection in addition. In the female genitalia, *giganteus* has the longest and largest ductus bursae, and *macdunnoughi* the smallest. However, *mizon* has the largest bursa copulatrix of the three species, as it averages about twice as long as the ductus bursae.

Hence it can be seen that the three species are structurally distinct, and an examination of the distribution map given as figure 1 shows that *giganteus* is widely separated geographically from the other two species. Both *mizon* and *macdunnoughi* fly in central California around the San Francisco Bay area, but more material is needed to determine whether or not any hybridization takes place. Specimens of *mizon* from this area tend to be more variable than do others of this species from other areas. However, specimens of *occidentalis* are also more variable in this area than in others. The significance of this fact is not known. Apparently, then, these three closely allied species form a superspecies, as they seem to fulfill all the requirements for this category.

Pero behrensarius (Packard)

Azelina behrensaria PACKARD, 1871, Proc. Boston Soc. Nat. Hist., vol. 12, p. 386.

This species is usually among the easier ones in this difficult genus to recognize. It can be distinguished by the gray ground color of the wings, the prominent black t. a. and t. p. lines, and the darkened and contrasting median area with the well-developed, angular, white, discal spot. The basal, subterminal, and terminal areas are usually finely sprinkled with black scales, and the area distad of the t. p. line may be lightly suffused with brown scales as well. The two cross lines are rather variable in their course, as they vary from being strongly but evenly curved to almost straight, and, as a result, the width of the median area is quite variable. Another variable feature is the color of the median area of the forewings, which can be light or dark gray, gray-black, grayish brown, light brown, or a solid deep brown.

MALE GENITALIA: Subscaphium narrow, with constriction three-fourths of the distance from base, the area distad extending ventrally to apex, V-shaped in profile, the surface of the constricted area finely spiculate, the basal portion of the subscaphium flattened and broadened anteriorly; aedeagus with small, terminal, sclerotized plate on left side posteriorly, curving around from dorsal to ventral surface, tapering in width while so doing, with a small spine dorsally, or with this plate reduced or absent; vesica unarmed. Ventral plate slightly constricted posteriorly, with two elongate, outwardly pointing, rounded lobes, with very small, dorsolateral, sclerotized ridges, and with weakly sclerotized or partially membranous area medially where the sides of the lobes meet.

FEMALE GENITALIA: Ductus bursae heavily sclerotized, in length less than twice the width of ostium, with posterior portion of elongate median chamber lightly sclerotized; ductus seminalis arising from left side of median chamber near junction with ductus bursae; bursa copulatrix rounded, longer than ductus bursae, membranous at junction with median chamber, the remainder of surface very heavily beset with large stellate indentations, these being separated from one another by less than the width of their bases.

RANGE: The Rocky Mountain and Pacific coast states, Alberta, and British Columbia.

REMARKS: This widely ranging species can be easily distinguished from those in the *giganteus* group by its lack of sexual dimorphism in coloration, its smaller size, and gray color, with the well-defined, contrasting median area. The shape of the subscaphium in the male genitalia is very different, lacking the long beak-like projection of the *giganteus* group, and the female genitalia have a much shorter ductus bursae and the surface of the bursa copulatrix is much more heavily covered with larger stellate indentations.

Pero behrensarius behrensarius (Packard)

Figures 6, 12, 19

Azelina behrensaria PACKARD, 1871, Proc. Boston Soc. Nat. Hist., vol. 13, p. 386. BUTLER, 1881, Ann. Mag. Nat. Hist., ser. 5, vol. 8, p. 33.

Azelina behrensata (sic!), PACKARD, 1876, A monograph of the geometrid moths . . . of the United States, p. 521, pl. 11, fig. 60. HULST, 1886, Ent. Amer., vol. 2, p. 49; 1896, Trans. Amer. Ent. Soc., vol. 23, p. 380.

Azelina hubnerata behrensata, J. B. SMITH, 1891, List of the Lepidoptera of boreal America, p. 65.

Pero behrensarius, GROSSBECK, 1910, Proc. U. S. Natl. Mus., vol. 38, p. 369, pl. 13, fig. 7 (adult), pl. 16, fig. 4 (male genitalia). BLACKMORE, 1918, Proc. Ent. Soc. British Columbia, vol. 8, p. 9. McDUNNOUGH, 1927, Canadian Ent., vol. 69, p. 267; 1949, Amer. Mus. Novitates, no. 1393, p. 6. BOWMAN, 1951, Canadian Jour. Zool., vol. 29, p. 151. J. R. J. L. JONES, 1951, Occas. Paper Ent. Soc. British Columbia, no. 1, p. 136.

In the nominate subspecies, the median area of the forewings above is quite variable in color, ranging from various shades of brown to dark gray. In many cases this gradation of colors is rather complete, with a mixture of both brown and gray scales being present, so that it becomes difficult to assign individual specimens to either a "brown" or "gray" category. Nevertheless, this has been done, with the following results. Unfortunately, material in series has not been available from the northern portion of the range; however, both the brown and gray forms appear to be present. One hundred and twenty-one specimens from Oregon are before the author; of these 54 are brown and 67 are gray, or 45 per cent of these examples are brown. Of this Oregon series, 103 specimens are from Spring Creek, near Baker, Baker County (J. H. Baker). In this population, 41 (30 males, 11 females) are brown, while the remaining 62 (49 males, 13 females) are gray; this means that 38 per cent of the specimens are brown.

From the mountains of California, 54 specimens are at hand; these represent localities in nine counties from the Oregon border as far south as Mariposa County. Of these, 24 are brown and 30 are gray, or 46 per cent brown. The largest series are from two localities in Plumas County. Of 12 specimens from Smith Lake, June 30–July 16, 1941 (F. H. Rindge), five (all males) are brown, and seven (six males, one female) are gray, i.e., 42 per cent are brown. From Mohawk (W. R. Bauer), three (one male, two females) specimens are brown, and four (all males) are gray, i.e., 43 per cent are brown.

South of Plumas County, the only specimens present in any sort of series are 10 from Meeks Bay, Lake Tahoe, Eldorado County (Sperry). Of these, one is aberrant, having no cross lines or differentiated

median area; the remainder are two brown and seven gray examples. In addition, there are seven examples from Mariposa County: two from Yosemite Park, the remaining five from near-by Miami Ranger Station. Here three examples are brown and four are gray. No examples have been seen from Madera County, which is south of Mariposa County. However, from Fresno, Tulare, and Kern counties, all specimens examined had the median area of the forewings gray, and they are assigned to the following subspecies.

