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NOTE.—It was impossible to issue the November number in proper time, so that the articles which would have composed it are given with the December number, making the same amount of pages.

ON PAPILIO MACHAON L., AND ITS N. AMERICAN REPRESENTATIVES—; PAPILIORUTULUS. BVD.—; AND PARNASSIUS. BEING PORTION OF A PRELIMINARY REPORT ON THE BUTTERFLIES OF WASHINGTON TERRITORY.

BY DR. H. A. HAGEN.

As far as I know all insects, hitherto described, from Washington Territory were collected west of the Cascade Mountains. The larger portion of this Territory east of the Cascade Mountains, north of the Columbia River, to the frontier of Idaho, has never been visited by entomologists, except perhaps the southeastern belt of the Wallula Valley. The climate of the country east of the Cascade Mountains is very different from that west of them, the latter being similar to the climate of California. The country east of the Cascade Mountains consists to a large extent of the basin of the Columbia River, with immense sage-brush deserts, and here falls the least amount of rain through the U. Sts. At right and left mountains, with a rich vegetation of forests and large fertile valleys, ascend to the Cascades, and the Rocky Mountains. It is one of the few parts in the U. Sts. not yet examined by entomologists, and the good chance to collect here was offered by the N. Transcontinental Survey, under the direction of Prof. R. Pumpelly. The collection of butterflies made by *Mr. S. Henshaw* and *Mr. R. H. Stretch* is large, and contains interesting species, which may justify a preliminary report.

The preparation and spreading of the butterflies has only been

commenced, so that but imperfect notes can be given, but as the collection of the Cambridge Museum, contains a large number of species, determined by the best authorities, the notes based upon a careful comparison of the Washington Territory species with those in the collection may be acceptable.

The specimens were collected from June 24 to July 27, from Umatilla to Spokane Falls. Some were taken near the Falls and at Umatilla, on the Oregon side of the Columbia River, where Mr. Morrison collected for a few days. After July 27 some were collected in Western Montana. In Washington Territory we crossed the desert opposite Umatilla, and followed the Yakima River and the valleys on the right side to the fork in the Cascade Mountains, returning *via* Ellensburg, and through the desert to Ainsworth and Spokane.

PAPILIONIDÆ.

P. ZOLICAON AND P. OREGONIUS.

The large number of specimens of both sexes (74) approves the statement that both species *cannot be separated*. Half of them were collected June 24, 25, at Umatilla, on the Oregon side of the Columbia River; the other half in Washington Territory, just opposite Umatilla, June 26. One old and torn specimen July 18, at Lone Tree Camp, near the Yakima River. Some collected at Spokane are in the collection of Mr. Ricksecker. The main part of the specimens belongs to *Pap. oregonius*. The typical *P. Zolicaon* is only represented by half a dozen specimens flying promiscuously with the others.

The true *P. Zolicaon* is to be recognized—I—by the black spot in the anal rufous spot *entirely* isolated above and below; II—by the cell of the primaries on the under side wholly black; III—by the abdomen being black, with only a yellow side stripe; IV—by smaller size (of W. H. Edwards). Concerning the black isolated spot (I.) I find among the Californian specimens in the collection one female with a continuation of the spot on the under side to the black stripe which edges the inner margin. Mr. W. H. Edwards has figured pl. 6 f. 4 *exactly* the same for the female of *P. Zolicaon*, without mentioning it in the description. The specimens from Washington Territory have the spot either isolated or connected below. Some specimens of the true *P. oregonius* possess isolated black spots, sometimes only in one wing. There are before me *all intermediate* forms of a spot entirely isolated, or partly or wholly connected with the black stripe of the edge. Concerning the cell of the primaries (II.) some *P. oregonius* with a connected spot and a yellow abdomen have the cell partly or even *entirely* black as *P. Zolicaon*; on the contrary, some *P. Zolicaon* (with a largely black abdomen) have the cell yellow as *P. oregonius*. The color of the abdomen (III.) is, indeed, largely black in *P. Zolicaon*; but sometimes true *P. oregonius* (with the spot

connected with the inner margin, and a yellowish cell of the primaries) have the abdomen as largely black.

The size is very variable. *P. oregonius* male expands from 80 to 98 mm. ($3\frac{1}{4}$ – $3\frac{3}{4}$ inch); the female from 100 to 110 mm. (4 – $4\frac{1}{2}$ inch). *P. Zolicaon*, male, from 78 to 86 mm.; female 92 to 94 mm. (100 mm., W. H. Edwards). The tail of the wings varies in length from 5 to 9 mm.; in breadth from 1 to $2\frac{1}{2}$ and sometimes to 3 mm.; its form is very variable, strongly spathulated or rounded or pointed at the tip.

