

STUDIES OF THE NORTH AMERICAN GEOMETRID MOTHS OF THE GENUS PERO.

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The genus *Pero* Herrich-Schaeffer (= *Azelina* Guenée in part) has been a perplexing one to American students, and from the beginning of my studies in the Geometridæ I have been gathering material with a view to a revision of the group in so far as it was represented on the American continent north of Mexico. At the outset three species were recognized, *honestarius* Walker (the *ancetaria* of our lists with its variety *peplaria*), *giganteus*, new species, then thought to be the *occidentalis* of Hulst, and a small western species that was generally regarded as identical with *honestarius*. *Behrensarius* Packard was not then autopically known to me. There were besides these several puzzling specimens which could not be placed with any of these three forms, and it was only as material accumulated that they were set aside as good species in themselves.

Finally my own collection of one hundred and fifty odd examples was grouped into species to my own satisfaction; slides were made and structures examined, and in all cases these bore out the arrangement as based on superficial characters. Before finally revising the genus, however, additional material was sought from all available sources.

Except for one or two odd specimens the original arrangement remained until the advent of about three hundred specimens from Dr. William Barnes. These specimens from many points in the United States and southern Canada showed a greater distribution of certain of the species, and the farther away from its metropolis a species ranged the more unlike the typical examples it appeared. The work was gone over again with the result that two more new species were discovered; and, while the distinctness of the other species was not at all rendered questionable, it was found that there existed a greater range of variation than was at first believed.

The final result of these studies shows that there are nine species represented in the faunal region above limited, and it is probable that one or two more remain to be discovered. Indeed, among the eight hundred odd specimens examined in reaching the conclusions here set forth are several examples which are doubtfully referred to two species. While it is quite probable that they represent geographical races of the species with which they have been tentatively associated, additional material may prove them to be distinct.

Five of these nine species, though, except one, originally described as distinct, have at one time or other been regarded as mere varieties of a single species (*honestarius*), and all but a very few of the hundreds of specimens sent me for study arrived under names synonymous with this. The other four species, here described as new, were, when received, also arranged under this name.

In the preparation of this paper the writer has to thank the following gentlemen for the loan of specimens, without which the paper could not have appeared in its present more complete form: Dr. William Barnes, of Decatur, Illinois, for his entire collection in this group; Dr. Harrison G. Dyar for the material in the United States National Museum; Messrs. William Beutenmüller and Jacob Doll for the material in the American Museum of Natural History, New York, and the Brooklyn Institute of Arts and Sciences, respectively; and Messrs. George H. Field and W. S. Wright, of San Diego, California; R. F. Pearsall, of Brooklyn, New York; William H. Broadwell, of Newark, New Jersey, and Otto Buchholz, of Elizabeth, New Jersey. To all these gentlemen the writer expresses his thanks. Further acknowledgment should be made to Prof. John B. Smith for the use of the material in the Hulst collection. I am also indebted to Mr. L. B. Prout, of London, England, for helpful suggestions in regard to the older generic and specific names, and for comparison of specimens with the Walker types in the British Museum.

Genus *PERO* Herrich-Schaeffer.

- 1850-58. *Pero*, HERRICH-SCHAEFFER, Samml. Auss. Schmett., p. 28.
1857. *Azelina* (part) GUENÉE, Spec. Gén., vol. 9, p. 156.
1860. *Azelina* WALKER, Cat. Brit. Mus., vol. 20, p. 185.
1876. *Azelina* PACKARD, Monogr. Geom., p. 520, pl. 6, fig. 12.
1881. *Azelina* BUTLER, Ann. and Mag. Nat. Hist., ser. 5, vol. 8, p. 33.
1883. *Azelina* MEYRICK, Trans. and Proc. New Zeal. Inst., vol. 16, p. 106.
1896. *Marmarea* HULST, Trans. Amer. Ent. Soc., vol. 23, p. 379.
1896. *Azelina* HULST, Trans. Amer. Ent. Soc., vol. 23, p. 380.
1900. *Azelina* DRUCE, Biol. Centr.-Amer., Lep. Het., vol. 2, p. 60.
1902. *Marmarea* HULST, Bull. 52, U. S. Nat. Mus., p. 344.
1904. *Marmarea* DYAR, Proc. U. S. Nat. Mus., vol. 27, p. 913=*Azelina*.
1905. *Azelina* WARREN, Nov. Zool., vol. 12, p. 367=*Pero*.

Front square, heavily haired but smooth; palpi stout, subascending, projecting beyond front, as a whole slightly longer than the width of the space between the eyes; tongue well developed; antennæ filiform or dentate, flattened, finely ciliate below. Thorax robust, heavily haired above and below, with distinct central crest dorsally. Abdomen rather stout, smooth, in male ending in broad tuft. Tibial epiphysis of anterior legs originating at middle of tibia and extending to or just beyond apex. Posterior tibia not swollen, with two pairs of spurs, without hair pencil. Fore wings broad, falcate; costa straight or slightly produced on basal third and turning abruptly near apex; outer margin excised between the veins from apex to Cu_2 . Veins R_1 and R_2 from cell; R_3 , R_4 , and R_5 stemmed and forming with R_2 an accessory cell; M_1 from cell. Hind wings with outer margin excised between all veins, especially from M_3 to Cu_2 . Sc anastomosing with R on second sixth; M_2 absent.

Marmarea Hulst was made a distinct genus on the character of the dentate antennæ of the male of *occidentalis*. Dyar mistaking *giganteus*, a species with filiform antennæ, for *occidentalis* made the genus a synonym of *Azelina*. In truth, *occidentalis* has dentate antennæ in common with *colorado*, but this, in my opinion, can hardly be considered of generic value, especially in view of the fact that *occidentalis* in habitus and genitalic structure has strong affinities with *modestus*, a species with filiform antennæ, while *colorado* has affinities in these same peculiarities with *morrisonatus*, also a form with filiform antennæ. In other words, aside from antennal structure they differ more from each other than they do from species with simple antennæ. For these reasons I have here regarded the genus as identical with *Pero*.