MALE GENITALIA: Described above.

FEMALE GENITALIA: Described above.

EARLY STAGES: Undescribed.

FOOD PLANTS: *Pseudotsuga taxifolia* (Poiret) Britton, *Picea engelmanni* Engelm. (Jones, 1951).

TYPE: In Museum of Comparative Zoölogy, Harvard College.

TYPE LOCALITY: Big Trees, California.

RANGE: From the Sierra Nevada Range of California to southern British Columbia, Alberta (Bowman, 1951), Idaho, and Wyoming. (See fig. 2.) On the wing from late May through June and July.

REMARKS: One hundred and eighty-four specimens and 13 genitalic dissections were examined.

Pero behrensarius vanduzeeata W. S. Wright, new combination

Pero vanduzeeata W. S. WRIGHT, 1921, Proc. California Acad. Sci., ser. 4, vol. 11, p. 109. McDUNNOUGH, 1938, Check list, p. 170 (as synonym of *modocata* Cassino and Swett).

In appearance similar to the nominate subspecies, except that the median area of the forewings above is gray in all specimens examined to date. Much more material is needed to show whether the brown coloration is completely absent in the moths from the southern Sierra Nevada Mountains, particularly in Tulare and Fresno counties, as only nine specimens have been examined from these two counties. However, a series of 13 moths (seven males, six females) from the Greenhorn Mountains, Kern County, are all gray.

MALE GENITALIA: As in nominate subspecies.

FEMALE GENITALIA: As in nominate subspecies.

EARLY STAGES: Unknown.

FOOD PLANT: Unknown.

TYPE: In the California Academy of Sciences, San Francisco.

TYPE LOCALITY: Huntington Lake, Fresno County, California.

RANGE: Southern portion of the Sierra Nevada Mountains, California. (See fig. 2.) On the wing in June and July.

REMARKS: Twenty-two specimens and three genitalic dissections were examined.

Pero behrensarius smithii (Grossbeck), new combination

Stenaspilates smithii GROSSBECK, 1906, Canadian Ent., vol. 38, p. 273.
RINDGE, 1955, Bull. Amer. Mus. Nat. Hist., vol. 106, p. 153.

Pero vanduzeeata W. S. WRIGHT, 1921, Proc. California Acad. Sci., ser. 4, vol. 11, p. 109 (*partim*).

Pero blackmorei CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 139.
MCDUNNOUGH, 1945, Canadian Ent., vol. 77, p. 68. (New synonymy.)

Pero occidentalis blackmorei, MCDUNNOUGH, 1938, Check list, p. 170.

In the mountains of southern California occurs a larger and grayer subspecies of *behrensarius*. The upper surface of the forewings is a light gray, and it tends to be more evenly and heavily dusted with black scales, giving the wings a more powdered appearance. As in the nominate subspecies, the two cross lines are well defined and prominent, but the t. a. line appears to be a bit more sharply indented into the cell below the costa, and the t. p. line tends to be slightly more angulate. The median area is usually dark gray, although it is sometimes shaded with brown. Beyond the t. p. line, there tends to be a rather broad suffusion of dark brown scales, which is much more noticeable than in nominate *behrensarius*. The expanse ranges from 36 to 41 mm. in this subspecies, while in the typical subspecies it is from 28 to 40 mm.

MALE GENITALIA: Similar to those of nominate *behrensarius*, but with constriction and terminal area of subscaphium slightly less developed.

FEMALE GENITALIA: As in nominate subspecies.

EARLY STAGES: Unknown.

FOOD PLANT: Unknown.

TYPES: Of *smithii*, in the American Museum of Natural History; of *blackmorei*, in Museum of Comparative Zoölogy, Harvard College.

TYPE LOCALITIES: Doble, San Bernardino County, California (*smithii*); Mt. Lowe, Los Angeles County, California (*blackmorei*).

RANGE: Mountains of southern California. (See fig. 2.) On the wing from late April to early August.

REMARKS: Thirty specimens and six genitalic dissections were examined. Two specimens of this series have the median area suffused with brown. The type of *blackmorei* is only sparsely dusted with black scales above, and tends to have the wings above with more brown suffusion than is usual for this population.

Pero behrensarius modocata Cassino and Swett, new combination

Pero modocata CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 180.
MCDUNNOUGH, 1945, Canadian Ent., vol. 77, p. 67.

Pero splendorata CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 181.
MCDUNNOUGH, 1945, Canadian Ent., vol. 77, p. 67.

Pero behrensarius splendorata, MCDUNNOUGH, 1938, Check list, p. 170.

The forewings above are light gray or grayish white, heavily overlain with black and brown scales, especially in basal portion of wing and in subterminal area, producing a finely speckled appearance. The median area is either ochraceous in the basal half and becomes dark brown externally, or it is gray, becoming darker in outer half, often mixed with dark brown scales. The discal mark is white, angular, usually prominent, preceded anteriorly with gray-black scales along costa, and extending around to lateral margin of discal mark. The area distad to t. p. line is often quite light in color, then heavily suffused with dark brown and black scales in the outer portion of the area.

MALE GENITALIA: Similar to those of nominate subspecies.

FEMALE GENITALIA: Similar to those of nominate subspecies.

EARLY STAGES: Unknown.

FOOD PLANT: Unknown.

TYPES: Of both *modocata* and *splendorata*, in the Museum of Comparative Zoölogy, Harvard College. McDunnough (1945) has pointed out that the "type male" of *modocata* is a female.

TYPE LOCALITIES: Modoc County, California (*modocata* and *splendorata*).

RANGE: Eastern slope of Sierra Nevada Mountains, extending into Nevada. (See fig. 2). On the wing in June, July, and August.

REMARKS: Forty-six specimens and 10 genitalic dissections were examined. This subspecies apparently represents the Great Basin influence on the *behrensarius* stock. It can be recognized by the very light gray ground color of both the upper and lower surfaces of the wings, and by the high percentage of brown specimens in the population. Of the 23 specimens from Smoky Valley, Tulare County, California, 13 (six males, seven females) are brown, and 10 (eight males, two females) are gray, or 57 per cent are brown. Of the other 14 California specimens, 10 are brown and four are gray. In the series from the Charleston Mountains, Nevada, only three (all males) of the eight specimens are brown, or 38 per cent. However, these moths agree in coloration with the others in this series, so they are included here. It might be noted, too, that the brown in the median area is usually of a lighter tone than in the nominate subspecies, being more yellowish, and it tends to darken considerably in the outer portion of the median area.

