

THE LIFE HISTORY OF THE BLACK MOUNTAIN RINGLET BUTTERFLY PERCNODAIMON PLUTO FEREDAY

G. W. GIBBS,
Victoria University of Wellington.

In spite of its abundance in the South Island alpine regions, the immature stages of **Percnodaimon pluto** Fereday have remained undescribed since Fereday named the butterfly in 1872. Hudson (1928) had presumably looked for larvae and from his observations that the butterflies frequented shingle slopes and were seldom seen settling on grasses and tussocks, he "fully anticipated" that the food-plant would be **Poa colensoi**, a low, tufted grass that grows on shingle screes.

This paper records some notes on the behaviour of adults and larvae, details of the life cycle and descriptions of the egg, larva and pupa. Most of the observations were made at Cupola Basin in the Nelson Lakes National Park where **P. pluto** is abundant on sunny scree slopes between 4,500 ft. and 6,000 ft. from December to February.

Oviposition: The flight of **P. pluto** is normally close to the ground and confined entirely to rocky areas. Moreover, as noted by Hudson (1928), the adults rarely alight on vegetation, preferring stones warmed by the sun. It is not surprising, therefore, that oviposition occurs on rock surfaces. The eggs are deposited singly on the lower surface of stones or in crevices. In these sites, the eggs could be warmed to a higher temperature than if on vegetation, thus making the most of relatively brief periods of sunshine in the mountains.

Eclosion: The larva eats around the crown of the egg and pushes it up to escape. The chorion is normally eaten after eclosion.

Larval habits: As Hudson (1928) had predicted, the small grass, **Poa colensoi** is a food-plant of this butterfly. This grass is common in many mountain habitats, but **P. pluto** larvae are found only where the tufts of **P. colensoi** are adjacent to rocky areas or growing as isolated clumps amongst the shingle of a stable scree slope. Larvae were never observed on their food-plant during times of warm sunshine while butterflies were on the wing. On the other hand, they were seen in cold, misty weather or especially at night, when they climb high on the grass leaves to feed off the terminal portion of the leaf. If disturbed, the larvae release their grip and fall. Their movements are extremely slow and it is my impression that they spend far more time amongst loose shingle or in the base of the grass tufts, than they do actively feeding.

Pupation: Occurs on the underside of loose stones. Pupal exuviae have been found up to three feet from the nearest food-plant.

The larvae becomes suspended by its anal prolegs from a silken network, closely adhering to the rock surface. The pupa itself, however, is not suspended in the conventional butterfly manner, but comes to lie parallel to the rock surface as shown in Fig. 1. It is rigidly held in this position by a massive cremaster, firmly embedded in the silk.

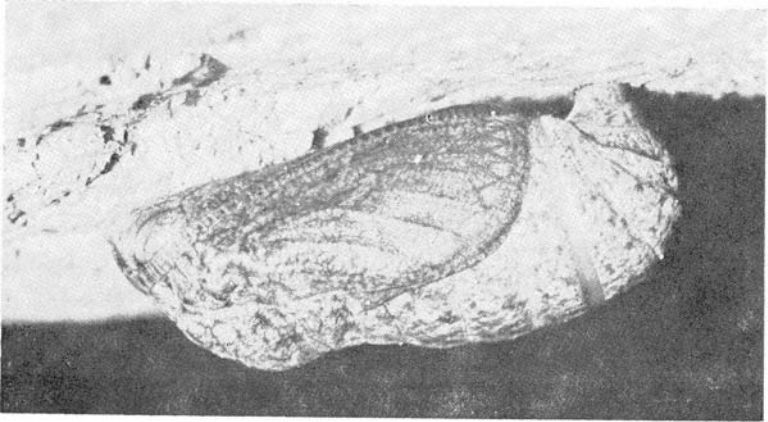


Fig. 1: Pupa of **Percnodaimon pluto** showing characteristic suspension on the under surface of a rock.

THE LIFE CYCLE

Eggs are deposited during the summer months. I have no record of incubation times in their mountain habitat, but at sealevel summer temperatures (approx. 20°C) 12 days elapsed before eclosion. This time could be considerably extended at 5,000 ft.