In Yakima Valley, July 5th, Mr. Henshaw found a full grown caterpillar feeding on wild parsnip, Mr. Stretch one on sage. The first one escaped by accident, but Mr. Stretch managed by ingenious contrivances to educate the imago, which proved to be *P. oregonius*. The caterpillar is very similar to that of *P. machaon* in form, color and pattern. As I am very well acquainted with the latter, I remarked directly a difference. The first transversal black band behind the head has a large gap in the middle, perhaps as large as the remaining part of the band, on each side. *P. machaon* has never this band interrupted, at least not in the specimens before me; nor find I mentioned such an interruption in any description or figure of the caterpillar; also not in Mr. Stretch's figure and description of *P. Zolicaon*, published by Mr. W. H. Edwards, and not in his description of *P. oregonius*, "PAPILIO," II., p. 120. The chrysalis agrees with that of *P. Zolicaon*. Mr. Stretch has made a colored sketch of the caterpillar. The chrysalis skin is before me.

After all, there is no doubt that *P. oregonius* is merely a variety of *P. Zolicaon*, mostly larger in size, more yellow, the black spot connected with the black interior anal band, which is somewhat dilated on tip, the black bands of the abdomen narrower.

P. oregonius (not *oregonia*, as Mr. Edwards writes), was very common on both sides of the Columbia River at Umatilla, June 24th to 26th; at The Dalles, June 23d, it was not observed, though eagerly looked for. It was not seen June 30th at Lone Tree on the Yakima River, but on returning to the same place July 18th, one old specimen was collected; probably *P. oregonius* had there appeared and disappeared in the time between those days.

At the mouth of the Natches river, at a higher elevation, July 4, the full-grown larva was still found, therefore the imago would not appear there before the end of July. The specimen raised by Mr. Stretch appeared July 25.

When *P. oregonius* was observed at Umatilla we all believed it to be *P. machaon*, the more so as Mr. W. H. Edwards had just published ("PAPILIO," p. 74) the capture of a specimen by Mr. H. Edwards at The Dalles, where we had looked for this species without success. A careful comparison of Mr. W. H. Edwards' paper with the materials at hand has given the following result.

The material consists for the European species, twelve specimens (Germany, Austria, Switzerland, Alsace) especially selected for the collection out of a very large number and representing all varieties in size, color and pattern, which I was able to observe; and one *P. hospiton*. The material for the Asiatic species (from East India, Amballa, Koolloo, Himalaya, about 6000' high, Jallore-pass, Himalaya, more than 10,000' high) thirty specimens especially selected out of about 500 specimens as representing all varieties. I possess only one male from Tokio, Japan. Finally a couple collected by Mr. Chas. Wright at Owaska, Kamschatka, probably fr. Wilkes' Exp.

Exp. alar.

European spec., male, 72 to 88 mm., female 82 to 92 mm.

Asiatic spec., male, 72 to 96 mm.; female 78 to 96 mm.

Kamschatka spec., male, 72 mm.; female 84 mm.

The tail of the hind wings.

European spec., length $5\frac{1}{2}$ to 9 mm.; breadth 1 to $1\frac{1}{4}$ mm.

Asiatic spec., length 5 to 10 mm.; breadth 1 to $1\frac{1}{2}$ mm.

Kamschatka spec., length 5 mm.; breadth 1 mm.

The main average of the size of *P. machaon* is smaller than in *P. oregonius* and similar to *P. Zolicaon*, though there exist males of *P. oregonius* of the same size of *P. machaon*. The tail of *P. oregonius* is mostly broader, but not longer.

The description of the var. ASIATICA Ménétries quoted by Mr. W. H. Edwards stated "the submarginal border of the hind wings to be very broad, with the inner edge straight, and reaching nearly the end of the cell." In my Asiatic specimens this border is broad 4 to 7 mm., and in the European specimens 4 to 6 mm. The inner edge of the border of the Asiatic is mostly less concave than in the European ones, and *exceptionally* nearly straight; others show the same curve as the European ones. In specimens from Switzerland the inner edge of the border goes as near to the cell as commonly in the Asiatic ones; and other Asiatic specimens show the cell even more distant from the border as commonly as the European ones. The final note by Ménétries, "the marginal border of the Himalayan specimens is very much larger," belongs, apparently, to a comparison with those of Kamschatka, as the words before the N. B., "de l' Himalaya et Kamschatka," prove. Indeed the latter have the marginal border of the male $2\frac{1}{2}$ mm. broad, of the female 4 mm. As the specimens from Himalaya and from Kamschatka mentioned by Mr. W. H. Edwards were communicated to him out of the collection of the museum, my remarks cover the same specimens.

The remark by Mr. Felder (Wien. Z. B. Ges., IV., p. 363, Mr. Edwards quotes the pamphlet edition, p. 75) "*var. asiatica* discrepans alis adhuc brevioribus posticisque in regione anali magis productis," is refuted by the measures given above. Mr. W. H.

Edwards quotes "the hind wings are shorter," which would be a contradiction.

I am not able to concur with Mr. W. H. Edwards that the name, *asiatica* Mén., does not apply to the prevailing type in Southern Asia; Mén. specimen was only a little more exaggerated. Mr. Kollar, in Huegel's Kaschmir, vol. IV, p. 406, saw some specimens from Himalaya, "different from *P. machaon* from Vienna, Austria, by darker yellow (this is true for the Koolloo specimens, but those from Jaloree-pass are bright yellow, just as the European ones), a little broader marginal bands, the black nervures in the yellow fields broader, more similar to the local varieties of Southern Europe and Dalmatia."

