

The Canadian Entomologist.

VOL. XXVII.

LONDON, APRIL, 1895.

No. 4.

VARIATION IN NEMEOPHILA PETROSA AT LAGGAN IN WESTERN ALBERTA.

BY THOMAS E. BEAN.

At 5,000 feet altitude, in the vicinity of Laggan, *Nemeophila petrosa* flies during July. This is one of our commoner moths, and appears to be the only bombycid of common occurrence in the district. Although occasionally found near timber line, it is rare at that elevation. Under natural conditions only one flight occurs in the season, and larvæ from eggs of that flight hibernate principally at an early stage. In the house, with a warmer night temperature, larvæ resultant from the July flight will go to imago late in October instead of hibernating. In the wild environment, a second flight is prevented by the low night temperature. *Petrosa* frequents moist banks, ditches, margins of old roads, and open ground well supplied with plants. A great majority of the individuals seen in flight are males, the disparity in relative number of males and females observed resulting from the quieter disposition of the females. The males are very restless and readily take flight, thereby attracting observation. The females, less demonstrative, fly but little and are seldom noticed. Males, the physiologists kindly inform us, are katabolic, and females anabolic; we may discover, unaided, that the terminology is diabolic. Results obtained by bringing to imago a large number of wild larvæ and pupæ indicate that the females of *Petrosa* somewhat outnumber the males. The larva is a general feeder, thriving on aster, strawberry, or grass, and extremely partial to the newly formed pupa of *Nemeophila petrosa*.

The plate which this notice is intended to explain and supplement has been prepared under the skillful supervision of Mr. H. H. Lyman. Selection of specimens for the purpose proved a difficult matter, on account of the necessary limitation to a single plate of twenty figures. Complete illumination of the subject would require at least five plates. Were such ample resources of illustration available, three of the plates would serve to present effectively the principal sequence of pattern

evolution, by displaying a progressive series of minute gradations of pattern; a fourth plate might be devoted to an accessory suite of specimens illustrating subordinate lines of variation; and on the final plate an interesting series of aberrant examples could be presented in an order suggestive of their systematic relationship. Five plates, so managed, would furnish a pictorial analysis of the pattern-building method of *Petrosa* more instructive than a laborious essay.

Limited to twenty figures, I found it advisable to select a set of examples suitable for a merely synthetic plate, indicating the leading results of the pattern development rather than its progressive details. The plate contains figures of eleven *Petrosa* males, and seven females. A somewhat fuller series of variations could have been shown by figuring only males. By selecting partly females, however, a distinct advantage was gained, as I have included four appropriate examples bred from one lot of eggs, and incidentally a direct proof is thereby supplied that the plate represents in its local specimens a single valid species. Numbers 1 to 9, inclusive, also 11 and 16, are males. Numbers 12, 13, 14, and 17 to 20, inclusive, are females. For comparison, two instances of *Nemophila plantaginis* are included, numbers 10 and 15. The former is a male, form *Hospita*, from northern Finland; the latter a female, from the Amour region in eastern Siberia.

My analysis of *Petrosa* is based on examination of 199 males and 160 females. The series is as complete as can be desired, comprising all specialties and stages of pattern caught or bred during seven collecting seasons. The entire material was first assorted in an order expressing the gradual modification of pattern, beginning with initial "*Scudderi*," and progressing to ultimate "*Petrosa*." In order to estimate in numerical terms the prevailing tendency or present attitude of the moth as to pattern, the extended column of variation has been sectioned into separate masses, thus distributing into convenient sections the pattern-distance between the two extremes of variation.

One hundred and seven flown males are first considered. Section 1 contains 14 of these specimens, which, as to upper surface at least, are formal *Scudderi*. Fig. 1 of the plate differs from the specimens of section 1 merely in having the light coloured spur (which extends from base of f. w. and is a rudiment of the longitudinal stripe of *Petrosa*) extended to greater length; in other respects it is *Scudderi*. Fig. 7 has this basal spur as in *Scudderi*.