The types of both *modocata* and *splendorata* are less extremely marked than are the specimens from farther south. However, they show the heavy overlay of dark scales on the pale ground color that is characteristic of this subspecies. Nominate *behrensarius* also occurs in Modoc County, as a single female has been studied from the South

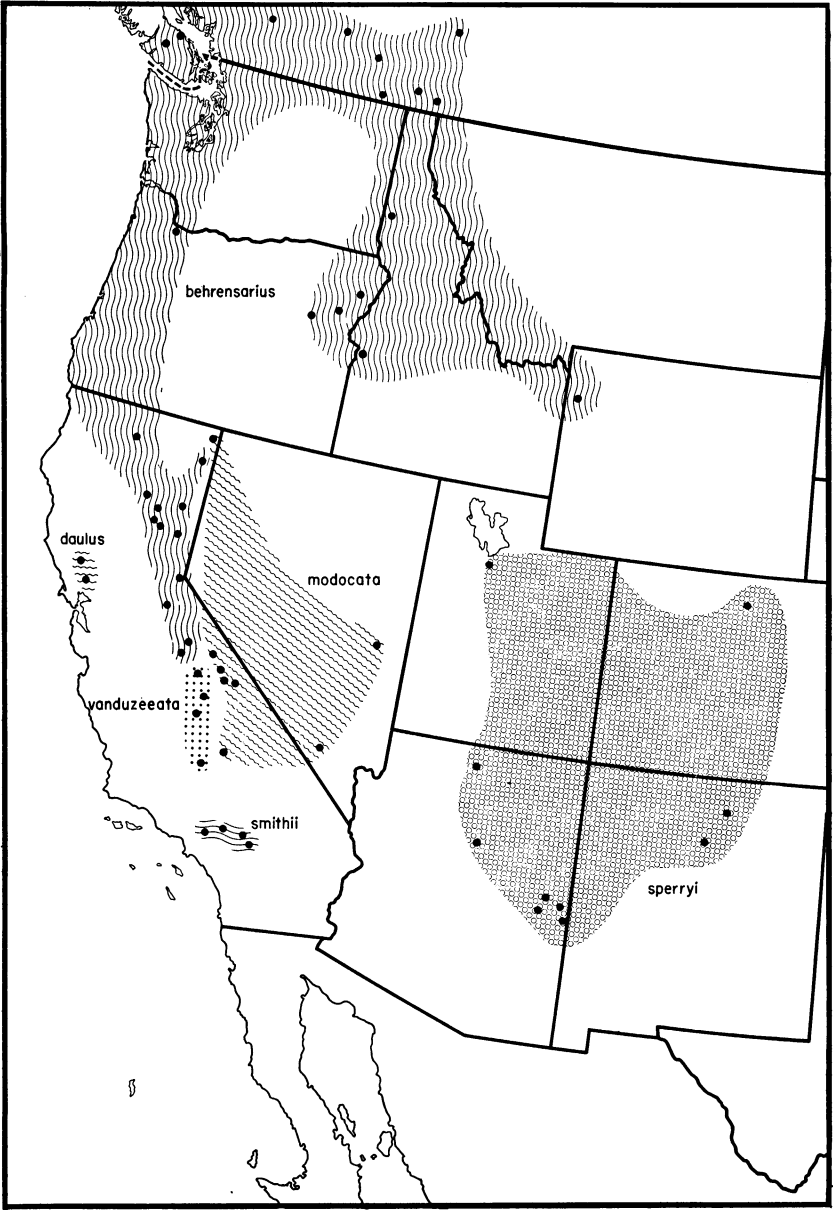


FIG. 2. Distribution of *Pero behrensarius* (Packard).

Warner Mountains, July 23, 1947 (J. A. Comstock). Unfortunately, the types of both *modocata* and *splendorata* are without a definite locality, but it is possible that they were collected at Davis Creek, a locality well represented in the Cassino collection. If so, this locality would place them in the Great Basin faunal area, as Davis Creek is down in the valley, as opposed to the higher elevations and life zones of the Warner Mountains.

Pero behrensarius daulus, new subspecies

MALE: Forewings above gray, heavily overlain with black and brown scales, with a very faint rose-purple luster; t. a. and t. p. lines black, prominent, as in nominate subspecies, the t. p. line with a narrow, white, external shading; median area grayish black, becoming more intense near t. p. line, suffused in cell as far as discal mark with brown; discal mark white, angular, prominent; area distad of t. p. line broadly suffused with brown, with the hind angle showing the posterior portion of a grayish subterminal line, and with outer portion of wing below apex heavily shaded with black scales. Hind wings above gray, evenly suffused with gray-black and brown scales, and having a faint purplish luster; cross line as in nominate subspecies. Lower surfaces of both wings dark gray, broadly suffused with brown; maculation as in nominate subspecies.

Expanse: 36 to 41 mm.; holotype, 40 mm.

FEMALE: Similar to male.

Expanse: 35 to 38 mm.; allotype, 35 mm.

MALE GENITALIA: Similar to those of nominate subspecies, but slightly larger.

FEMALE GENITALIA: Similar to those of nominate subspecies, but slightly larger.

EARLY STAGES: Unknown.

FOOD PLANT: Unknown.

TYPES: Holotype, male, Spring Mountain, Napa County, California, April 10, 1947 (W. R. Bauer); allotype, female, Anderson Springs, Lake County, California, April 18, 1949 (W. R. Bauer); both in the American Museum of Natural History. Paratypes: Seventeen males and one female: same data as holotype, April 10-17, 1947, April 4, 1948, May 4-6, 1946 (W. R. Bauer), 14 males and one female; same data as allotype, April 1, 1948, May 22, 1948 (W. R. Bauer), three males. Paratypes in the collections of the American Museum of Natural History, W. R. Bauer, and the author.

RANGE: Central California, in the mountains north of the San Francisco Bay area. (See fig. 2.) On the wing during April and May.

REMARKS: Twenty specimens and three genitalic dissections were examined. This is the darkest and most heavily marked of all the known subspecies of *behrensarius*, apparently reflecting the more humid coastal conditions. It can be distinguished by the darker gray of the wings, the almost black median area with the brown suffusion in the cell, the extensive area of brown shading in the subterminal area, and by the faintly rosy-purple cast to the wings in fresh specimens. In a few specimens, there is a suggestion of brown scalation in the median area of the forewings, but no truly brown specimens have been seen.