De Haan (Papil. nederl. overz. bezit. p. 42) says, "*P. machaon* is also found in Japan, without difference in colors; but the hairs on the end of the abdomen and on the inner border of the hind wings are longer and cover a part of the middle cell, which is not the case in the specimens from Netherlands." This is true for Himalaya specimens before me, but I have some European ones with equally long hairs. One male of *P. machaon* from Tokio, Japan, is before me. The hairs are as described by De Haan; the yellow color is as bright as in the European specimens; the blue spots in the band of the hind wings are larger and brighter. The submarginal series of yellow spots along the margin of the front wings is large and orbicular, the first and the last spot are ovoid. The European specimens have those spots as half moons, sometimes in crescent-shape. The external border of the spots offers a straight but interrupted line. The Himalayan specimens have these spots partly as in the European ones, partly orbicular as the Japan specimen, or more or less rounded, sometimes very small and largely distant. The Kamschatka specimens have the spots similar to the European ones. Meigen has figured a variety from Europe with all the spots connected, forming a band. There is to be found in the Tijdschr. v. Ent., 1852, vol I., p. 129, a remarkable paper by Mr. Ver Huell, with a colored plate of *P. machaon*, caterpillar, chrysalis and imago, which I find nowhere used or even quoted. The late brother of Mr. Ver Huell had raised (as he believed) an imago from a caterpillar before the last moult, being in the third stage. The editor believes this statement to be erroneous, "as nearly all caterpillars had changed after the last moult from black to green." The editor tried to repeat the observations of his brother by collecting a number of not full-grown caterpillars and providing them with a satisfactory quantity of food. Nevertheless some of them were black when transforming into chrysalis. As he supposed, they had maintained the black color after the fourth moult. From one-third of these chrysalis were raised two imagos, somewhat crippled but enough developed to show the identity with the specimen raised by his brother, which is figured. Besides the very small size (the

figure shows a dwarf expanding 55 mm.) "the black bands and spots are larger; the orange spots on the under side of the hind wings are rarely seen in a well-developed imago." Ver Huell declared this imago to be *P. sphyrus* Huebn.

The collection of the museum has a similar dwarf from Switzerland (length of upper wing 30 mm., in Ver Huell's figure only 28 mm.); but Ver Huell's description does not mention two very important characters represented in the figure; the basal half of the cell on the under side of the primaries is black and their sub-marginal band suddenly diminished before reaching the costal-margin. The statement of the rare appearance of the orange spots in the imago is not true, after the specimens before me.

The same volume of the Tidschr has a paper by Mr. M. C. Verloren, "Observations sur le *P. machaon*," p. 90-108, which has been also entirely overlooked. The paper is the first, as far as I know, in which the influence of the cold temperature on the colors is acknowledged. Mr. Verloren observed many varieties in the coloration of the caterpillars; the black caterpillar is the most remarkable one. The black color replaces the green main color entirely; only some faint dorsal lines and some irregular green spots on the sides are left. The black variety belongs to the spring generation of the imago, at the beginning of the fall being rare, it becomes later dominant. The imago belonged to *P. sphyrus*. The paper contains besides many interesting observations not used by later Lepidopterologists.

I have never seen *P. sphyrus* (figured by Huebner, I, 155, p. 775-776.) from Europe. Huebner's figure represents, indeed, a *real machaon*, in size and colors exactly like the *var. asiatica* from the Himalaya.

Mr. Dutreux, Stett. E. Zeit., XV., p. 320, in his abridged translation of Ghiliani's paper on *P. hospiton* states, that *P. sphyrus* is on the whole similar to *P. hospiton*; the blue band above the orange spot is just as in *P. machaon* and not separated from the orange by a black border as in *P. hospiton*. I have only one specimen of *P. hospiton* before me, and I agree that it is a *very exaggerated* variety of *P. machaon*. Nevertheless, there exist more prominent differences, except the one quoted by Ghiliani between *P. hospiton* and *P. machaon*. The tails are excessively short, 2 mm.; the black band of the hind wings is much larger, covering nearly the outer half of the wing and reaching very nearly the cell. Nevertheless, the nervures in the basal yellow half are considerably less black than in the primaries and even less than commonly in *P. machaon*; the hairs of the abdomen and of the anal border of the hind wings are longer and more numerous; the under side of all wings differs even more, the basal part of the cell of the primaries is black; the marginal black band of all wings show between every two nervures a black elliptical curve, and the

band of the under wings lacks on its internal margin the black bands; instead of them the small blue spots are internally surrounded by a very small black elliptical curve, at some distance from the inner margin of the band.

Zeller, in *Isis*, 1847, p. 216-219, speaks at some length on *P. sphyrus* and *P. hospiton*. *P. sphyrus* he puts with a ? as the spring form of *P. machaon* (Freyer, New Britr., I, p. 139, says; "*P. sphyrus*, Hueb., is simply a *P. machaon*,") pilosior abdominis dorso late nigro, alarum anteriorum venis dilatis, omnium fascia postica latiore. He concludes with acknowledging the very considerable variation of *P. machaon* in color, pilosity, size, shape and in the length of the tail.