The duration of the larval stage was determined from two sets of field collections taken in early December and again in midJanuary, together with observations made in the laboratory. Measurements of the width of 80 head capsules from wild and partially reared larvae indicated five distinct larval instars (Fig. 2). The duration of the first, third and fourth instars was found to be about one month at laboratory temperatures:-

First instar	24, 30, 35 days
second instar	not completed
third instar	28, 36 days
fourth instar	36 days
fifth instar	not completed

These times indicate that in a mountain climate, where the growing season is limited to about four months, the larval life must occupy more than one year. When larvae were collected at Cupola Basin in early December, second, third and fourth instars

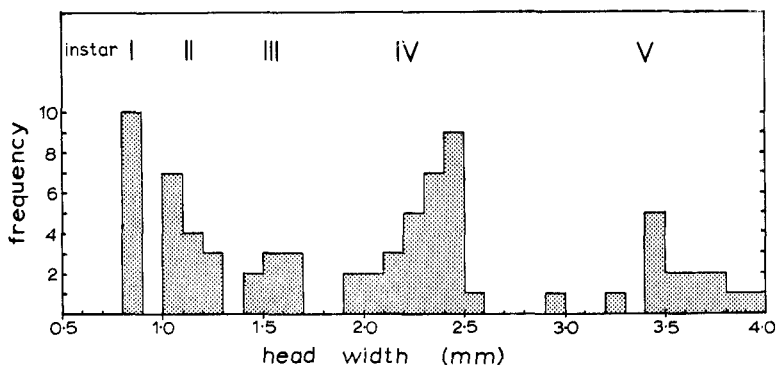


Fig. 2: The distribution of width measurements of 80 head capsules of *Percnodaimon pluto* larvae.

were present. One month later, all instars except the first (and these may have easily been overlooked) were found. At Temple Basin, Arthur's Pass, a collection in early December revealed all instars except the third. The December samples were taken from the margin of winter snow and are presumed to represent overwintered stages. These field samples suggest, firstly that *P. pluto* larvae can pass the winter in any instar, and secondly that the life cycle is at least two years and may often be three years.

Duration of the pupal instar is unknown, but is probably relatively short (i.e. 2-3 weeks). From the evidence available, it appears likely that fifth instar larvae reach maturity in the late summer and overwinter to pupate early the following summer. A short pupal stadium could thus account for the appearance of butterflies in early December, soon after the snow has melted.

DESCRIPTIONS OF IMMATURE STAGES

Egg: (Fig. 3A). Barrel-shaped; 1.18mm high x 1.12mm diameter at widest point; sides with about 32 longitudinal ridges, the surface between the ridges and the ridges themselves sculptured with very fine transverse lines; crown slightly recessed with a low central dome, sculptured in a fine reticulate pattern. Colour uniform pale blue when laid; becomes irregularly mottled with brown after two days, resulting in a highly cryptic pattern against grey-wacke rock; mottled pattern is lost two days prior to hatching and dark brown larval head capsule becomes clearly visible in the upper third of the egg.

Larva I: (Fig. 3B). Length 3-4.5mm; width to length ratio about 1:5.5; almost parallel sided, tapering very slightly to posterior from mid-length. Head capsule rounded, maximum width 0.80-0.85 mm, surface closely punctured, punctures dark brown, areas be-