Section 2 contains 16 intergrades very close to *Scudderi*. Some are like fig. 1 of the plate, some have the longitudinal stripe of f. w. prolonged nearly to a junction with the oblique bar, a few have slightly developed light markings on hind wing. In several examples the oblique bar on f. w. is largely produced, and on basal side projects a branch backward toward the systematic point of junction with the longitudinal stripe, although this stripe is only developed to the extent of a short basal spur. In section 3 are 20 intergrades near to *Scudderi*, but having usually a well defined light pattern on h. w., as in figures 3 and 7 of the plate. Section 4 comprises 7 very characteristic intergrades nearer to *Scudderi* than to *Petrosa*. Fig. 5 stands for this section, and is nearer than the rest of section 4 to the character shown in section 3. The other 6 specimens in section 4 appear to form a progression in pattern of h. w. away from fig. 5 in the direction of *Petrosa* (fig. 16). This progress, however, does not consist of sharply defined gradations like the h. w. pattern steps seen in figures 8 and 4, which figures so normally lead toward fig. 16. In the progression formed by these 7 specimens, the h. w. black area, extending in fig. 5 from the central white band to the base of the wing, becomes in the other specimens increasingly indefinite and finally nebulous, as if the black were eliminated atom by atom without any definite pattern evolution. In the 7th term of this progression, the h. w. is practically like that of fig. 2, except that the basal part of the wing, in addition to the two black streaks seen in fig. 2, has also a slight haze of black scales. This 7th term, however, is not as to f. w. a typical *Petrosa*, for the longitudinal stripe is extremely tenuous at its end next the oblique bar. In the other 5 specimens the longitudinal stripe is scarcely more developed than in fig. 5 of the plate. Section 5 has 10 intergrades, very uniform, decidedly nearer to *Petrosa* than to *Scudderi*. They come between fig. 11 and fig. 8, but nearer the latter. Section 6 is formal *Petrosa*, consisting of 41 specimens. Figures 2, 6 and 16 exemplify this section, fig. 16 being the dominant local form. In section 6 variation is subordinate to a general equality or maturity of pattern.

Sections 1, 2 and 3 are not in the slightest degree distinct in a systematic sense. Together they number 50 individuals, constituting the form *Scudderi* with its inseparable variations. Section 4 agrees in system with the previous section, but between the two masses there is an appearance of discontinuity. In case fig. 5 and another specimen were

lacking, a rather broad gap between sections 4 and 3 would result. Even in that case, the systematic unity of pattern would remain evident. Section 5 accords entirely in system with section 6, yet it happens that actual intergrades between them are extremely scarce, so that these two bodies of variation are also nearly isolated from each other. The only intermediates between sections 5 and 6 are figures 8 and 4 and a single additional specimen; all three are bred specimens—"missing links" are not always so easily obtained.

Sections 5 and 4 are not visibly harmonic. Between them exists a break of continuity by lack of intergrades, and this break resembles a systematic partition, from the fact that the methods of pattern growth in the two series appear discordant. Although the section 5 pattern is more like formal *Petrosa* than is the pattern of section 4, yet a higher stage of the method of section 4 reaches practically the *Petrosa* pattern without in transit assuming the section 5 pattern, or so it seems. It is a fact that section 5 shows more plainly its alliance with sections 2 and 3 than with section 4, while section 4 more clearly manifests its alliance with section 6 than with section 5. Yet sections 4 and 5 undoubtedly belong in the relative positions mentioned. Study of the males alone does not relieve this apparent discord. The males matured indoor from estray pupæ, or from larvæ found wild and fed up, have not supplied any examples reconciling this lack of harmony. I have bred two considerable families from eggs, but it has singularly occurred in each instance that all the resulting males belong on the "*Petrosa*" side of this gap. Figs. 11 and 16 were from one lot of eggs, and although they are a good distance apart as to pattern advancement, yet they are plainly identical in method, fig. 11 being intergraded with fig. 16 by figs. 8 and 4, as also by section 5 and by some other specimens. Study of the females supplies convincing evidence that this apparent lack of harmony at one point in the series of flown males is not due to a systematic partition. In the series of females no corresponding discord is found. Also, we have in figures 12 and 17 direct evidence uniting the extremes of the general series. These two females were bred from the same lot of eggs which produced figs. 11 and 16. Fig. 12 is almost normal *Petrosa*. Fig. 17 may safely be considered a very moderate divergence from formal *Scudderi*. These two females efficiently unite the extreme terms of the series. The lack of unity between sections 4 and 5 is due mainly to the fact that there is a meagerness of representation at that part of the series of males. The

principal masses of individuals occur near the extremes of the pattern-distance, and the intermediate position is in comparison thinly occupied. A divisive attitude is manifested.

Additional to the flown males, my series contains 74 males matured in the house from estray pupæ or wild larvæ. Of these, 13 are *Scudderi*; 11 are intergrades very near *Scudderi*; 15 are somewhat more divergent, yet pretty near to *Scudderi*. One is a stage agreeing with section 4 of the flown males; 6 are nearer to *Petrosa* than to *Scudderi*, and intergrade closely with fig. 11 of the plate and with section 5 of the caught males, 5 of them being intermediate between fig. 11 and section 5, and the other 1 between section 5 and fig. 8 of the plate. Twenty-eight are formal *Petrosa*. These 74, then, distribute as to pattern development in about the same numerical proportions as the caught males, and with a similarly feeble representation at the centre of the pattern-progress as compared with the extremes.

The caught females are but 25, all told. Of females matured in the house from wild larvæ and estray pupæ, there are 111. Total number of females, not including those bred from the egg, 136. Of these, 16 are *Scudderi*, 20 are intergrades very near *Scudderi*, 26 are more divergent, yet all pretty near to *Scudderi*; 9 are of composite pattern, combining in the same individual a considerable degree of *Petrosa* character, as to some parts of the pattern, with a predominant *Scudderi* tendency in other pattern elements; 9 are well-balanced intermediates between *Petrosa* and *Scudderi*; 18 are gradations near to *Petrosa*; 38 are formal *Petrosa*.