The genus *Pero* comprises a well-defined and distinctive group of insects, and has for its ally the genus *Azelina* Guenée (= *Stenaspilates* Packard), as it is now limited by Warren, from which it is distinguished chiefly by the simple or dentate antennæ in the male. The coloring in the genus varies from light gray and light ochereous, through all shades of these to dark umber brown. The primaries are typically divided into three transverse regions, though the partial obsolescence of the inner line frequently gives the appearance of but a single division; or this line may be obscured by shadings of a similar color producing the same effect. The inner or intradiscal line originates on the costa about one-third out from the base, extends obliquely outward to the center of the cell, turns inward to the cubital vein, and is thence twice outwardly scalloped to inner margin, the last sweep usually extending considerably inward to the base of the wing. The anterior portion of this line is heaviest and is always visible to at least the center of the cell; usually it is very conspicuous.

The outer or extradiscal line begins about one-fourth in from the apex, follows in general the course of the outer margin of the wing and may be either gently waved or strongly undulated, one outward wave being between R_5 and Cu_1 and another between Cu_2 and the anal vein; the inward wave produced by the union of these two is larger and deeper than either of the outward ones. The secondaries are divided into two regions by a straight, slightly curved, undulate or denticulate line which crosses the wing outward of the middle and terminates at the inner margin at a variable distance from the anal angle.

The genitalia when mounted on slides are more or less triangular or pentagonal in form and display excellent characters for the separation of the species. The apical-inner margin of the harpes, bearing what by analogy should be the clasper, is very characteristically shaped and affords the best means of distinguishing between the various species. The spreading out and mounting of the genitalia apparently does not in the least interfere with the shape of the structure, and in a series of ten mounts of one species all were practically alike. This was true of the other species, and constancy of form is the rule with all the parts of this structure. The uncus may be straight or slightly bent according to the species. The scaphium usually offers something that is distinctive. The penis may or may not have an apical process which is much alike in related species.

TABLE OF SPECIES.

- | | |
|--|-----------------------|
| 1. Species variegated with brown, yellow, and olivaceous..... | 2 |
| Species not variegated or, if so, entirely lacking the olivaceous tint..... | 3 |
| 2. Ground color of primaries bright yellowish or faintly yellowish-olivaceous, the inner cross line relieved; shadings burnt brown..... | <i>morrisonatus</i> . |
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| 3. Species large, 45 mm. or over in expanse..... | <i>giganteus</i> . |
| Species smaller, 40 mm. or less in expanse..... | 4 |
| 4. Outer line of primaries very strongly sinuous..... | <i>modestus</i> . |
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| 6. Primaries scattered over with cinereous scales, outer line externally and inner line internally bordered by a narrow cinereous line..... | <i>occidentalis</i> . |
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| Ground color of wings stone or bluish gray or reddish-brown..... | 8 |
| 8. Male with grayish shadings and a yellowish patch opposite discal spot; female with bright reddish-brown shadings..... | <i>peplarioides</i> . |
| Male with black shadings; female with reddish-brown shadings with an umber hue..... | <i>honestarius</i> . |

PERO HONESTARIUS Walker.

Plate 13, figs. 1, 2; Plate 14, figs. 1, 2, 4-8; Plate 15, fig. 1.

1860. *Azelina hubneraria* ‡ WALKER, Cat. Brit. Mus., vol. 20, p. 186.
 1860. *Azelina honestaria* WALKER, Cat. Brit. Mus., vol. 20, p. 258.
 1866. *Azelina stygiaria* WALKER, Cat. Brit. Mus., Suppl. 5, p. 1548.
 1868. *Azelina honestaria* GROTE and ROBINSON, Trans. Amer. Ent. Soc., vol. 2, p. 81=*hubneraria*.
 1876. *Azelina hubnerata* ‡ PACKARD, Monogr. Geom., p. 520, pl. 11, figs. 58, 59.
 1876. *Azelina stygiaria* PACKARD, Monogr. Geom., p. 523.
 1881. *Azelina hubneraria* BUTLER, Ann. and Mag. Nat. Hist., ser. 5, vol. 8, p. 33.
 1881. *Azelina honestaria* BUTLER, Ann. and Mag. Nat. Hist., ser. 5, vol. 8, p. 33.
 1881. *Azelina stygiaria* BUTLER, Ann. and Mag. Nat. Hist., ser. 5, vol. 8, p. 33.
 1886. *Azelina hubnerata* HULST, Ent. Amer., vol. 2, p. 49.
 1886. *Azelina stygiaria* HULST, Ent. Amer., vol. 2, p. 49=*hubnerata*.
 1886. *Azelina honestaria* HULST, Ent. Amer., vol. 2, p. 49=*hubnerata*.
 1890. *Azelina hubneraria* ‡ PACKARD, Fifth Rept. U. S. Ent. Comm., p. 526.
 1895. *Azelina peplaria* HULST, Ent. News, vol. 6, p. 14.
 1895. *Azelina stygiaria* HULST, Ent. News, vol. 6, p. 14=*peplaria*.
 1895. *Azelina hubnerata* HULST, Ent. News, vol. 6, p. 14, var. of *peplaria*.
 1895. *Azelina honestaria* HULST, Ent. News, vol. 6, p. 14=var. *hubnerata*.
 1900. ?*Azelina hubneraria* ‡ DRUCE, Biol. Centr.-Amer., Lep. Het., vol. 2, p. 61.
 1900. *Azelina honestaria* DRUCE, Biol. Centr.-Amer., Lep. Het., vol. 2, p. 61.
 1900. *Azelina peplaria* ‡ CAUDELL, Ent. News, vol. 11, p. 583, larva.
 1902. *Azelina ancetaria* ‡ HULST, Bull. 52, U. S. Nat. Mus., p. 344.
 1902. *Azelina honestaria*, HULST, Bull. 52, U. S. Nat. Mus., p. 344=*ancetaria*.
 1902. *Azelina peplaria* HULST, Bull. 52, U. S. Nat. Mus., p. 344, var. of *ancetaria*.
 1902. *Azelina stygiaria* HULST, Bull. 52, U. S. Nat. Mus., p. 344=var. *peplaria*.
 1903. *Azelina ancetaria* ‡ HOLLAND, Moth Book, p. 352, pl. 45, fig. 23.