Pero behrensarius sperryi, new subspecies

Figure 13

MALE: Forewings above light gray or grayish white, overlain with black and brown scales, especially in subterminal area of wing; t. a. and t. p. lines black, prominent, as in nominate subspecies, both lines tending to have faint whitish external shading; median area grayish black, sometimes shaded with brown; discal mark white, angular, usually very prominent. Hind wings light gray above, darker basad of extra discal line; fringe tending to be darkened at ends of veins. Lower surfaces of both wings light gray, overlain with dark scales, producing a finely speckled appearance; maculation similar to nominate *behrensarius*, with cross line of secondaries tending to be slightly more prominent.

Expanse: 34 to 38 mm.; holotype, 36 mm.

FEMALE: Similar to male.

Expanse: 33 to 36 mm.; allotype, 34 mm.

MALE GENITALIA: Aedeagus (fig. 13) with terminal sclerotized plate reduced to a vestigial thickening, sometimes almost completely membranous; juxta lightly sclerotized.

FEMALE GENITALIA: Similar to those of nominate subspecies.

EARLY STAGES: Unknown.

FOOD PLANT: Unknown.

TYPES: Holotype, male, Kaibab Lodge, Coconino County, Arizona, June 16, 1938 (G. H. and J. L. Sperry); allotype, female, same data; both in the American Museum of Natural History, *ex* collection G. H. and J. L. Sperry. Paratypes, 15 males and four females: same data as types, three males; Greer, Arizona, June 9, 1937 (G. H. and J. L. Sperry), one male; White Mountains, Arizona, May 26, 28, 1934 (J. A. Comstock), June 19, 1935 (G. H. and J. L. Sperry), six males; Hannigans Meadow, White Mountains, Arizona, May 26, 1934 (G. H. and J. L. Sperry), one male; Todds Lodge, Oak Creek Canyon,

Arizona, May 6, 1950 (G. H. and J. L. Sperry), one male; Alpine, Arizona, June 16, 1937 (G. H. and J. L. Sperry), one male; Tesuque Canyon, New Mexico, August 4, 1932 (H. Ruckes), two males, one female; 16 miles east of Taos, New Mexico, July 1, 1935 (G. H. and J. L. Sperry), one female; Estes Park, Colorado, July, 1934 (Andrews), one female; Stockton, Utah, June 27, 1907 (Tom Spalding), one female (cotype of *Pero modestus* Grossbeck). Paratypes in the collections of the American Museum of Natural History and Los Angeles County Museum.

RANGE: Southern Rocky Mountain states. (See fig. 2.) On the wing from May to August.

REMARKS: Twenty-one specimens and nine genitalic dissections were examined. This population represents *behrensarius* in the southern Rocky Mountain states. It can be distinguished by the lighter ground color and by the contrasting median area, with its prominent discal mark. The usual color for the median area is gray, but it occasionally is suffused with brown, in part or totally so. Two of the five known females and three of the 16 males are brown in this area. The male genitalia are more distinct for this subspecies than in any other, with the reduction in the sclerotized plate at the terminal end of the aedeagus.

Pero occidentalis (Hulst)

Marmarea occidentalis HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 380.

The males of this species have dentate antennae, which set them apart from all the other species that are known to occur in this country. In general, the adults have browner wings than are found in *behrensarius*, with the inner and outer areas of the forewings variably suffused with this color. The moths appear to be rather dimorphic in this respect, as most populations have examples with the ground color either gray or brown. The color of the median area is rather constant, being a dark brown or gray brown; it does not show the great variability that is found in *behrensarius*. The course of the t. a. line is more sinuate than in *behrensarius*, with a deep sinus in the cell and with shallower ones in cells Cu₂ and A.

Unfortunately, very little can be said about the females in this group, as they are so poorly represented in collections. So far as can be determined, they are similar in color and maculation to the males, but with the tendency to have the forewings more heavily dusted with dark scales.

MALE GENITALIA: Subscaphium with a constriction three-fourths

of distance from base, with a small, median, somewhat truncate lip at base of constriction, the surface thereof usually minutely spinose, and with distal area produced into a median knife-like ridge, the sides tending to be slightly concave; aedeagus with terminal, small, sclerotized plate on left side posteriorly, elongate, tapering, or with this plate reduced or absent; vesica with some small spicules or unarmed. Ventral plate narrowed posteriorly, with two elongate, rounded lobes, with small dorsolateral, sclerotized ridges, these continued posteriorly beyond end of lobes as bluntly pointed projections, and with weakly sclerotized or partially membranous area medially where the sides of the lobes meet.

FEMALE GENITALIA: Ductus bursae heavily sclerotized, in length less than twice the width of ostium, with posterior portion of elongate median chamber lightly sclerotized, the surface with numerous longitudinal striations; ductus seminalis arising from left side of median chamber near junction with ductus bursae; bursa copulatrix rounded, subequal in length to, or slightly longer than, combined lengths of ductus bursae and median chamber, membranous at junction with the latter, the remainder of surface heavily beset with large stellate indentations, these being separated from one another by the width of their bases, or slightly more, and becoming smaller anteriorly.

REMARKS: The genitalia are very similar to those of *behrensarius*. In the males, the subscaphium of *occidentalis* tends to be slightly broader than in *behrensarius* and to have the median portion of the terminal area produced as a knife-like ridge. The sclerotized plate at the apex of the aedeagus tends to be smaller than in *behrensarius* and to be less extended ventrally. The ventral plate tends to have the pair of terminal projections dorsad to the terminal lobes, and these are usually lacking in *behrensarius*. In the females, the ductus bursae tends to be slightly shorter than in *behrensarius*, while the bursa copulatrix is slightly longer. The stellate indentations of the latter appear to be slightly less numerous than in *behrensarius*, and they become smaller anteriorly in this species.

Pero occidentalis occidentalis (Hulst)

Figures 8, 14, 20

Marmarea occidentalis HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 380. DYAR, "1902" [1903], Bull. U. S. Natl. Mus., no. 52, p. 343.

Pero occidentalis, GROSSBECK, 1910, Proc. U. S. Natl. Mus., vol. 38, p. 370 (*partim*), pl. 13, fig. 12 (male). McDUNNOUGH, 1949, Amer. Mus. Novitates, no. 1393, p. 6 (*partim*).