The females display a pattern sequence more even and harmonic than that of the males, with less tendency to break into divisions by lack of intergrades, and more fully sustained in the central part of the chain of variation. At the same time, the females vary as extensively as the males, and they exhibit at least an equal amount of aberration and as great a degree of inequality or oscillation in the progress of the several pattern constituents.

All through the range of variation, in both sexes, it is conspicuously evident that *Petrosa* is exceedingly unstable in regard to the relative development of the various elements of pattern. This is sufficiently illustrated in figures 3 and 5, also by figs. 9 and 11. The oblique bar of primary is the only element which approaches fixedness. The f. w. cell-

spot may be very small or very large, and may be isolated, joined to the oblique bar, or connected with the longitudinal stripe. The longitudinal stripe of f. w. is peculiarly vacillating. Sometimes it shows large development in an otherwise very dark wing, as seen in figs. 3 and 9; on the contrary, in some patterns it is but a mere basal spur, although the other light elements are highly conspicuous, as in fig. 5.

In the summer of 1888 three families were bred from eggs.

Progeny in family A. :

Males.—5 formal *Petrosa*; fig. 16 of the plate is one of them. One intergrade, somewhat nearer to *Petrosa* than to *Scudderi* in the method of its pattern, but at least as near to *Scudderi* as to *Petrosa* in degree of development of pattern; this is fig. 11 of the plate.

Females.—3 nearly formal *Petrosa*; fig. 12 is one. Ten intergrades, all nearer to *Scudderi* than to *Petrosa*, of which the one nearest to *Scudderi* is fig. 17 of plate.

Progeny in family B. :

Males.—One, formal *Petrosa*. Two, near *Petrosa*. Six, a little nearer to *Petrosa* than to *Scudderi*, and all much alike.

Females.—One, nearly formal *Petrosa*. Seven, a little nearer to *Scudderi* than to *Petrosa*, and all much alike. Three, nearly *Scudderi*.

Family C.—Eggs from a female of extreme *Petrosa* characters. Resulting progeny, 3 composite males, *Scudderi* as to hind wing, but with f. w. approximating *Petrosa* nearly in equal degree to the f. w. of fig. 11. Two of them are precisely the form "*Geometrica*," as figured in Plate 2, Proc. Ent. Soc., Phil., Vol. 4, 1865. The third specimen differs by having a single small white dot on each hind wing.

A question has been raised whether *Nemeophila plantaginis* occurs in North America. At Laggan, *Plantaginis* is not found. The local *Petrosa*, throughout its immense range of variation, is at no point of its pattern-sequence coincident with *Plantaginis*. Of the latter I have compared a small but broadly geographical series. The typical *Plantaginis* from Saxony is a larger form than our moth of the Bow Valley, and is besides a far more gorgeous affair, with hind wing black and red in the ♀, black and saffron in the ♂. The type form from polar Norway is smaller, but retains nearly the same pattern, and in my examples the colours are but little toned down. From northern Finland I have a pair,

representing still the typical form, but with the brilliancy of the colours greatly reduced; these are smaller than most local *Petrosa*, and the ♀ is not more brightly coloured, but the ♂ has the tawny yellow ground of hind wing, never found here in male *Petrosa*. From Saxony, from polar Norway, and from northern Finland, I have the male form *Hospita*, in which the saffron or tawny yellow ground of h. w. is replaced by white; this form approaches the local ♂ *Petrosa* by a practical concord of colours. Fig. 10 of the plate represents *Hospita* male from northern Finland. *Hospita* is the nearest phase of *Plantaginis* to the Bow Valley *Petrosa* male. Fig. 15 represents my only Asian instance of *Plantaginis*, a ♀ from eastern Siberia, an example nearer of kin to the Laggan *Petrosa* ♀ than any other *Plantaginis* I have seen. One local female corresponds so closely to this Amour *Plantaginis* that they are separable by a single character only. This final point of distinction is the apical element of the light pattern of primary, the light coloured marking near apex of f. w., exterior to the oblique bar. The apical element seems to be persistent in *Plantaginis*, but in the local *Petrosa* it is only occasionally seen, and even when present is in most cases rudimentary in degree. Fig. 14 illustrates an extreme development of *Petrosa*, in which the apical inscription is blended with the oblique bar. Even in extreme stages of the *Petrosa* pattern the apical element is usually absent. It appears sometimes in intergrades very near to "*Scuderi*." Occurrence or lack of this character, and the degree of its development when present, appear not to be correlated to the degree of advancement of the general pattern. The extensive material before me strongly supports the view that *Petrosa* and *Plantaginis* are distinct species.

Aside from the two *Plantaginis* figures, the plate represents a single species. This conclusion is derived from examination of the caught series, and independently proved in the families bred from eggs.

NOTE.—As the Entomological Society of Ontario supplied the plate, Mr. Bean generously presented the specimens from which it was made to the Society's collection.

H. H. L.