Male.—Expanse, 36 to 40 mm. Head and thorax umber brown scattered over with fine gray scales; antennæ yellowish with a white spot at the base of each; front with a white V or U shaped mark across the superior portion which connects the spots on the antennæ; palpi concolorous with tint of head. Abdomen gray or brownish; when the latter, the segments are narrowly darkened posteriorly. Ground color of wings soft gray and usually finely strigate, especially outwardly and along costa, though the strigations are often reduced to shapeless atoms. Inner line of primaries blackish, the scallops not strongly pronounced; outer line rather smoothly undulate. Inner area heavily shaded or mottled with umber brown, the ground color showing through, especially just internally of the limiting cross line. Median area similarly shaded and assuming an intense blackish-brown along outer line. Outer area shaded with olive gray. Discal spot white, angular, linear. Fringe brown. Transverse line of secondaries curved, more or less denticulate though sometimes quite straight and even. Inner area smoky, densest at cross line. Outer area smoky, sometimes strigate with gray or brown. Three black intervenular spots on outer margin near the anal angle are always present, and frequently two or three other smaller ones nearer the

outer angle. Discal spot absent or barely visible. Fringe as in primaries. Beneath, smoky with the ground color showing through outwardly, the costal and central portions and the veins washed with reddish-brown. Lines of primaries absent; that of the secondaries faintly showing. Discal spot of fore wings white, conspicuous; of hind wings white, sometimes partly margined with black scales which occasionally cover the spot and give a decidedly dusky or even black appearance.

Female.—Differs from the typical male in that the ground color and darker shadings are of a reddish-brown cast, in that the shadings are not so dense and thus the inner cross line shows up more distinctly and in the outer cross line being, on the whole, considerably more sinuate.

Habitat.—Maine to Florida and westward to Alberta, Colorado, and Texas. According to the specimens before me the species flies in the Atlantic States from March 14 continuously to September 16; in the Northwest in June and July, in Colorado in August, and in Texas in June.

This is the only species in the East that is not decidedly variegated in color, and may be distinguished by that fact alone. The genitalia belong in the same series with *giganteus*, *peplarioides*, and *behen-sarius*, but differs from all in some marked respects. The lower projection of the clasper is considerably longer than in any, the scaphium is relatively larger and stouter, and the form of the apical process of the penis is peculiar to itself alone.

Evidently the metropolis of the species is in the North Atlantic States, where the typical form of both sexes is common. At the extreme points, especially in the Northwest, the colors are not so bright, and the contrast between the ground color and the ornamentation is less striking.

The male is the dark form that has hitherto been called *peplaria*. That it is simply the male of *honestarius* is shown by the fact that of the 132 specimens under observation 68 of the 80 males were the black form, while 12, though dark, had the reddish-brown cast of the female. In no case did the female resemble the male in general color, all of them having the reddish-brown cast.

There are few American species of Geometridæ that have fallen into greater confusion than has *honestarius* with its sexual color variation and supposed varieties.

The name *ancetaria*, under which it has gone for a number of years, must disappear from our lists. It was first used in 1806 by Hübner in his *Sammlung Exotischer Schmetterlinge*, volume 2, and was merely an erroneous application on his part of *anceta* Cramer, a species different from the one he figures and which Mr. L. B. Prout tells me

is well known from South America. His figures, moreover, though apparently illustrating a typical *Pero*, do not represent any form known to me from North America. In build, shape, and markings it resembles most nearly our *marmoratus*, but does not have the blotch just outside the outer line on the primaries so characteristic in that species, and is suffused with a crimson tint—a character possessed by none of our species in the slightest degree.

Peplaria, which, according to our catalogue, is the next oldest name for the species, was also used by Hübner in his *Zuträge*. His figures (709, 710) represent both upper and under surfaces, and though we have his statement that the species comes from North America, I know of nothing in our fauna that approaches it. Certainly it is not the form to which Hulst applied the name. It probably is congeneric with the species listed in our fauna under *Stenaspilates*, though from the female (which sex alone is depicted) this can not be said with absolute certainty. The course of the extradiscal line of both wings is peculiar, the sharp angle in that of the secondaries being especially characteristic, while the yellowish color of the under side of the wings is unique, reminding one of certain of our *Gonodontis* species.

Hubneraria Guenée ^a is another name for Hübner's *ancetaria*, the author discovering the distinctness of the latter species from *anceta* Cramer and rightly renaming it.

Honestaria Walker is the first valid name for our North American species. The measurement he gives seems small, but Mr. Prout assures me that it is identical with American specimens sent him for comparison.

Stygiaria Walker is apparently a typical male of *honestarius*.

Packard, in his monograph, mixes specimens of what is undoubtedly *peplarioides* with *honestarius*, but refers to them in the remarks following his description as being larger in expanse of wings.

Druce says that Central American specimens of *hubneraria* (= *honestarius*) are usually darker than those from the United States. It is probable that Mr. Druce did not have the true *honestarius* before him, as on the same page he lists *honestarius* as a separate species, remarking that the specimens of this latter species are almost identical with Walker's type.

Lastly, I have excluded *atrocolorata* Hulst from the synonymy. This was described ^b as a variety of *Azelina hubnerata* from seven examples. Of these types I have located only four, two in the Brooklyn Institute Museum and two in his own collection at New Brunswick. Three are typical *honestarius*, but the fourth, a female from Florida, is a totally different species with the general aspect of a

^a Spec. Gén., vol. 9, p. 159.

^b Ent. Amer., vol. 1, p. 205.

Stenaspilates. I am, therefore, holding Hulst's name on this specimen, representing a species which apparently has as yet received no other appellation.