Concerning *P. hospiton*, Zeller discusses in detail the figures and description of Herrich-Schaeffer, pl. 53, f. 249-250, p. 140. (They agree exactly with the specimen in the collection of the museum.) Zeller mentions specimens collected near Messina, Sicily, and concludes, finally, that the only difference of importance is represented in the black line separating the red spot in the angle of the hind wing from the blue lunule above the spot. But, he continues, the shape of the red spot (a crescent by Herrich-Schaeffer, and transversal ovoid in the museum's specimen) is variable in *P. machaon* and *entirely wanting* in the variety from Hamburg, figured in Freyer, New Britr., I pl., 74. This variety is even more remarkable as the figure of the under wing has on the under side a small red crescent divided from the blue spot by a large black band just as in *P. hospiton*; the basal half of the cell of the primaries is black, except a small paler spot near the base, just as in *P. sphyrus*. Zeller does not mention these two differences.*

The only description of the caterpillar of *P. hospiton* by Mr. Boisduval, Index p. 1-3, is short, "green with black, whitish and red punctated, with aborted spinules; living on *Ferula communis*." Mr. Zeller objects against the spinules, but Mr. Verloren, l. c., p. 95, says: "Before the fourth moult the caterpillar possesses short spines, which disappear nearly entirely after the fourth moult. In the black variety these spines remain more apparent than in the green caterpillars." Besides that Mr. Boisduval has not stated that his caterpillar was full-grown, Verloren's remarks cover the case.

Dr. J. Delaharpe, Contribut. à la Faune d Sicile, Lausanne, 1860, p. 33, describes as intermediate form between *P. machaon* and *hospiton* a large female from Sicily. The primaries are as in *P. machaon*, the underwings and abdomen similar to *P. hospiton*.

Mr. Bellier de Chavignerie, Am. Soc. Ent Fr., 1860, p. 674

* In *P. Zolicaon* the red spot in the angle of the hind wing is always separated from the blue lunule above it by a black line; but I find in some *P. oregonius* the indication of a black line, beginning from the outside to separate the red spot on the under side of the wings; even some of the var. *asiatica* show the same, but more faint.

says: All *P. machaon* from Sicily belong to *P. sphyrus*, but the spring form is darker and intermediate of *P. machaon* and *P. hospiton*.

I have given, as I believe, before ample and satisfactory proof concerning the variation in color of *P. machaon* and its most extreme forms, *P. hospiton*, *P. sphyrus* and *P. asiaticus*. It should be remarked that Dr. J. Delaharpe, l. c., p. 1-6, gives, 1860, very detailed and interesting examination of the causes which produce a change of color in butterflies and caterpillars. His paper has never been used in the literature concerning this question.

But not only the imago shows a large variation in color by *P. machaon*. The caterpillar and the chrysalis differ also considerably. Concerning the caterpillar, all stages, except the second, are well figured by Sepp. F. I., G. I., pl. 3.

The full-grown black variety, by Ernst T., I., pl. 34, f. 68, b.; by Freyer, l. c., pl. 74, the first stage and the full-grown black variety; by Ver Huell, l. c., pl. 7, f. 1, the full-grown black variety. The full-grown green caterpillar is everywhere figured, sometimes together with the first form, Huebner Gesch. Schmett., pl. 47 and 49 with the chrysalis. Also De Geer gives good descriptions of the previous stages of the caterpillar. It is stated that the black variety gives imagos alike *P. sphyrus*.*

There are commonly two forms of the chrysalis, one green, the other gray, which forms do not belong to the different sexes.

There are numerous communications in the Ann. Soc. Ent., Fr., about the two forms, after 1868. Mr. Fettig had contended that the color of the chrysalis changes conforming to the attachment on green or dark objects. Mr. Fallou, ibid Proc. 1871, p. 54, proves, by experiment, that this is not the case. The same author and Mr. Mabile, l. c., 1872, Proc. p. 55, state the same difference in the chrysalids of *P. hospiton*. A figure of the chrysalis of the black variety of the caterpillar is given by Mr. Ver Huell, l. c., pl. 7., f. 2.

Having tried to state the hitherto known limits in which *P. machaon* of the old world can vary, I arrive to the knotty question of the American *P. machaon*. Of the specimens quoted by Mr. W. H. Edwards ("PAPILIO," I, p. 75), I have only seen the type of *P. aliaska*, Scudder. I had the benefit to compare this type, together with the specimen of *P. Zolicaon* with which the author had compared it. A comparison with the Asiatic form was in 1869 entirely impossible for the author, as then no specimen existed in American collections, and only very few in Europe. The type of *P. aliaska* expand 80 mm.; and is identical with *P. oregonius*. The tails are very short, a little less than 5 mm. long. Among the differences noted by Mr. Edwards, the first one is remarkable, the hind margins of the fore wings are convex in all specimens seen by him. This is exactly the case in *P. aliaska*.

* Dr. Weisman Stadien, vol. II., pl. 2, f. 36, figures the sixth segment of the caterpillar of *P. hospiton* (apparently black var.), *P. machaon*, *P. Zolicaon*.

