The Androconial Scales in the genus *Pieris*

2. The Nearctic species of the *Napi* — Group

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So much interest has been shown in my previous paper on this subject (Entomol. Tidskr. 82: 121—148; 1961), and I have received so many offers of material to continue the work, that I was glad to accept the kind suggestion of my friend Mr. Cyril dos Passos to supply me with a complete set of the races of the *napi*-group known to occur in the Nearctic Region. Lack of material, as well as the difficulties of identification, had prevented me making more than a passing reference to these races before (*loc. cit.*), so the value of such specimens, identified by an expert in systematics who had devoted considerable study to this group, was obvious. The results obtained were fully as important as I expected, for examination of the material disclosed the existence of six distinct species, the outcome of at least three separate lines of evolution; in addition many characteristics of scale-development previously recorded were confirmed and emphasized.

The three lines of evolutionary development spring from the Palaearctic species *bryoniae, napi* and *narina.*

P. bryoniae is represented by three subspecies located in the most northern areas of the region. The subsp. *hulda* (fig. 1), and subsp. *pseudobryoniae* (figs. 2, 3), are monogenerational; the scales of the latter resemble those of typical *bryoniae* most nearly. The subsp. *frigida* produces a 2nd. generation, known as the seasonal form *acadica*; it seems rare and is the only form I have not seen. There remains little doubt however, that the scale of the 2nd. generation will resemble fig. 4. The latter is from a monogenerational specimen, taken at Fort Smith, N. W. T., at 60°N. The 1st. generation scale is seen in fig. 6, from N.E. Belle Isle, Newfoundland, about 52°N. The difference of development between the scales of the 1st. and second generations in all species (previously described *loc. cit.* p. 128), is very marked in this race, the much broader, more primitive formation of the distal half of the scale of the 1st. generation being very obvious. I have demonstrated (*loc. cit.* p. 45), that the monogenerational subsp. *bryoniae* of the Alps is the equivalent of the 2nd. generation insect of lower levels and has retained the same type of scale. It may be thought in view of the early date of emergence of the Fort Smith specimens, that there might be a 2nd. generation in that locality. But in spite of the degree of heat known in summer in that area, if a 2nd. generation was produced it would not be possible for the resulting larvae to attain the pupal stage before the advent of winter in that northern latitude, so the

species is compelled to establish a singlegeneration habit if it is to survive. In all such cases the monogenerational scale assumes the type of the normal 2nd. generation one. I may here add that my previous idea that this was not the case in *P. napi,* is probably a mistake, accounted for by the fact that in the Alps at any rate, the species scarcely attains an altitude of 4000 feet, and that at this level it can still retain the bigenerational habit.

In each of the three Nearctic subspecies of *P. bryoniae* one finds the characteristic, pear-shaped, primitive scale of the species, as seen in figs. 3 and 5.

P. napi. This species is represented by a single race, the subsp. *marginalis.* This western race is however, of great interest. The scale of the 1st. generation (fig. 10), is strikingly similar to that of the northern Palaearctic races of the species, *kamtschadalis* and *adalwinda*; while the scale of the 2nd. generation (fig. 11), is very close to that of the southern *napi* races (see *loc. cit.* pl. 1, figs. 5, 6, 13). I have previously proved that these two types of scale are racial in *P. napi,* and that the advanced one could in certain conditions revert to the more primitive one. But the subsp. *marginalis* gives us the first