The nominate subspecies has the forewings above with the ground

color a yellowish brown, cinnamon brown, or gray, and the median area dark brown; the entire wing is more or less sprinkled with darker scales or strigae, especially in the basal one-third of the wing. The median area is often suffused with ground color in the cell, broadly extending to the usually prominent, angled, white discal spot, and beyond this in the costal area. This lighter-colored area sometimes extends to the inner margin in the basal portion of the median area, but the distal part is always darker in color. The expanse of the males ranges from 35 to 40 mm., and of the females from 33 to 37 mm.

MALE GENITALIA: Described above. Aedeagus (fig. 14) with sclerotized plate tending to curve around to ventral surface; vesica often lightly armed with spicules.

FEMALE GENITALIA: Described above.

EARLY STAGES: Unknown.

FOOD PLANTS: Unknown.

TYPE: In the United States National Museum.

TYPE LOCALITY: California, possibly Alameda County (McDunnough, 1949).

RANGE: San Francisco Bay area, California. (See fig. 3.) On the wing in April, May, and June.

REMARKS: Twenty-two males, two females, and three genitalic dissections were examined. This population seems to be rather variable, with at least three different color "forms" represented. One of these has the ground color of the forewings above yellowish brown, more or less heavily overlain with darker strigae; included here are specimens from Alameda (figured by Grossbeck), Sonoma, and Marin counties. From Inverness, Marin County (W. R. Bauer), most of the specimens have the ground color darker, being more of a reddish brown. In the mountains of Sonoma and Lake counties (W. R. Bauer), the ground color is a smooth gray, with the median area grayish brown, although in one specimen this area is the more normal dark brown. The totals are 15 brown and six gray males, with one female of each color being present. Just what these three subdivisions represent is impossible to say at this time, as insufficient material is at hand. It is possible that they will prove to be distinct geographical entities, but much more material is needed.

Pero occidentalis packardi Cassino and Swett, new combination

Azelina ancetaria occidentalis, DYAR, 1904, Proc. U. S. Natl. Mus., vol. 27, p. 913.

Pero occidentalis, GROSSBECK, 1910, Proc. U. S. Natl. Mus., vol. 38, p. 370 (*partim*), pl. 16, fig. 5 (male genitalia). BLACKMORE, 1918, Proc. Ent. Soc. British Columbia, vol. 8, p. 8. McDUNNOUGH, 1927, Canadian Ent., vol. 69,

p. 267; 1949, Amer. Mus. Novitates, no. 1393, p. 6 (*partim*). BOWMAN, 1951, Canadian Jour. Zool., vol. 29, p. 151. J. R. J. L. JONES, 1951, Occas. Paper Ent. Soc. British Columbia, no. 1, p. 136.

Pero packardi CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 135. McDUNNOUGH, 1945, Canadian Ent., vol. 77, p. 68.

Pero colorado packardi, McDUNNOUGH, 1938, Check list, p. 170.

The ground color of the upper surface of the forewings is either ochraceous or reddish brown, or is a dark gray, apparently varying geographically. Topotypical material from Wallace, Idaho (O. Huellemann), consist of four brown and one gray males. The three males from Moran, Wyoming (G. H. and J. L. Sperry), are all gray. The next area that is represented in series is Oregon, where 32 brown and 17 gray males are present; all six females are brown. In the mountains of northern and central California, this ratio is reversed, as 24 brown and 36 gray males are represented; the five females are four gray and one brown. In the southern Sierra Nevadas, three brown and four gray males are present, and the single female is brown. In the north coastal area of California, represented by Laytonville, Mendocino County (R. F. Sternitzky), there are one brown and three gray males, and two gray females. Based on these figures, it would seem that moths tend to become grayer as one progresses south from Oregon to California; there is not nearly enough material on hand from the northern part of the range to determine what the situation is in this respect. In California, there does not seem to be the break just north of Fresno, Tulare, and Kern counties that is present in *behrensarius*, although more material is needed from this area. The median area of the forewings above is more consistent in color, being a dark brown and often suffused with the ground color basally and along the costal area. The expanse of the males varies from 30 to 38 mm., and of the females from 33 to 38 mm.

MALE GENITALIA: As in nominate subspecies, but with lip-like projection of subscaphium tending to be slightly less robust, and with sclerotized plate of the aedeagus not curving around to ventral surface; vesica usually unarmed.

FEMALE GENITALIA: As in nominate subspecies.

EARLY STAGES: Dyar (1904) described the egg and first two larval instars, at which point the caterpillars began to hibernate, and they finally died before completing any further growth.

FOOD PLANTS: Unknown.

TYPE: In the Museum of Comparative Zoölogy, Harvard College.

TYPE LOCALITY: Wallace, Idaho.

RANGE: Northern Rocky Mountains, into Alberta (Bowman, 1951),

and the Pacific coast states, extending through the Sierra Nevada Range of California. (See fig. 3.) There is a single male in the Sperry collection labeled Kitchener, Ontario, May 13, 1944 (F. A. Stricker); this locality needs to be verified. On the wing from April through August.

REMARKS: One hundred and forty-eight males, 14 females and 24 genitalic dissections were examined. This subspecies is smaller and grayer than the nominate one. While both populations have brown specimens, the color in this group is of a duller, less warm hue than is found in the coastal examples.

Pero occidentalis canaster, new subspecies

MALE: Forewings above, ground color light gray, more or less heavily sprinkled with black scales, or yellowish brown, more or less heavily sprinkled with dark brown scales; median area gray brown or dark brown, becoming darker distally; discal spot angular, tending to be somewhat reduced, especially in the posterior portion; t. a. line black, well defined, with very deep indentations; t. p. line black, rather strongly sinuate. Secondaries light gray, heavily overlain with black or dark brown scales; maculation as in nominate subspecies. Lower surface: both wings gray, overlain with black or dark brown scales; maculation as in nominate subspecies.

Expanse: 33 to 39 mm.; holotype, 37 mm.

FEMALE: Similar to male; forewings above gray, heavily overlain with black scales; median area dark brown.

Expanse: 34 to 35 mm.; allotype, 34 mm.

MALE GENITALIA: As in the nominate subspecies, but with projections of subscaphium tending to be even stronger, as is the sclerotized plate of the aedeagus.

FEMALE GENITALIA: As in the nominate subspecies.