Among the large number of *P. oregonius* very few have this border straight, and only one a little convex. Among *P. Zollicaon* one from Mendocino and one from Washington Territory have the margin as convex as *P. aliaska*. Among the Asiatic specimens those from Kamschatka and two from Koolloo, Himalaya, have the margin convex, several others only a straight margin. Among the European specimens before me some have a straight margin, none a convex one. But the two varieties quoted before as figured by Ver Huell and Freyer have a convex margin. I think if even all Hudson's Bay and Aliaska specimens should possess a convex margin, this can only be considered to be a local variation. Messrs. Scudder and Edwards do not mention the shortness of the tail; after all, my measures show its extreme variability.

The second difference noted by Mr. Edwards, that the black parts are more intensely colored and less dusted by yellow scales, and the nervules very considerably edged with black, is not true for *P. aliaska*. The large material before me proves this statement for the Himalayan specimens, and even for some European ones to be incorrect.

I have given considerable attention to another difference; the black sub-marginal band of the primaries between the yellow part and the row of yellow spots near the margin. Mr. Scudder has used the same character for the band on the upper side of the wing. I speak here only about the same band on the *under-side* of the wing. It is very rarely entirely black, mostly more or less dusted with yellow scales in the middle of each cell. I find it entirely black in one *P. Zollicaon* from California, and three *P. oregonia* from Washington Territory. Mostly the yellow dust in the cells is connected to form a narrow or larger yellow middle line. Finally the band becomes yellowish-gray, bordered on both sides by a black line, the internal one broader. Near the anal margin the end of the band remains mostly black; near the costal margin the large marginal cell connected with the band is entirely black, or in part, or entirely yellow, with a broad black border on its basal end. The sub-marginal band is equally broad throughout or narrowed in approaching the costal margin. In the latter case two different ways are followed; or the inner margin of the band is straight to the tip and only gently sloping to the external margin, forming a more or less pointed band, or the two last cells have the internal black border removed more outwardly, so that those cells are similar to the steps of a stair. There exist intermediate forms where the internal margin of the second cell is oblique and connected at its base with the margin of the third cell so that this part of the band is sloping.

P. machaon from Europe has this band mostly straight, only the first cell narrower, broad 4 mm., first cell 2 mm., or broad 3 mm., first cell 2 mm. Some specimens from Austria, Alsace,

and Switzerland belong to the intermediate form. The specimens from the Himalaya have the band as the European ones (sometimes larger, 6 to 4 mm., 4 to 3 mm.); a number belongs to the intermediate form (3 to $1\frac{1}{2}$ mm.) and a few to the sloping forms (4 to $1\frac{1}{4}$ mm.). The Japan specimen has the European form, but the black borders of each cell are curved instead of being straight. In *P. hospiton* the curvature is much more exaggerated. The couple from Kamschatka have very narrow sloping bands ($3\frac{1}{2}$ to 1 mm., $2\frac{1}{2}$ to 1 mm.).

P. Zolicaon and *P. oregonius* have mostly sloping bands (4 to 1 mm., or even 6 to 1 mm.). But there are specimens of both species of the intermediate form and even of the European form; to the latter one belongs *P. aliaska* (4 to 2 mm.).

Therefore the band is generally straight in the European specimens; of the intermediate form in the Asiatic specimens, sloping in the American specimens. But everywhere specimens exist ranging exactly or nearly so with those of the other parts of the world. Besides the breadth of the band is equally variable in all those parts. Nevertheless the mostly sloping form of the band is about the principal character for the American specimens of *P. Zolicaon* and *P. oregonius*.

De Haan (in Verh. over de Naturl. Gesch. von Nederl. overz. Bez. Zool. Lepid. p. 42., pl. 5, f. 2) published and figured a variety of *P. machaon* female of much larger size exp. $4\frac{1}{2}$ inch (115 mm.); on the primaries the basal band less sharply cut and on the costal margin more nebulous, as is also the band along the margin of the under wings, which passes over the tip of the cell. Tails twice as long as usually; on the underside the four spots along the costal margin nearly yellow; on the under wings the middle band darker blackish, with sky-blue spots in the middle, internally cut in curves, externally ending in a yellowish color. Collected at Nangasaki, Japan, by Siebold.

Mr. Felder (in Wien. Z. B. Gesell., XIV, p. 314 and 362, No. 201) has made of this variety after two females from Japan his species *P. hippocrates*. This description, though somewhat difficult to understand, differs not from De Haan's, but he adds that the front wings are shorter, the hind wings longer, the blue moon above the red anal spot well separated from it.

The collection of the Cambridge museum possesses several males and females of this species from Kanagawa, Japan, collected by Mr. Gulick. After a comparison of those with a female from the Columbia River, Oregon, Mr. W. H. Edwards described *P. hippocrates* var. *oregonia* (in Trans. Amer. Ent. S., vol. V, p. 208). "It bears much the same relation to *P. hippocrates* as *P. aliaska* bears to *P. machaon*. With some exceptions it agrees well with females of *P. hippocrates*." Mr. W. H. Edwards (in the Butterfl. of N. A., vol. II., part IX) describes the specimen as *P. oregonia* and gives the differences from *P. hippocrates*.

The three males from Kanagawa exp. 95 to 105 mm.; two females 105 to 112 mm.; the tail is 9 to 13 mm. long.