The complete life history of *honestarius* has not yet been worked out; nor indeed has it been worked out in any of our species.

The larva is described by Mr. A. N. Caudell as follows:

Length, 35 mm. Head 2.5 mm. wide, strongly bilobed, the lobes light ash-colored above and obtusely angled. Inner anterior borders of the lobes darker, almost fuscous. Face lighter, especially the lower half of the triangular clypeus. General color of the body brownish, mottled with longitudinal splashes of a lighter shade. Tubercles black, minute. Hairs microscopic, black. Thoracic legs on outer side concolorous with the body; on the inner surface, lighter. Abdominal legs colored same as the body on the outer surface, but black on the inner sides, and the venter between the anal pair is also black, bordered posteriorly with white. There is an irregular, not prominent, transverse ridge on the twelfth segment.

The larva fed on wild cherry, and entered the ground on July 10, the imago emerging in the following August.

Professor Packard states in his *Forest Insects* that Miss Emily L. Morton raised it commonly on wild cherry, and that those fed on maple, "the usual food plant," died.

PERO GIGANTEUS, new species.

Plate 13, fig. 3; Plate 15, fig. 3.

1904. *Azelina occidentalis*† DYAR, Proc. U. S. Nat. Mus., vol. 27, p. 913, var. of *ancetaria*; larva.

1906. *Azelina occidentalis*† TAYLOR, Check List Brit. Col. Lep., p. 37.

Expanse, 45 to 51 mm. Head and body pale purplish-gray to reddish-brown, the latter color usually predominant in the female, though not entirely confined to that sex. Antennæ yellowish with a white spot at the base of each which are frequently connected by a concolorous line that extends across the superior part of the front. Ground color of wings whitish-gray with more or less of a yellowish, brownish, or faint purplish cast. Inner line of primaries broad and conspicuous from costa to center of discal cell, thence obsolete to cubitus, but reappearing less strongly below this vein and continuing with the usual scallops to inner margin. Outer line brown, sharply defined externally but blending with the median shade internally, usually quite strongly sinuous and sometimes forming angles on the veins in the lower part of the wing. Inner area speckled, often profusely, with gray. Median area with or without speckles and usually filled in with umber-brown (male) or reddish-brown (female) which becomes intense at the outer line. Outer area with the speckles finer, and forming transverse strigations which, between veins M_3 and Cu_2 near outer line and on inner margin near anal angle, are clustered together in more or less dense clouds.

Small, pure white dots usually surrounded by a brown border are between veins R_5 to Cu_1 near the outer margin, though frequently two or more of these are absent. In the cell between the branches of cubitus a black dot is situated. Discal spot white, conspicuous, linear. Fringe brown. Secondaries with irregular transverse line brownish followed by a whitish line which is the more prominent of the two. Inner area slightly darker outwardly, the color increasing in height in the outer area. Sometimes a still darker shade, becoming intense at the anal angle, is present in the outer area extending parallel and close to the cross line. On the margin near the anal angle are from one to four jet black spots. Discal spot absent or reflected from beneath as a very faint dusky spot. Fringe as in primaries. Beneath paler than above and dusted over more or less profusely with grayish or blackish atoms. Outer line of primaries well marked, denticulate; discal spot white, linear, sometimes marked inwardly with black. Transverse line of secondaries very sharply denticulate; discal spot large, black, oval.

Habitat.—From British Columbia southward to California and eastward to Colorado. Specific localities are: British Columbia: Arrowhead Lake, July 1 to August 7; Kaslo, July 15 to August 21; Wellington, April 15. Vancouver: July 16 to 23. Washington: Tacoma. Oregon: Dally. California: Cazadero, Sonoma County, August 18. Utah: Stockton, July 24 to August 1; Provo, July 29 to August 12. Colorado: Glenwood Springs, June 8 to September 15; Chimney Gulch, Golden, June 30.

This is the largest species of the genus and may be known by its large size alone. It is a close ally to *peplarioides* which species also approaches it most nearly in size. In *giganteus* the outer line of the primaries is usually considerably more angulate at the veins, and the male lacks the faint olivaceous tint of *peplarioides*. Perhaps the best distinguishing feature will be found in the habitat of the two species; *giganteus* is apparently common in British Columbia and Vancouver Island, becoming more rare as the southern and eastern limits of its range are approached, and may not extend south of the northern third of California; *peplarioides* extends through New Mexico and Arizona, and is common in the southern third of California. The two forms may fly together in middle California. The genitalia of *giganteus* are much like those of *peplarioides*; the clasper is narrower than in that species and the scaphium and uncus are somewhat broader.

This species has been generally regarded as the *occidentalis* of Hulst and indeed not without some justification, as Hulst himself has a female specimen in his collection labeled as a type. This, however, is from Colorado, and in his diagnosis of *occidentalis* he specifically gives California as the locality from whence the species is described.

Type.—Cat. No. 13124, U.S.N.M.

Doctor Dyar has described the egg and first two stages of the larva as follows:

Egg: Elliptical, smoothly and evenly rounded, no perceptible flattening nor truncation; surface smooth, shagreened. Shining sordid olivaceous, under a lens minutely black speckled; size, 0.9 by 0.7 by 0.65 mm.

Stage I: Head rounded, bilobed, pale brown, erect, sutures depressed. Body moderately elongate, normal, whitish, marked with irregular green rings from the alimentary canal before eating; a very faint, narrow, brown subdorsal line. Segments annulate; cervical shield small, black; tubercles black, a slight blackening around the hair dots only; setæ stiff, minutely flared at tip.

Stage II: Face below and epistoma broadly bluish white, edged above with a straight black shade; vertex yellowish, with brown black spots in alternating oblique rows; width, 0.75 mm. Body moderately slender, normal, dark gray, many fine irregular brown lines on a greenish-gray ground; venter darker than dorsum, which is irregularly diluted greenish. Feet concolorous; tubercles round, black; setæ pointed, dark.