EARLY STAGES: Unknown.

FOOD PLANT: Unknown.

TYPES: Holotype, male, upper Santa Ana River, San Bernardino County, California, May 30, 1948 (Grace H. and John L. Sperry); allotype, female, same data and collectors, June 6, 1948. Paratypes, 78 males and one female: same data as types, various dates in May and June, 1947-1949 (Grace H. and John L. Sperry, and A. L. Melander), 59 males; East Fork, Santa Ana River, San Bernardino County, California, June 9, 1947 (A. L. Melander), one male; Barton Flats, San Bernardino County, California, June 1, 1946 (Grace H. and John L. Sperry), 10 males; Big Bear Lake, San Bernardino County, California, June 3, 1950, 6800 feet (C. Hill), five males and one female; Chilao, Los

Angeles County, California, May 5, 1947 (C. Henne), one male; Pine Flats, California, June 23, 1933 (Minahan), one male; Idyllwild, Riverside County, California, May 29, 1940 (Fred H. Rindge), one male. Holotype and allotype in the collection of the American Museum of Natural History; paratypes in the collections of the American Museum of Natural History, Los Angeles County Museum, and of the author.

RANGE: Mountains of southern California. (See fig. 3.) On the wing in May and June.

REMARKS: Eighty-one specimens and four genitalic dissections were examined. In this population, 57 of the males have the ground color of the primaries above gray, while the remaining 22 males are yellowish brown. This situation is similar to that found in the Sierra Nevada Range, but there the average is approximately three gray to two brown specimens.

Specimens of this subspecies are distinguished from *packardi*, in addition to the above color ratio, by the color of the wings. In *canaster*, the gray is lighter than in *packardi*, while the brown specimens have a much more yellowish tint to the ground color. The median area of the forewings in the present subspecies is a gray brown, rather than the dark reddish brown found in *packardi*.

Pero occidentalis helvus, new subspecies

MALE: Forewings above, ground color a clear golden brown, lightly dusted with dark scales basally and becoming darker near outer margin; median area rather broad, dark reddish brown; discal spot angular, white, prominent; t. a. line black, with rather shallow sinuses; t. p. line black, weakly sinuate. Secondaries gray brown, heavily overlain with dark brown scales; extra discal line dark, bordered with white distally, prominent, somewhat concave, passing about 2 mm. from indistinct discal spot. Lower surface: both wings gray brown, overlain with brown scales; maculation as in nominate subspecies, but with extra discal line of secondaries more prominent, straighter, and with narrow terminal line.

Expanse: 35 to 39 mm.; holotype, 38 mm.

FEMALE: Unknown.

MALE GENITALIA: As in *packardi*, but with projections of subscaphium weak and with sclerotized plate of aedeagus small.

EARLY STAGES: Unknown.

FOOD PLANT: Unknown.

TYPES: Holotype, male, Saw Mill Spring, Charleston Mountains, Nevada, May 12, 1934 (Grace H. and John L. Sperry). Paratypes, five males: same data as holotype, May 11, 1934, one male; Charleston

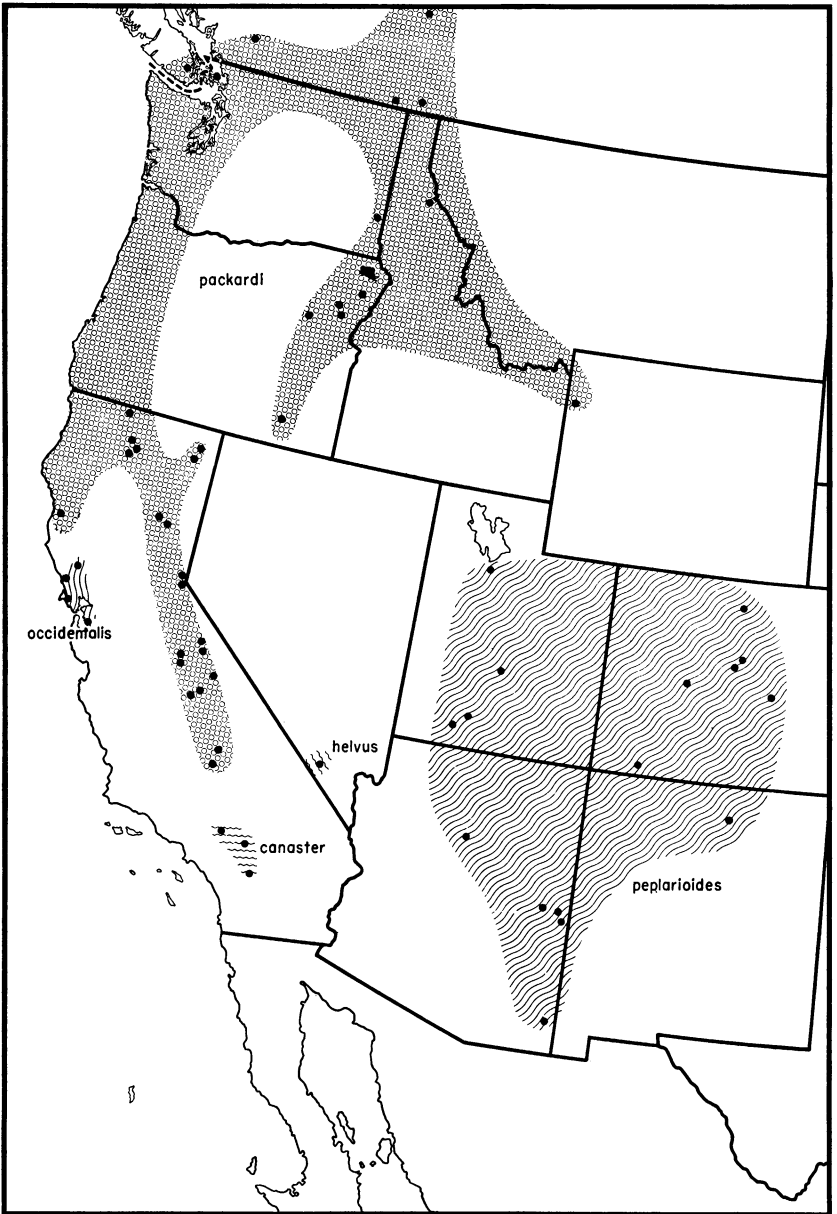


FIG. 3. Distribution of *Pero occidentalis* (Hulst).