The females differ, indeed, more from *P. machaon* and *P. oregonius* than the other varieties. The yellow on the upper side is paler, more whitish, and of considerably less extent; the black ends more nebulous; the under side has more yellow, the black nearly disappearing; the blue moon above the red anal spot is separated by a strong black band. Of the three males one approaches in the color of the upper side more the females, but the two others are similar to *P. oregonius*, except that the yellow middle band of the primaries is narrower, the black band of the under wings larger, covering the end of the cell; the blue moon well separated by a black line. The tail of one male is not longer than in *P. oregonius*. The under side differs principally in the primaries where the black in the cell along the costal margin and along the nervures has disappeared. The black sub-marginal band is sloping, its internal margin waved (just as in the form from Tokio). The large black band at the apex of the cell is on the under side of all wings and in one female on the upper side, divided by a faint yellow line, which is more perspicuous on the Tokio specimen. The black band of the hind wings has the inner border straight or nearly so, reaching the end of the cell or not reaching it.

Mr. H. Pryer (in Trans. Ent. Soc., Lond., 1882, p. 486), on certain temperature forms of Japanese butterflies, says of *P. machaon*, "The difference between the temperature forms is very striking. March specimens are about $2\frac{1}{2}$ to $2\frac{3}{4}$ inch in expanse and very pale colored, the summer forms expanding over five inches and are very dark, handsome insects. No alteration takes place in the markings, the colors being intensified only."

I think there can be no further doubt about *P. hippocrates* being only a marked and large variety of *P. machaon*. It is interesting to state that the colors and pattern of *P. hospiton* are about intermediate between the Tokio form and *P. hippocrates*.

Prof. A. Pagenstecher (in Verh. Heidelberg Nat. Medic. Ver., 1874, N. Serie. Heft I, p. 22, separ.), Ueber den ursprung einiger Europ. Schmetterlinge, speaks at some length about *P. hippocrates*. He has seen only the summer form, which he believes to be different from *P. machaon* and proposes for it the name *P. micado*, because he has not seen intermediate specimens," nor was he able to compare De Haan's work. He gives a full description. This paper has not been used by N. Amer. Lepidopterologists, though it treats at some length nearly all N. Amer. Papilios, and is very interesting, as he arrives to the final conclusion that the European forms are derived from the American ones. It treats at considerable length *P. asterias* and its related forms.

Can the separation of the American species be maintained? I answer boldly, *no!* After the examination of a hitherto unpar-

alleled series of specimens, showing EVERYWHERE INTERMEDIATE FORMS, they should be considered as local or climatic varieties of one and the same species of *P. machaon*. I was very near supposing that *P. zolicaon* may be a spring form, as it is said for *P. sphyrus* in Europe. But though I consider the last statement as proved, for the American species double breeding has first to be proved. It seems more probable to consider *P. oregonius* as a climatic form, occurring in a region where nearly no rain falls through the summer, where the heat is excessive (we had only two weeks below 90° and more than a week above 100°), and which is, in fact, a sage-brush desert on basaltic soil. There is a gap still to be filled; the careful and exhaustive examination of the genital appendages of the male. The pattern is the same in *P. machaon* and *P. oregonius*, but there are differences in the finishing of the detail—as it is always in varieties or races. The parts are very complicated and satisfactory description should be given by specialists.

Mr. Pryer, l. c., p. 489, has now united eleven, perhaps twelve species of *Terias* as belonging to one and the same species, and remarks in conclusion, p. 491, that neither size, shape nor color can be relied on as guides for specific distinction and that temperature has a great evolutionary effect in the character of the insects. I believe that a revision of the N. Amer. Butterflies on this basis is a want. It is probable that *P. brevicauda*, *Bairdii*, *Indra*, *Pergamus* and probably *Americus* belong all to *P. asterias*.

The *Nymphalidæ*, *Satyridæ* and *Lycænidæ* will certainly not stay behind in similar reductions.

PAPILIO RUTULUS.

We collected at Yakima City, W. T., on milkweed, July 1 and 2, 4 males and 4 females of *P. rutulus*, and before a dead chrysalis at Portland, Or., Exp. male 96–104 mm.; fem. 104–110 mm. Length of tails 10–14 mm. The form of the tails is very variable. They are simply sloping from 3 mm. at the base to a little more than 1 mm.; or 1½ mm. broad, a little larger on the rounded tip, or twice as large on tip; or broader 2½ mm., and decidedly spathulated on the 4 mm. broad tip.

I have before me in the collection of the museum 10 specimens, 6 from California, one of them with the locality San Francisco, and 4 collected by Mr. Garman on the way from Gr. Salt Lake, Utah, to Ft. Bridger, Wy., on an elevation to 7000 feet, in July and August, male and fem. Exp. 90 to 104 mm., tail 8 to 12 mm. long, or sloping, or of equal breadth, rounded on tip or spathulated.