In the second stage the larvæ began to hibernate and finally died off so that the complete life history was not obtained.

PERO PEPLARIOIDES Hulst.

Plate 13, figs. 4 and 5; Plate 15, fig. 2.

1871. ?*Azelina hubneraria* ‡ PACKARD, Proc. Bost. Soc. Nat. Hist., vol. 13, p. 386.

1881. ?*Azelina hubneraria* ‡ BUTLER, Papilio, vol. 1, p. 221.

1898. *Marmarea peplarioides*, HULST, Can. Ent., vol. 30, p. 218.

1902. *Marmarea occidentalis*, var. *peplarioides*, HULST, Bull. 52, U. S. Nat. Mus., p. 343.

Male.—Expanse, 35 to 38 mm. Head and thorax soft gray with a delicate tinge of purplish. Abdomen gray with a light reddish-brown cast. Antennæ pale yellowish with a white mark at the base of each which frequently are connected by a faint whitish line across the superior part of the front. Ground color of wings whitish-gray with or without a faint washing over of yellowish or olivaceous, and more or less sparsely irrorate with blackish. Occasionally the surface of the fore wings is slightly washed over with a warm brown tint, but this, a constant character of the female, is of the rarest occurrence in the male, and is never so marked as in the opposite sex. Inner line of primaries conspicuous from costa to middle of cell as a rather broad brown dash directed outwardly; below this point the line is absent or only vaguely indicated. Outer line brown, not separated from the median shade, variably sinuous, but usually not very strongly so. Inner area becoming slightly darker outwardly, continuing darker into median space and becoming very dark umber brown in the outer portion of this area. In the costal portion of the discal cell, between the inner line and discal spot, is a yellowish patch usually very conspicuous and never altogether absent. Outer area composed of the unmodified ground color, or with diverse clouds, more or less intense, but when present always arranged as to leave an irregular whitish line extending through the center of the field. Near the outer margin

a small white dot is present between veins R_5 and M_1 and another still smaller one is between veins M_3 and Cu_1 . Very rarely this second dot is absent. Also a black dot of similar proportions is between the two branches of cubitus. Discal spot, white, linear. Fringe concolorous with ground color or distinctly brownish. Transverse line of secondaries irregular, faintly brownish, and bordered outwardly with white—the really conspicuous part of the line. Outer area darkly shaded at anal angle. A black spot between veins Cu_1 and Cu_2 and sometimes two or three other smaller ones between adjacent veins. Discal spot absent or showing as a faint dusky patch. Fringe as in primaries. Beneath, paler than above, sometimes almost whitish, and more or less dusted with blackish atoms, especially on secondaries; both wings shaded costally and outwardly with faint purplish or brownish. Outer line of primaries showing on anterior portion of wings. Discal spot as above. Transverse line of secondaries present across wing; dark shading in anal angle as on upper side; discal spot large, black oval.

Female.—Expanse, 39 to 42 mm. The ground color of the wings is approximately the same as in the male, but entirely lacks the olivaceous tints of that sex and is so heavily shaded with browns of various shades that a different insect is suggested. The head, thorax, and abdomen may vary from lilacinous, through pale yellowish-brown to dark purplish brown, the head and thorax always being the most heavily shaded. Primaries and secondaries with the ornamentation as in the male, but instead of the umber brown shadings is suffused with warm browns, pale yellowish to dark purplish-brown with a reddish admixture. Beneath the sexes are much alike, the female, on the whole, a little darker.

Habitat.—Southern half of California, New Mexico, and Arizona. Specific localities: California: San Diego, March 14 to July 1; Palo Alto, March; Haviilah; Claremont; Alameda County, May; Los Angeles; Pasadena, May 1; Alta Vista, March 31. New Mexico: Beulah, 8,000 feet, July 28 to 31. Arizona: San Francisco Mountains, 8,000 to 10,000 feet, July 23; Yuma County, March.

This species is allied to the preceding, and for distinguishing characters see remarks under that form.

PERO BEHRENSARIUS Packard.

Plate 13, fig. 7; Plate 16, fig. 4.

- 1871. *Azelina behrensaria* PACKARD, Proc. Bost. Soc. Nat. Hist., vol. 13, p. 386.
- 1876. *Azelina behrensata* PACKARD, Monogr. Geom., p. 521, pl. 11, fig. 60.
- 1881. *Azelina behrensaria* BUTLER, Ann. and Mag. Nat. Hist., ser. 5, p. 33=
honestaria?
- 1886. *Azelina behrensata* HULST, Ent. Amer., vol. 2, p. 49=*hubnerata*.
- 1896. *Azelina behrensata* HULST, Trans. Amer. Ent. Soc., vol. 23, p. 380.

Expanse, 35 to 39 mm. Head and body granite-gray to grayish-brown, the segments of the abdomen usually dark brown posteriorly;

palpi and inferior portion of front often light brown; antennæ yellowish or light brown with a white spot at the base of each, which are rarely connected by a faint, broken line across the front. Ground color of wings soft granite-gray, more or less speckled over with dark-brown atoms which occasionally form short strigations on the costa and in the outer area of primaries. Inner line of primaries conspicuous, sometimes broad and diffuse, scalloped, the first sweep from costa less oblique on the whole than in the other species. Outer line distinct, rather evenly sinuous, usually not producing angles at the veins. Median area fawn-brown, rarely deep brown, contrasting strongly with the granite-gray inner and outer area. Discal spot white, angular, linear, quite large, and conspicuous. Secondaries divided subcentrally by a denticulate or wavy line, the greatest angle or wave on the first anal vein. A small brownish discal spot sometimes showing. Three or four black lunules are on the outer margin near the anal angle. Beneath, smoky-gray, washed over with pale brownish on costal and outer areas, and with a patch of dark brown strigations on inner area of secondaries. Cross lines occasionally visible. Discal spot of fore wings as above, but smaller and margined on one side with black; of secondaries quite large, conspicuous, and composed of closely set atoms which rarely disperse, leaving a dusky spot.