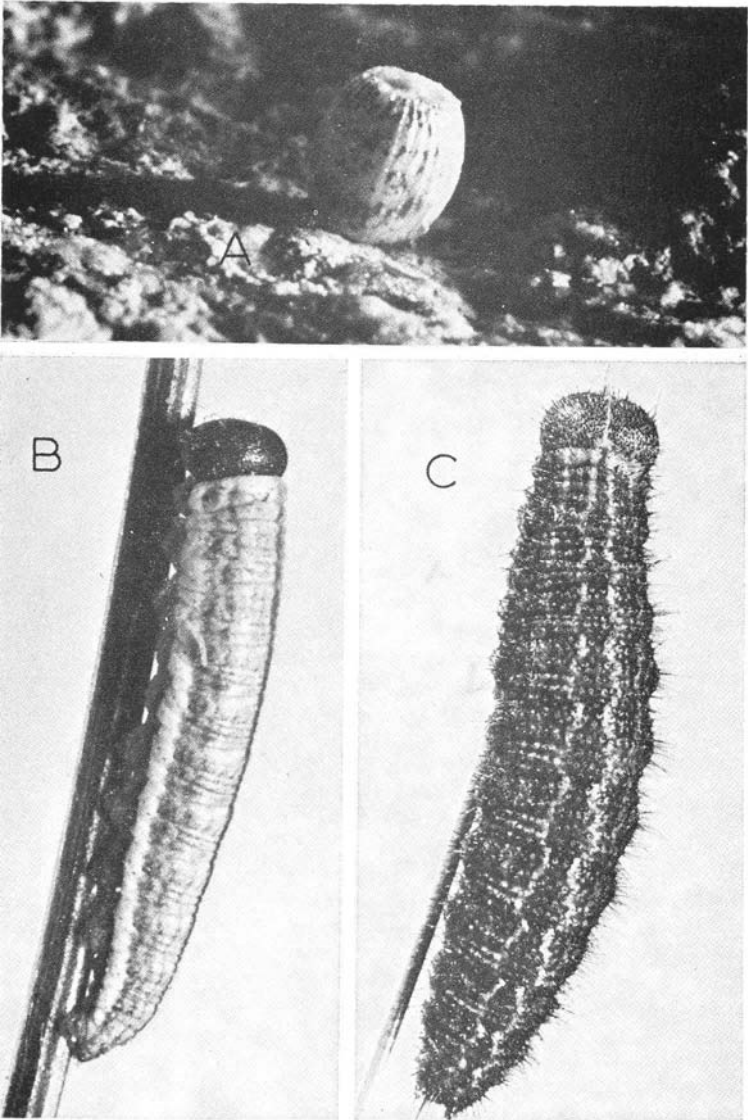


Fig. 3: Immature stages of *Percnodaimon pluto*. A: Egg at 4 days. B: First instar larva. C: Fifth instar larva.

tween paler, but punctures so closely spaced that overall appearance is dark brown; setae short, inconspicuous. Trunk roughly circular in section with a slight lateral ridge; segmental furrows

apparent but somewhat confused by the presence of 3 or 4 transverse grooves towards posterior of each abdominal segment; terminal segment rounded posteriorly without projections. Trunk setae very short, each arising from minute brown sclerotised ring. Spiracle circular, dark brown. Colour of trunk pale bluish-grey with pale brown stripes; a broad mid-dorsal line margined with white, a narrow, broken subdorsal line and a more distinct supra-spiracular line; a broad greyish-white lateral line margined with brown, the dorsal margin containing the spiracles; under surface and abdominal legs greyish. Proleg crochets of uniform length, in a single band.

Larva II: Length 4-7mm; head capsule width 1.02-1.29mm. Differs from first instar as follows: punctures on head capsule more widely spaced so that general colour is ochreous; two small postero-lateral 'tails' present on terminal trunk segment; trunk setae have slightly clubbed tips; trunk colour varies from pale straw to greenish-grey with mid-brown stripes.

Larva III: Length 7-11mm; head capsule width 1.46-1.68mm.

Larva IV: Length 11-17mm; head capsule width 1.95-2.55mm.