Mountains, Nevada, May 12, 13, 1934, four males. Holotype and one paratype in the collection of the American Museum of Natural History, the remaining paratypes in the Los Angeles County Museum.

RANGE: Known only from the Charleston Mountains of Nevada, in May. (See fig. 3.)

REMARKS: Six specimens and two genitalic dissections were examined. All known examples have the clear golden brown ground color, which distinguishes them from all other known populations. In addition, the median area of the forewing tends to be slightly wider than in *packardi*, the discal spot is more prominent, and the cross lines are less deeply excavated. On the secondaries, the cross line is placed nearer the discal spot than in other populations.

This population apparently represents a parallel development to *behrensarius modocata* in the Great Basin area. However, specimens from Smoky Valley, Tulare County, where both subspecies occur, agree better with examples of *packardi* than they do with *helvus*. Similarly, examples from the eastern slopes of the Sierra Nevadas are more like *packardi*, as they do not have the golden brown wing color or the other characteristics of *helvus*.

Pero occidentalis peplarioides (Hulst)

Figure 15

Marmarea peplarioides HULST, 1898, Canadian Ent., vol. 30, p. 218. RINDGE, 1955, Bull. Amer. Mus. Nat. Hist., vol. 106, p. 151.

Marmarea occidentalis peplarioides, DYAR, "1902" [1903], Bull. U. S. Natl. Mus., no. 52, p. 343.

Pero peplarioides, GROSSBECK, 1910, Proc. U. S. Natl. Mus., vol. 38, p. 368 (*partim*). McDUNNOUGH, 1949, Amer. Mus. Novitates, no. 1393, p. 4.

Pero colorado GROSSBECK, 1910, Proc. U. S. Natl. Mus., vol. 38, p. 374, pl. 13, fig. 8 (holotype male, *nec* female). BARNES AND McDUNNOUGH, 1912, Contributions to the natural history of the Lepidoptera of North America, vol. 1, no. 4, p. 45, pl. 21, fig. 14 (cotype male). McDUNNOUGH, 1945, Canadian Ent., vol. 77, p. 68; 1949, Amer. Mus. Novitates, no. 1393, p. 9. (New synonymy.)

Pero patriciata CASSINO AND SWETT, 1925, Lepidopterist, vol. 4, p. 41. McDUNNOUGH, 1945, Canadian Ent., vol. 77, p. 68. (New synonymy.)

This is one of the largest of the *occidentalis* subspecies, and the wings above are lighter in color than in the other populations. The ground color of the upper surface of the primaries is a light grayish brown, particularly in the outer one-third of the wing, being lightest in color next to the t. p. line. The median area becomes a progressively darker brown towards the t. p. line, contrasting sharply with the pale outer area. The t. a. line tends to be slightly less dentate than in the nominate subspecies. The discal mark is white, angled, and usually prominent. The expanse ranges from 34 to 39 mm.

The females are poorly represented in collections; only two are known to the author. They have the forewings rather heavily dusted with dark scales, especially in the outer one-third of the wings. Grossbeck's allotype female, from Durango, Colorado, is not conspecific with the type male, as the genitalia show it to be a specimen of *morrisonarius* Hy. Edwards.

MALE GENITALIA: Similar to those of *packardi*, but with weakly developed projections on the subscaphium, with the sclerotized plate at the end of the aedeagus (fig. 15) wholly or partially lacking. In all the specimens examined from Utah (six slides from three localities), this sclerotized plate is present but is smaller in size than in any of the other subspecies. In the dissections from Arizona, New Mexico, and Colorado, the plate has completely disappeared. In other respects the genitalia of the Utah specimens, as well as the color, maculation, and size, agree quite well with those of the specimens from the other southern Rocky Mountain states, so the Utah specimens are included here.

FEMALE GENITALIA: Similar to the nominate subspecies, as far as can be learned from the limited material available.

EARLY STAGES: Unknown.

FOOD PLANT: Unknown.

TYPES: Of *peplarioides*, lectotype male, designated by McDunnough (1949), and of *colorado*, holotype male, both in the American Museum of Natural History. McDunnough (1945) designated a lectotype male for *colorado* as a specimen in the United States National Museum collection. In his later article (1949), McDunnough realized his error, as the specimen labeled by Grossbeck as being the type male is in the collection of the American Museum of Natural History. Accordingly the 1945 designation of the lectotype is invalid. For a further discussion of Grossbeck's types, see above under *giganteus*. Of *patriciata*, in the Museum of Comparative Zoölogy, Harvard College.

TYPE LOCALITIES: San Francisco Mountains, Coconino County Arizona (*peplarioides*); Durango, Colorado (*colorado*); Kenosho Pass, Colorado (*patriciata*).

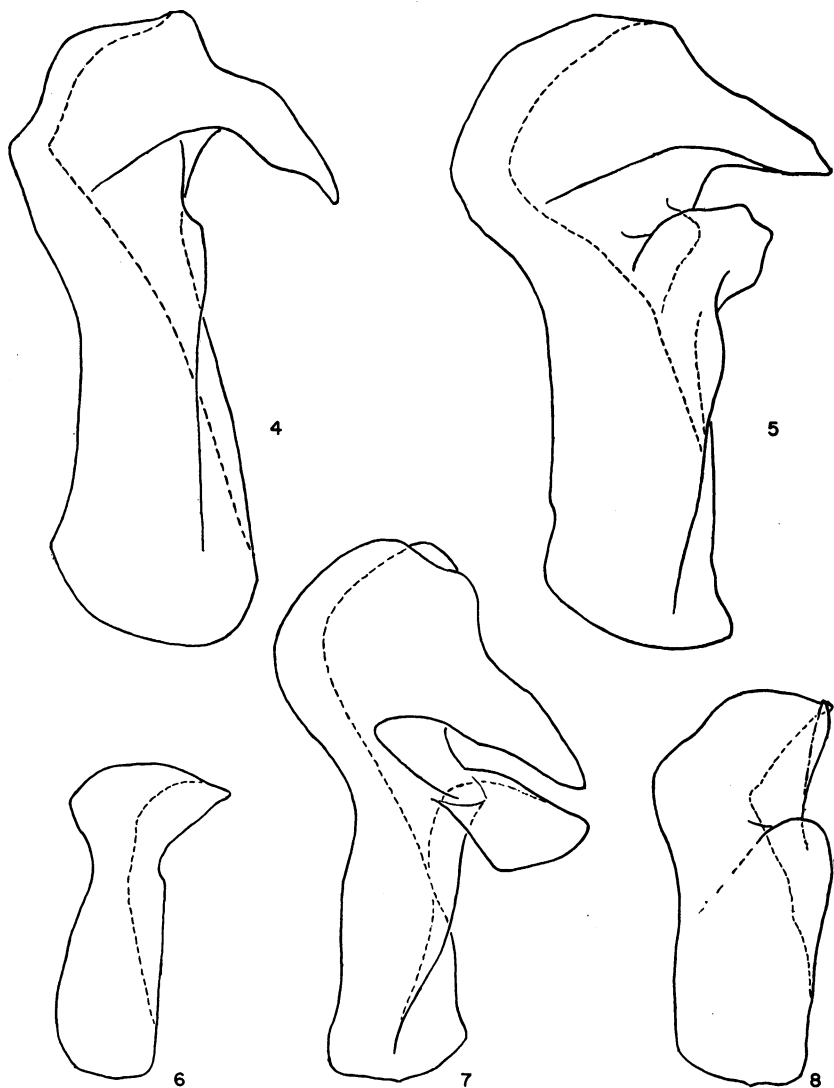
RANGE: Southern Rocky Mountain states. (See fig. 3.) On the wing in May, June, and July.