Habitat.—"California" (Packard); Sierra Nevada, California, Oregon (Am. Mus. Nat. Hist.); Oregon (W. S. Wright); Portland, Oregon, June (J. A. G.); Rossland, British Columbia, June 3 (U.S.N.M.).

A very distinct and easily recognized species, separable from all others by the granite-gray ground and the sharply defined brown median area. The male genitalia are nearest to *honestarius* but are more triangular in form.

Judging from the specimens in hand Oregon is the true home of the species, since seven of the nine examples come from that State through three different sources. The other two localities, however, bespeak a range extending from lower British Columbia to central California. It is probable that the species is alpine, occurring on the Cascade and Sierra Nevada mountains.

PERO OCCIDENTALIS Hulst.

Plate 13, fig. 12; Plate 16, fig. 5.

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

Expanse, 38 to 40 mm. Head and thorax light to dark brown, the latter occasionally sprinkled with cinereous scales, especially on the collar; abdomen paler, more or less finely mottled. Antennæ yellowish, with a white spot at the base of each, and usually a whitish line extends across the front connecting these spots. Ground color of wings dark yellowish, rarely granite gray, and sparsely sprinkled

over with cinereous and some black scales. Inner line of primaries dark brown or black, well defined, usually complete and with the scallops strongly marked. A faint cinereous line, often mixing with the ground color, just precedes it. Outer line black, rather evenly but strongly sinuous and succeeded by a fine cinereous line. Inner area slightly shaded with brown, and with a cinereous cast on costal and inner margins. Median area shaded heavily with brown, usually from the center of the field to the outer line, where it frequently assumes an intense brown. Outer area only very slightly shaded and more or less strigate. There are two to four white submarginal spots between veins R_5 and Cu_1 and a black spot between Cu_1 and Cu_2 . Discal spot white, angular, linear, though sometimes reduced to a small even spot. Fringe brown or yellowish. Secondaries smoky with a tinge of ochreous. The transverse line brown, irregular, and bordered externally by a conspicuous white line which occasionally becomes quite broad toward inner margin. Three black triangular marks are on the outer margin between Cu_1 and the inner margin, and sometimes the marginal line, usually brown, is of this same color. Discal spot absent or only vaguely indicated. Fringe as in primaries. Beneath light brown to smoky, whitish toward inner margin of both wings and more or less scattered over with dark-brown scales or strigations. Outer line of primaries in part and transverse line of secondaries repeated, the latter more sharply denticulate than above and conspicuously marked externally with white. Discal spot of fore wings as above, but marked to some extent on one side with black; of hind wings large, oval and black or dark brown. Fringe as above.

Habitat.—Rossland, British Columbia, June 8; Pullman, Washington, May 15 (Dyar); Oregon (Wright); Sierra Nevada, California (Beutenmüller); California (Hulst); Nevada (Doll).

A species resembling *modestus* in ornamentation, but on the whole larger. The scattering of cinereous scales over the primaries and the similarly colored narrow borders to the cross lines are peculiar.

The species has not been recognized since it was first described, and indeed it is doubtful whether Hulst himself knew the limits of his species, as no *occidentalis* probably ever reached an expanse of wings of 50 mm., the greatest measurement given by him in his diagnosis of the species. The species from which this measurement was made undoubtedly refers to *giganteus*, a Coloradan specimen of which is in his collection labeled as a type of *occidentalis*.

The dentate antennæ of the male, on which character the genus *Marmarea* was based and of which *occidentalis* is the type, determines to which of the two species the name should apply.

The genitalia are stout and robust and the basal projection of the clasper short and broad. The scaphium hook is provided with a shoulder, as in *behrensarius*.

PERO MODESTUS, new species.

Plate 13, fig. 13; Plate 16, fig. 6.

Expanse, 30 to 38 mm.; average expanse, about 34 mm. Head and body light to dark gray with a yellowish tint, and sometimes more or less heavily shaded with umber brown. The brown, where it occurs on the thorax, is usually smoothly applied, but on the abdomen it is distributed in minute speckles. Antennæ light grayish-yellow, usually with a white spot at the base of each, which rarely are connected by a concolorous line across the front. Ground color of wings light gray with decidedly yellow or very pale brownish cast. Usually, though not always, there is a sparse scattering of brown atoms over the surface; rarely these are profuse and then cluster together in transverse shapes and give to the wings a markedly strigate appearance. Inner line of primaries dark brown or blackish, always conspicuous, narrow, and never diffuse; the scallops are usually pronounced, particularly the one between veins radius and cubitus, which extends far into the cell. Outer line concolorous with inner line, strongly sinuate, sharply defined throughout, and shaded internally with lighter brown. Inner area composed of the ground color without modification except for the atoms occasionally clustering and assuming transverse positions. Median area usually composed of the ground color, though rarely the entire field is decidedly reddish-ocherous, contrasting strongly with the remainder of the wing. There is no shading along the inner line, and that along the costa and outer line rarely reaches to the center of the field and nearly always not more than half so far. Outer area frequently with a faint diffuse cloud of light brown following the outer line but separated from it by a narrow band of ground color. Other diffuse clouds are sometimes present at the outer margin between R_5 and M_3 or near the anal angle. A narrow terminal line is present in all well preserved specimens and one to six small white intervenular dots are between veins R_4 to Cu_2 . Discal spot small, white, rounded to linear angular, and sometimes bordered with a narrow brown ring; rarely it is absent. Fringe slightly darker than ground color. Transverse line of secondaries brown, bordered externally with whitish and irregularly dentate in its course, or simply waved; it terminates on the inner margin within a rather short distance from the anal angle. Terminal line and fringe as in primaries, the former broadened and heightened in color near the anal angle and sending three or four triangular-shaped marks into the wing between M_1 to the anal vein. The outer area, especially toward and at the anal angle, is sometimes darker than the rest of the wing. Discal spot absent or indistinctly showing as a dusky spot. Beneath, paler than above and sparsely dusted with brown atoms. The extradiscal lines are usually very conspicuous, on the secondaries

more denticulate than above and frequently bordered externally with pure white. The discal spot on the fore wings is whitish and linear, but on the hind wings is large, oval, and dark brown.