Larva V: (Fig. 3C). Length 17-25mm; width to length ratio approximately 1:4.5; maximum width at about mid-length, tapering slightly towards the head, more markedly towards posterior. Head capsule rounded, maximum width 2.95-3.90mm; dorsal and lateral surface of epicrania above eyes with a uniform pattern of roughly circular punctures, the punctures black, areas between brownish-grey, giving an overall appearance of dark brownish-grey; frontal and genal areas free of black punctures; whole head densely clothed with black setae, 0.5-0.7mm long, arising from areas between punctures. Trunk circular in section in thoracic region, becoming more semi-circular with development of lateral ridges towards posterior; segmental divisions marked by transverse furrows; 3 or 4 minor transverse furrows on each segment; terminal segment with a pair of very short 'tails' above the anus. Setae of trunk less dense than on head; 0.2-1.0mm long, tapering only slightly and with flattened tips, black fading to grey at tip. Spiracles circular, dark brown. General colour varies from bluish-grey through shades of brown to ochreous; a prominent dorsal stripe, broad at the mid-point of each segment, narrower in inter-segmental regions, dark brown or greyish-brown, flanked with ochreous; subdorsal area irregularly blotched with dark brown, darker colour most prominent at level of spiracles; lateral line ochreous or grey; under surface greenish-grey. Proleg crochets of uniform length, in a single band.

Pupa: (Fig 1). Length 16mm; width to length ratio approximately 1:2.6. Roughly circular in section with a very slight 'waist' behind the thorax. The most characteristic feature is its suspension from a very massive cremaster in such a way that the pupa hangs almost horizontal, adjacent to the rock surface, and not vertically down-

wards. Head approximately half width of thorax; squarish with a blunt frontal angle; thorax domed above, without median keel; abdomen sharply recurved ventrally so that segments 6-8 overlap along ventral mid-line, cremaster oval, 0.37mm wide, densely covered with short hooklets. Colour bluish-grey, with irregular brownish markings that tone perfectly with substrate.

DISCUSSION

The eggs and larvae of *P. pluto* are similar to those of many Satyrine butterflies... Within New Zealand, however, where there are only four species of these butterflies, the larvae of *P. pluto* differ markedly from the better known species—*Argyrophenax antipodum* Dbld. and *Dodonidia helmsi* Fered. which have very elongate, bright green larvae with distinctly bifid head capsules. Larvae of *P. pluto* resemble those of *Erebiola butleri* Fered. in general form but may be readily distinguished by the features given here and particularly by their habitat, since *E. butleri* occurs on snow tussocks (unpublished data).

Larvae of *P. pluto* have probably avoided the attention of entomologists by their nocturnal feeding habits. It is possible they also avoid certain predators by this means since their feeding position at the tip of a narrow blade of grass would render them very conspicuous during the day when avian predators are active. In daylight, the colouration of the larvae would provide maximum protection amongst stones or within the layers of dead leaves beneath tufts of *Poa colensoi*.

Pupal suspension varies greatly amongst the Satyrine butterflies. Some are suspended vertically by the cremaster, others remain loosely amongst leaves on the ground while some are subterranean. The remarkable horizontal position of suspension adopted by *P. pluto* may be related to its rocky habitat, since on the undersurface of a thin piece of rock a pupa can remain protected yet still receive the benefit of solar heating. Of eleven pupae, or pupal exuviae, found in this study, all were in a position consistent with this view. Possible heating benefits to the egg, which is also placed on rock surfaces, have already been mentioned. Oviposition on rocks has been noted by Warren (1936) and Mani (1962) for several high altitude butterflies.

The two or three year life cycle of *P. pluto* contrasts with the more lowland species of New Zealand Satyrine butterflies, *A. antipodum* and *D. helmsi*, which complete development within one year. The longer cycle is no doubt an adaptation to the high altitude environment and is paralleled by alpine grasshoppers (Bachelier, 1967). Mani (1968) points out that it is advantageous for an alpine insect to be able to enter a dormant phase in almost any developmental stage in order to withstand sudden snowfalls or frosts. *P. pluto* larvae appear to have this ability.

Warren (1936) refers to a European species of **Erebia** Dalm. that must almost be an ecological homologue of **P. pluto**. This species differs from typical members of its extensive genus by having both surfaces of its wings coal-black, by its lack of sexual dimorphism, by being confined to the rocky slopes at high altitudes and by depositing its eggs on stones instead of grasses. All these features are shared by **P. pluto**. It is a strange coincidence that the European "homologue" should be known as **Erebia pluto** (de Prun).

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