REMARKS: Fifty-five males, two females, and 13 genitalic dissections were examined. There is some variation in the color of the forewings above. The median area is usually a reddish brown or a dark brown, although in some specimens it may be a yellowish brown (type of *colorado*). The course of the t. a. line is rather variable, but it usually is less dentate than in the nominate subspecies.

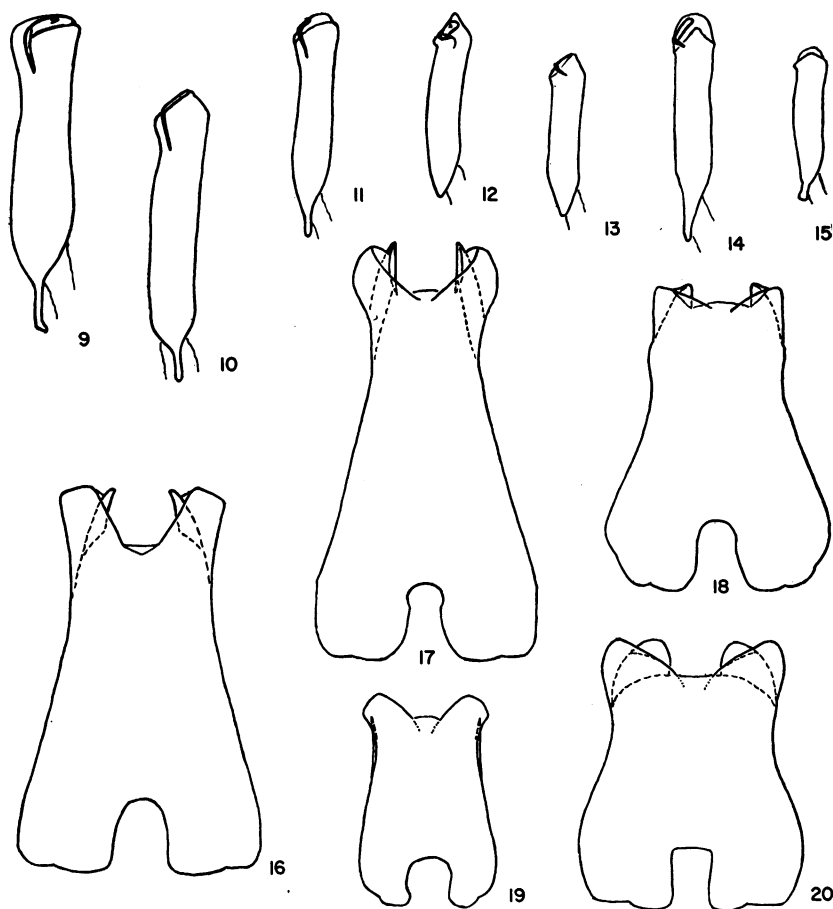
The type of *patriciata* is a rather weird specimen, but the antennae

and wing shape refer it to this species. The specimen is unquestionably an aberration, so it will probably remain a unique.

The variation in the male genitalia of this species parallels that in *behrensarius*, as both show the loss of the sclerotized plate at the apex of the aedeagus. McDunnough (1945, 1949) has discussed the drawing of the male genitalia given in Grossbeck's paper, and he is correct in stating that the illustration given does not apply to *colorado*.



FIGS. 4-8. Male genitalia of *Pero*, subscaphium, ventrolateral view. 4. *P. giganteus* Grossbeck, holotype, Provo, Utah, August 7, 1908 (Tom Spalding). 5. *P. mizon* Rindge, holotype, Spring Creek, near Baker, Oregon, July 29, 1949 (J. H. Baker). 6. *P. behrensarius behrensarius* (Packard), Spring Creek, near Baker, Oregon, May 26, 1949 (J. H. Baker). 7. *P. macdunnoughi* Cassino and Swett, San Juan Capistrano, California, July 23, 1949. 8. *P. occidentalis occidentalis* (Hulst), Pine Flat, Sonoma County, California, April 28, 1940 (W. R. Bauer).



FIGS. 9-20. Male genitalia and eighth sternite. Drawn from the same specimens as illustrated in figures 4-8, except as noted. 9-15. Aedeagus, ventral view. 9. *P. giganteus* Grossbeck, holotype. 10. *P. mizon* Rindge, holotype. 11. *P. macdunnoughi* Cassino and Swett. 12. *P. behrensarius behrensarius* (Packard). 13. *P. behrensarius sperryi* Rindge, paratype, Greer, Arizona, June 9, 1937 (G. H. and J. L. Sperry). 14. *P. occidentalis occidentalis* (Hulst). 15. *P. occidentalis peplarioides* (Hulst), lectotype, San Francisco Mountains, Arizona, July 23, 1897. 16-20. Eighth sternite, ventral view. 16. *P. giganteus* Grossbeck, holotype. 17. *P. mizon* Rindge, paratype, British Columbia Biological Station, Departure Bay, July 9, 1909. 18. *P. macdunnoughi* Cassino and Swett. 19. *P. behrensarius behrensarius* (Packard), same data, June 16, 1950. 20. *P. occidentalis occidentalis* (Hulst).