Habitat.—Arizona, New Mexico, Colorado, Utah, and southeastern California. Specific localities: Arizona: Huachuca Mountains; Santa Catalina Mountains; Palmerlee, Cochise County; Redington; Prescott, Yavapai County; Baboquivaria Mountains, Pima County. New Mexico: Fort Wingate; Las Vegas; Hot Springs, 7,000 feet. Colorado: Durango; Golden; Glenwood Springs. Utah: Stockton; Beaver Valley. California: Argus Mountains. Flies from May 24, through June, July, and August, to September 21.

A rather small variable species common in the Southwest. In the course of the transverse lines it is much like *occidentalis*, but the outer line is more strongly sinuate. The ground color varies from white to yellowish or yellowish-brown and the cross lines are pronounced.

The genitalia are comparatively short and broad, as is also the clasper.

Type.—Cat. No. 13125, U.S.N.M.

PERO MORRISONATUS Hy. Edwards.

Plate 13, fig. 6; Plate 16, fig. 7.

1881. *Azelina morrisonata* HY. EDWARDS, Papilio, vol. 1, p. 121.

1886. *Azelina morrisonata* HULST, Ent. Amer., vol. 2, p. 49=*hubnerata*.

1902. *Azelina ancetaria*, var. *morrisonata* HULST, Bull. 52, U. S. Nat. Mus., p. 344.

Expanse, 35 to 37 mm. Head and thorax pale brown or yellowish, the thoracic crest paler, and the whole with scattered whitish scales. Abdomen concolorous with thorax or yet paler and usually profusely mottled with dark brown scales which sometimes congregate and form continuous bands on the posterior part of the segments. Antennæ yellowish, rarely whitish at the base. Front sometimes darker brown than vertex, the superior edge rarely with an indication of a white line connecting the whitish spots at base of antennæ. Ground color of wings variegated pale yellowish with a faint olivaceous cast to bright yellow. Inner line of primaries dark brown or blackish, well scalloped and usually well defined across the wing. Outer line moderately or rather strongly sinuate, concolorous with inner line, defined externally, shaded internally one-fourth across the median space. Inner and median areas mottled, often profusely, with dark brown, the mottlings assuming, on the whole, a transverse position. Outer area finely and rather sparsely strigate, with two oblique wavy bands, more or less pronounced, between which is a paler brown cloud. A rounded darker brown cloud is usually present between veins M_1 and Cu_2 , close to the outer line. One to three intervenular white dots near the outer margin, the subapical one largest, and a black spot between the branches of cubitus. Discal spot white,

linear, angular, often partially bordered with black. Fringe yellow or brown. Secondaries more or less suffused with smoky, rather heavily strigate, especially at inner margin and in outer area. Transverse line irregular, brown, bordered outwardly with a narrow band of ground color. A row of intervenular black spots on outer margin near anal angle. Discal spot absent. Fringe as in primaries. Beneath paler than above, finely strigate with brown, especially heavy on secondaries. Outer line of primaries evident near costa; on secondaries strongly marked and sharply denticulate. Discal spot of fore wings white; of hind wings large, brown and conspicuous.

Habitat.—Canadian region of the Boreal life zone extending southward along the mountain chains in both the east and the west. Specific localities: Arizona; Durango, Colorado; Washington; Victoria, British Columbia, June 13, 20; Wellington, British Columbia, June 15; Arrowhead Lake, British Columbia, June 1 to 15; Miniota, Manitoba, July 21; Winnipeg, Manitoba, June 8 to 15; Indian Valley, Catskill Mountains, New York, June 7, 16, July 5, 28, 30; Cohasset, Massachusetts, June 8, 30.

This peculiarly mottled form is distinguished from *marmoratus*, which it most resembles superficially, by the bright yellow or yellowish ground color which has sometimes a trace of olivaceous in it. The basal and median areas are not completely suffused with brown as in *marmoratus* and in consequence the inner line shows up more prominently. In genitalic characteristics this species is allied to *colorado* and in this structure both species depart widely from the others of the genus. The clasper is long and narrow with the basal projection also long and thumb-like in shape. The uncus as differentiated from the next species is straight, and the scaphium hook is more slender and less curved.

PERO COLORADO, new species.

Plate 13, figs. 8 and 9; Plate 16, fig. 8.

Expanse, 36 to 38 mm. Head and thorax light yellowish-brown to grayish-brown, the latter sometimes with scattered whitish scales; abdomen creamy yellow to yellow with occasionally a grayish cast. Antennæ light yellow; a white spot at base of each and the white line crossing the superior part of the front usually diffuse. Ground color grayish-white, with or without a rusty-yellow cast, and more or less besprinkled with brown scales, those of the female usually profuse and forming short strigations. Inner line of primaries yellowish-brown to darker brown, rather narrow and nearly always complete. The scallops are defined but not particularly bold. Outer line concolorous with inner, variably sinuous, though usually not very strongly so. Inner area composed of the unmodified ground

color. Median area decided yellow to brown, intensified from center to outer line, at which it becomes very dark. Outer area variously shaded and mottled with dark brown, rust color and a tinge of olivaceous, though sometimes evenly composed of the ground color. One or two usually minute submarginal white spots are between veins R_5 to Cu_1 and a black spot also is occasionally present between the two branches of cubitus. Discal spot conspicuous, white, angular, linear. Fringe testaceous to brown. Ground color of secondaries whitish, rarely with a yellowish or testaceous cast and overlaid with fuscous scales, especially along the transverse line and, to a less extent, the inner margin. Transverse line brown, variously waved and denticulated and followed by a conspicuous line of ground color. Three or four intervenular black triangles are on the outer margin near the anal angle and occasionally there are other smaller ones along the remainder of the outer margin. Discal spot absent or showing as a white, linear mark. Fringe as in primaries. Beneath whitish or very pale smoky with or without a yellowish or testaceous cast. Lines of above except the inner of primaries repeated, that of secondaries strongly denticulate. Discal spot of fore wings white, often edged on one side with black; of hind wings large, black, oval.