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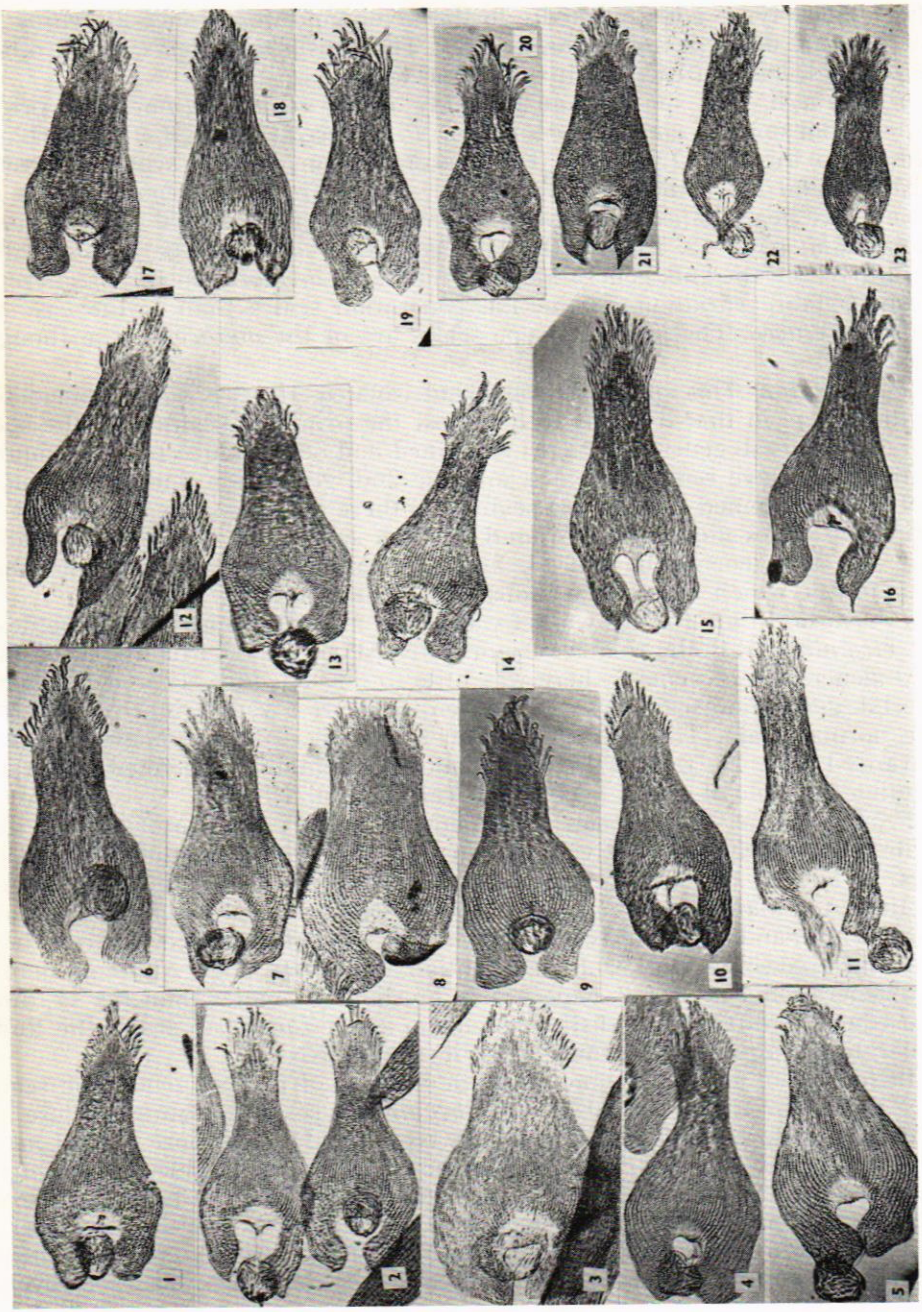
Explanation of Plate

Androconial scales of the Nearctic species of the *napi*-group of the Genus *Pieris*

1. *P. bryoniae hulda,* Skagway, Alaska. May 1925. Single generation.
2. *P. bryoniae pseudobryoniae,* mile 102, Steese Highway, Alaska, 2500 feet, June 23, 1955. Single generation.
3. *P. bryoniae pseudobryoniae,* Mackenzie delta, N. W. T., June 1955, about 68° N. L., primitive type. Single generation.
4. *P. bryoniae frigida,* Fort Smith, N. W. T., about 60° N. L., May 27, 1955. Probably single generation. (2nd. gen. type scale).
5. *P. bryoniae frigida,* primitive type; data as No: 4.
6. *P. bryoniae frigida,* N.E. Belle Isle, Newfoundland, July 6, 1939, 1st. generation.
7. *P. oleracea,* Grande La Cloche Island. N.W. Georgian Bay, Ontario; May 15; 1st. generation.
8. *P. oleracea,* primitive type scale; data as No: 7.
9. *P. oleracea,* seasonal form *cruciferarum,* (2nd. gen.), July 17, 1936.
10. *P. napi marginalis,* March 26, 1926, Oregon. 1st. generation.
11. *P. napi marginalis,* seasonal form *pallida,* July 17, 1937, Lake St. Clair, Washington. (2nd. gen.).
12. *P. oleracea macdunnoughii,* Alamosa, Colorado, June; 1st. generation.
13. *P. oleracea macdunnoughii,* Rocky Mt. National Park, Colorado. (? generation, 1st. or possibly single).
14. *P. oleracea macdunnoughii,* seasonal form *pallidissima* (2nd. gen.); Salt Lake City, Utah, July 26. 1931.
15. *P. mogollon,* White Mountains, Arizona. June 9, 1934. 1st. generation.
16. *P. mogollon,* (2nd. generation), July. Arizona.
17. *P. venosa,* Santa Cruz, California. April 3, 1929. 1st. generation.
18. *P. venosa,* Santa Cruz, California, March 11. 1st. generation.
19. *P. venosa,* seasonal form *castoria,* Plumas Co., California, June 6. (2nd. generation).
20. *P. venosa,* Lake Louise, Alberta, 6000 feet, July 14, 1939. Single generation. (2nd. generation type scale).
21. *P. virginiensis,* Grande La Cloche Island, N.W. Georgian Bay, Ontario; May 17. Single generation.
22. *P. virginiensis,* bred *ab ovo*; Catskill Mountains, New York. (Specimen slightly undersized, scale reduced in proportion. Single generation.
23. *P. virginiensis,* data as No. 22.