Concerning the literature about *P. rutulus*, nothing exists but the original description by Boisduval and Lucas, both 1852,

and the translation of the first by Rev. Morris. Mr. Felder (Wien. F. B. Ger., 1864, p. 361) says: By the shape of the wings easily to be distinguished from *P. turnus*. The female looks — primo intuitu — very similar to *P. daunus*. Mr. Mead (Wheeler's Exped., 1875, T. V., p. 741, says: Closely allied to *P. turnus*; the only constant distinction seems to be that the submarginal ray (of yellow spots) on the underside of the primaries (*secondaries* Edw., is probably a misprint) is continuous; in *P. turnus* it is broken up in distinct spots, S. Utah; Colorado in June. Mr. Strecker (Lepid. 1877, p. 128) describes dwarfish specimens Exp. 70 mm. from Arizona as var. or ab. No figure of *P. rutulus* is known to me.

Mr. Boisduval says: *P. rutulus* differs from *P. turnus* in that the upperside of the secondaries have not the fulvous crescent on the internal angle, and the underside has not the fulvous crescent in the border, nor the sagittate spots between the border and discoidal cellule of *P. turnus* (Ann. Soc. Ent. Tr., 1852, p. 280, and Morris Lep. N. A., p. 4). Mr. Lucas says: *P. rutulus*, though very similar to *P. turnus* differs by very marked characters. The black margin of all wings is always darker and internally less sinuated; the five bands of the wings are deeper blackish, broader, principally the basal one, and internally less dentated. The series of marginal spots on the secondaries has only five crescents, sometimes only four, one of them fulvous; the yellow submarginal spots on the underside of the primaries form a continuous band; on the secondaries the fulvous marks in the centre of the submarginal spots are wanting.*

The characters admitted as proving the difference between *P. rutulus* and *P. turnus* are:

I. The submarginal ray of yellow spots on the underside of the primaries forming a continuous band (W. H. Edwards; Lucas).

II. The lack of the fulvous crescent on the upperside of the secondaries at the internal angle (Boisduval; Lucas).

III. The lack of the fulvous marks and the sagittate fulvous spots on the underside of the secondaries (Boisduval; Lucas).

IV. The margin of the wings and the five bands are broader and of a deeper black (Lucas).

It is very obvious that none of those differences are of decided importance. The examination of the constancy of those characters gives the following result:

Concerning I. and III., all 18 specimens before me agree in showing the characters mentioned here. Concerning II., 10 specimens ♂ ♀ have no spot at all on the internal angle of the secondaries; 8 spec. ♂ ♀ have a small yellow spot, or only a few

* Dr. Behr. Stett. Ent. Z., 1866, p. 216, says: *P. eurymedon*, *rutulus* and one n. sp. can be perhaps only local var. of *P. turnus* but ibid. 1863, p. 300, he says: *P. rutulus* is surely different from *P. urnus*,

yellow scales, or a spot more or less elongated to 3 mm. All specimens show on the same place on the underside of the wings a large yellow spot. Concerning IV. the marginal band of the upper wings is mostly 7 mm. of 2 spec. 9 mm. The second and third band near the costal margin are 5 to 7 mm. broad. The statement of Mr. Lucas that the bands and the margins are of deeper black, and the margins internally less sinuated in *P. rutulus* does not agree with the specimens of both species in my hands.

There are before me 28 *turnus* males, females and ab. *P. glaucus* from the most different localities of the U. St. (Me., Mass., N. Y., Md., La., Miss., Ky., Tex.), and one yellow female from Owaska, Kamschatka. They were chosen out of a very large number to represent all varieties in the collection. The size is very different, the smallest one from S. E. Kentucky has the size and characters of pl. 5 of 1 W. H. Edw., representing the arctic form. A female ab. *glaucus* from the same locality measures only 82 mm. The largest male and fem. from Dallas, Tex., measure 125 mm., also pretty near 5 inches, more than Mr. Edward's maximum. The length and form of the tail is very variable from 10 to 15 mm., decidedly spathulated or not at all. A male from Osage, Miss., has a tail only 10 mm. long, but the spathula 4 mm. broad. Comparing the differences quoted for *P. rutulus* with *P. turnus*, we find as follows:

I. The sub-marginal ray of yellow spots on the under side of the primaries of *P. turnus* consists commonly of a series of separated spots of semi-circular or semi-oval shape, the convex side internally. Sometimes these spots are connected and form a band more or less waved internally, as the female from Kamschatka. A male from Lutherville, Md., and one from Kentucky have a straight, sloping band, only the two last spots near the hind margin separated. A male from Norway, Me., the same band, only the last spot separated, just in the same manner as some *P. rutulus*. The yellow female from Lutherville, Md., has the ray as commonly in *P. turnus*.

II. The fulvous spot at the internal angle is never wanting; the females possess a very large round spot; the males have a very small spot 2 to 1 mm. long, fulvous or red (yellow and more linear in *P. rutulus*). I have males from Texas of *P. turnus* with a very small yellow spot, only interiorly with a few fulvous scales; but a male from Osage has linear yellow spot 3 mm. long, just as some *P. rutulus*.

III. The fulvous marks and the sagittate spots are wanting in two males from Osage, Miss., and from Massachusetts. Indeed, there is a faint indication of fulvous scales in the cell above the eyespot of the anal angle, but I find similar indications by some *P. rutulus*. A female from Osage, Miss., has the fulvous marks and spots as commonly.