Type.—In collection of Dr. William Barnes.

Habitat.—Durango, Colorado, May 24 to 30, June 8 to 15, July 8 to 15; Glenwood Springs, Colorado, June, July 8 to 15, 24 to 30; Yellowstone Park, Wyoming, July 8 to 15—all from Doctor Barnes.

A light-colored species with rusty-yellow or brownish shadings. In one female before me (fig. 9 on Plate 13) there is a slight tinge of olivaceous in the outer area, and in other slight respects the specimen resembles *morrisonata*, but the rusty-brown shade at once distinguishes it from that form. As in *occidentalis* this species has dentate antennæ in the male. The clasper of the genitalia is long and narrow and constricted immediately above the thumb-like projection. The scaphium hook is stout and much curved.

PERO MARMORATUS, new species.

Plate 13, figs. 10 and 11; Plate 14, fig. 14; Plate 16, fig. 9.

Expanse, 30 to 34 mm. Head and thorax chocolate brown, with or without a sparse scattering of yellowish scales. Abdomen somewhat paler, variously mottled with yellowish and light and dark shades of brown, the darker shades frequently at the posterior edge of the segments; anal brush of male light yellowish. Antennæ pale yellow below, dark brown above. A more or less pronounced whitish U-shaped mark crossing the front and connecting similarly colored spots at the base of the antennæ. Ground color yellowish-olivaceous in the male, brownish in the female. Inner line of primaries choco-

late brown, not strongly relieved from the surrounding shadings; best marked on costal area, where it appears as a broad, oblong blotch preceded by a patch of ground color; rather vaguely indicated on lower portion of wing and sometimes preceded by a narrow, broken line of ground color. Outer line brown or blackish, strongly sinuous and preceded by a rather broad, intense chocolate brown shade. Inner and median areas largely laid over with chocolate brown with a tinge of purplish, the ground color showing through in the costal portion of the wing; both areas more or less strigate with darker brown. Outer area sparsely and finely strigate in male, more profusely strigate in female, and with a dense patch of scales bordering the outer line between M_3 and Cu_2 . Other grayish-olivaceous clouds are so disposed as to leave two oblique streaks of ground color directed toward outer margin. One to three submarginal white dots between veins R_5 to M_3 and a black dot between Cu_1 and Cu_2 . Discal spot white, bordered with blackish and often composed wholly of this latter color. Fringe brown or ochereous. Secondaries purplish-brown, rather uniform in coloring and somewhat strigate, especially in outer area and at inner margin. Ground color showing only at anal angle and along inner edge. Transverse line irregular, whitish, sometimes preceded by a brown line. Three or more black spots along outer margin and a white spot between R and M_1 . Discal spot absent. Fringe as in primaries. Beneath, ground color whitish but largely suffused with warm and purplish-brown. Inner area of secondaries strigate. Cross lines of above except inner line of primaries showing as denticulate whitish lines, occasionally bordered inwardly with brown. Discal spot of primaries white, frequently marked on the inner edge with black. Discal spot of secondaries black, usually oval, occasionally divided, sometimes large, though may be reduced as to be practically absent and is then replaced by a whitish spot. Fringe as above.

Habitat.—Massachusetts and New York, southward to Virginia and westward to Illinois. Specific localities: Massachusetts: Cohasset, July 5, 10, 15, 18, 19, August 15; Newton Highlands. New York: New Windsor, July 30. New Jersey: Chester, August 4, 10. Pennsylvania: Scranton, May, July 20; Pittsburg. Maryland: Plummer's Island, April 28; Cambridge, May 24. Washington, District of Columbia. West Virginia. Illinois: Quincy, August 1 to 15; Elkhart, August 1 to 7.

Though in a degree resembling *morrisonata*, this species may be recognized at a glance by the decidedly olivaceous tint of the ground color and the clear chocolate-brown shadings. The elongated genitalia are widely different from all the other species.

Type.—Cat. No. 13126, U.S.N.M.

EXPLANATION OF PLATES.

PLATE 13.

- Fig. 1. *Pero honestarius*, male.
2. *Pero honestarius*, female.
3. *Pero giganteus*.
4. *Pero peplarioides*, male.
5. *Pero peplarioides*, female.
6. *Pero morrisonatus*.
7. *Pero behrensarius*.
8. *Pero colorado*, male.
9. *Pero colorado*, female.
10. *Pero marmoratus*, male.
11. *Pero marmoratus*, female.
12. *Pero occidentalis*.
13. *Pero modestus*.

PLATE 14.

- Fig. 1. Wings of *Pero honestarius*, showing venation.
2. Venation of *P. honestarius* in the vicinity of the accessory cell, more enlarged.
3. Venation of *P. marmoratus* in the vicinity of the accessory cell, illustrating the crowding of the veins in this species.
4. Anterior leg of *P. honestarius*.
5. Middle leg of *P. honestarius*.
6. Posterior leg of *P. honestarius*.
7. Head and palpi of *P. honestarius*.
8. Section of antenna of *P. honestarius*.

PLATE 15.

- Fig. 1. Genitalia of *Pero honestarius*.
2. Genitalia of *Pero peplarioides*.
3. Genitalia of *Pero giganteus*.

PLATE 16.

- Fig. 4. Genitalia of *Pero behrensarius*.
5. Genitalia of *Pero occidentalis*.
6. Genitalia of *Pero modestus*.
7. Genitalia of *Pero morrisonatus*.
8. Genitalia of *Pero colorado*.
9. Genitalia of *Pero marmoratus*.



Grossbeck, John A. 1910. "Studies on the North American geometrid moths of the genus *Pero*." *Proceedings of the United States National Museum* 38(1753), 359–377. <https://doi.org/10.5479/si.00963801.38-1753.359>.

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