Magnification of photographs 450 times natural size; reduced on plate to about 300.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example of both types occurring in one race. The seasonal segregation of these racial types adds markedly to the taxonomic importance attaching to all seasonal dimorphism in these scales. The subsp. *marginalis,* as all other *napi* races, has lost the primitive type scales.

P. oleracea. This species, and probably all the remaining ones, has originated from some *P. narina*-like ancestor. *P. oleracea* (figs. 7, 8, 9), is perhaps closest to the anecstral type. The seasonal forms of the scales are very distinct, and the primitive type (fig. 8) differs from the *bryoniae* type in being less pear-shaped, and rather more rectangular. In the subsp. *macrunnoughii* (figs. 12, 13, 14), the 1st. generation scales are perhaps equally primitive, but the 2nd. generation ones incline to be more advanced. There is perhaps more variation on the 1st. generation scales than is the case in subsp. *oleracea.* The primitive type scales are of the *oleracea* form, though narrower.

P. mogollon. This species is somewhat isolated. It bears some connection with *P. napi* in that it seems to have lost the primitive scales; but the specimen of the 1st. generation that I examined had been stained by some liquid which may have removed scales, and the 2nd. generation one also, though not stained, seemed to have lost scaling, so there remains some little doubt if primitive scales might not be found in fresh specimens. The normal scales (fig. 15, 1st. generation, and 16, 2nd. generation), have evolved on some unique line which has left no indication of their ancestry.

P. venosa. In my former work I was led to unite this species and the next (*P. virginiensis*). Both are in a very primitive stage, and as I had not seen the 2nd. generation of *venosa,* there was little to rely on. Figs. 17 and 18, show the 1st. generation scales; as can be seen these are a very primitive type for the normal scale. The 2nd. generation scale (fig. 19), is somewhat more advanced. Fig. 20, from a high-level monogenerational specimen, gives us another example of a 2nd. generation scale in such a race.

P. virginiensis. This species is perhaps the most primitive of all, for the scales are entirely of primitive formation. Fig. 21, shows a normalsized scale, figs. 22 and 23, are from a bred, undersized specimen, and the scales react in the same manner as one sees in undersized *Pieris* specimens in general. Both *venosa* and *virginiensis* have very small scent cells, which suggests they both suffered some check in their evolution at an early stage. Although many 1st. generation scales of *P. venosa* may be slightly smaller than fig. 17, and consequently difficult to distinguish from the *virginiensis* scale, the 2nd. generation scales of the former are quite distinctive.

In conclusion it may be noted that the likeness of the 1st. generation scale of *P. napi marginalis,* fig. 10, to some *bryoniae* types is not quite as close as it may seem to be. The 2nd. generation type, fig. 11, is a more typical *napi* type, but fig. 10, is actually identical to the 2nd. generation scale of *napi adalwinda* (see *Entomol. Tidskr.* 1961, pl. 1, fig. 4). Also it must be remembered that *P. napi marginalis* and *P. mogollon* are (so far as my material goes), the only North American races in which the primitive *bryoniae* or *narina* scales are wanting. Every known *bryoniae* race has these scales in every generation.