IV. The black bands and margins show no palpable difference. Considering these statements, there exist no character belonging exclusively to one of these two species, except that the females possess always a very large fulvous spot on the internal angle of the secondaries in *P. turnus*, but never observed in *P. rutulus*; besides that of the first species, black aberrations of the female occur frequently in the Southern and Middle States.

The caterpillar of *P. rutulus* is not yet known. The differences of the chrysalis from those of *P. eurymedon* are given by Mr. H. Edwards. Dr. Behr, l. c., 1868, p. 300, says the caterpillar of *P. rutulus* lives on fruit trees.

There is, I believe, no doubt that *P. rutulus* has to be considered as a Western form of *P. turnus* as long as no other differences are known to exist. I am more in doubt or better not able now to give a decided opinion about *P. Daunus*, as the material in the museum is not sufficient. It consists of seven specimens in very poor condition. The interior tail is broken. There were two large males collected on the same place with *P. rutulus* and flying promiscuously, July 3, at Yakima City and one smaller, very poor, at Spokane Falls, July 22. The large predominant yellow field with narrow and widely-separated black lines is, indeed, very striking. In the collection are three rubbed specimens collected together with *P. rutulus* by Mr. Garman, between Great Salt Lake and Ft. Bridger, at 7000' about elevation. There were more than a dozen, but merely fragments, not worthy of being preserved. At the same time, July and August, and in the same place, Mr. Garman collected *P. eurymedon*. One *P. daunus* from Arizona is also before me. Of course, it is well-known that different species live together at the same place and time, but in examining nearer my specimens I am entirely at loss to find characters which can be considered to be good ones to separate *P. daunus* from *P. rutulus*. The internal tail of *P. rutulus* is never longer than in *P. turnus*; say 1 to 2 mm. About the tail of *P. daunus* I can say nothing, as it is wanting in all my specimens. All other differences consist in a larger or smaller development of the main color and the pattern without decisive influence. Entomologists with a larger and more satisfactory material at hand will have to give satisfactory characters to separate the two species. But I suppose this will be a difficult task, if not an impossible one. I do not know *P. pilumnus*.

I cannot speak with certainty about the relations of *P. eurymedon*, as I have only five specimens from the Gulf of Georgia in a somewhat tolerable condition before me. It may be only stated that two specimens collected by Mr. Garman, together with *P. rutulus* and *P. daunus* will be very difficult to separate from *P. eurymedon*, and have been, indeed, united with this species by experienced Lepidopterologists, who visited the museum. Both specimens are in very bad condition.

I possess the chrysalis of *P. turnus*, *rutulus*, *daunus*, but there is no possibility to ascertain differences of value after the comparison of one or two specimens.

A gap is also for those species that the appendages of the genitals are unknown. This gap can only be filled in a manner to allow scientific conclusions when the appendages of *P. turnus* are studied in many specimens, to begin with fresh or living ones. Only after the extreme limits of variation for one species are known, a scientific comparison with those of the other species will be possible and will give reliable results.

PARNASSIUS.

Mr. Stretch collected one female July 23, in Colville Valley, W. T., between Little Spokane and Loon Lake where granite first appears. A second specimen was seen. Exp. 65 mm. The whole body below, the front and the thorax above and the extreme base of the primaries were thickly covered with intensely yellow hairs. The veins of the wings on the under side were yellow, and also the membrane when the insect was fresh had a decidedly yellow tinge. Species known with yellow hairs are *P. Eversmanni* and its female (*P. thor*, as I am informed by Mr. H. Edwards) and *P. Nomion*, Fischer. A detailed comparison of the figures and descriptions of *P. Eversmanni* do not allow to bring the female to this species. *P. Nomion* is much larger, but, indeed, the marks and the pattern of the wings are very similar. I have no female var. *Smintheus* before me agreeing with the female from Washington Territory. The excellent figures of Mr. W. H. Edwards do not contain one exactly alike, pl. 2, f. 2, seems to be the nearest to it. Mr. W. H. Edwards speaks of partial covering of the body with dirty yellow hairs by *P. smintheus*, and as the pouch differs not notably from this species, it will be considered better as an exaggerated variety of *P. smintheus*.

Later, in W. Montana, August 7, I saw not far from the stage-coach, before New Chicago, some specimens flying, with the appearance of larger males of *P. smintheus*.

NOTES ON ORGYIA LEUCOSTIGMA.

BY N. COLEMAN, Berlin, Conn.

A few notes on the various changes observed during the growth of the larvæ of *Orgyia leucostigma*, Smith, may not be uninteresting to the readers of "PAPILIO."

My attention was first directed to these changes in the summer of 1877, by finding some larvæ differing in color from Harris' description of this species. Harris describes the larvæ as "of a bright yellow color, sparingly clothed with fine yellow hairs on the sides of the body, and having four short and thick brush-like



Hagen, Hermann August. 1882. "On *Papilio machaon*, L. and its North American representatives ; *Papilio rutulus*, Bvd.; and *Parnassius*. Being portion of a preliminary report on the butterflies of Washington territory." *Papilio* 2(9/10), 149–164.

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