The Leaf-mining Insects of New Zealand: Part 4—Charixena iridoxa *Meyr.*, Apatetris melanombra *Meyr.*, Philocryptica polypodii *Watt (Lepidoptera).*

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[*Read before the Wanganui Philosophical Society, 28th October, 1921; received by the Editor, 31st December, 1922; issued separately, 8th July, 1924.*]

Plates 25–31.

(24.) Charixena iridoxa Meyr. (The Astelia-moth). (Plates 25, 26, and Plate 31, figs. 1–3.)

Philpottia iridoxa Meyr., *Trans. N.Z. Inst.*, vol. 48, p. 417, 1916.
Genus *Charixena* Meyr., *Trans. N.Z. Inst.*, vol. 53, p. 335, 1921.

This, one of the most beautiful and striking of the endemic moths, has an extremely interesting life-history, and amongst leaf-mining insects its mine is the largest, the most conspicuous, and most interesting of all. Owing to its being subalpine I have had no opportunity for a continuous study of its habits, the present paper being the result of some five or six short visits to Mounts Egmont and Ruapehu, spread over the same number of years. Although the following notes are therefore far from complete, their publication may be a useful guide to any one wishing to study this moth in its native habitat. Although the mine and the larval and pupal forms were long known, it was not until recently that the imago was successfully reared and the identity of the insect established.

The curious large zigzag tracks on the leaves of the *Astelia* first attracted my attention in 1914, but it was not till Christmas, 1918, that I was able to give them further attention in the same locality, Mount Egmont. The zigzag markings on the leaves widened as they descended, and eventually disappeared into the heart of the plant; and on digging up a plant and separating the leaves around the bulb a white spindle-shaped dipterous-like larva was discovered. A number of larvae were found, but, my holiday coming to an end, my observations had to be left at this stage. Again in February, 1920, I succeeded in finding several of the curious cocoons containing pupae, which I later took home to Wanganui, and managed to keep them alive for several months, until I tried forcing them by means of gentle artificial warmth, when all dried up and died.

In January, 1922, on Mount Ruapehu, some thirty or forty plants containing the immature stages of the insect were secured, taken to Wanganui, and replanted. Having to go to Dunedin in March, I dug up some of the plants and took them with me, carefully potting them. In June I returned to Wanganui on a short visit, and before leaving Dunedin handed the plants to the care of Mr. C. E. Clarke, and took several more plants down when I returned. The plants all stood this repeated digging up and replanting. One day in early August, considering it time to place a cover

over the plants, I opened one of the cocoons, and what I found made me hastily open the rest: the worst had happened—all had recently emerged and flown. Less than an hour later I visited Mr. Clarke, and on our inspecting the plants I had given him, there, resting on one of the leaves just above its cocoon, was a splendid specimen of *C. iridoxa*. The other three in Mr. Clarke's care emerged during the next few days. What was considered to be a rare moth proves to be plentiful and widespread, its emergence in the very early spring being the secret of its supposed scarcity, since almost all alpine collecting in New Zealand has been done in mid-summer.

The Imago.

A most beautiful moth, metallic purple-bronze with pale lemon-yellow markings.

Meyrick's Original Description.—See *Trans. N.Z. Inst.*, vol. 48, p. 417, 1916.

Distribution.

First taken on Mount Burns, Hunter Mountains, 3,250 ft., on 29th December, 1914, by Mr. Philpott. I think the imago was not again seen till Mr. Clarke and myself reared it as noted above. The moth is, however, a common one, its mines being very numerous on Mounts Egmont and Ruapehu; Mr. Clarke has found them plentiful on many of the mountains of Otago; Mr. Philpott records them as common on the Mount Arthur track at 4,000 ft.; and Mr. Fenwick has sent me specimens and records them numerous on the Milford track.

Food-plant.

Astelia montana (alpine bush-flax).

The Ovum and Egg-laying.

Nothing known.

The Larva. (Plate 26, fig. 1.)

A full-grown larva is 21 mm. or more in length, cylindrical, spindle-shaped, its greatest diameter about 3 mm. at the third abdominal segment, thence much attenuated towards either end. To the naked eye it is apparently without legs, these being very small, and it is very sluggish in its movements when exposed. The segments are shallowly incised, excepting the seventh and eighth abdominals. Spiracles small, brown, circular. Head small, flattened, light brown. General body-colour transparent shiny white. Tubercles and setae minute and very inconspicuous. Owing to the want of material of known age, no setal charts and head-structure are given at present. The larva throughout its whole life mines within the bulb of the plant below the ground-surface. The duration of the larval existence, the number of moults and their respective periods, are unknown, though from the length of the mines and age of the leaves containing them one may conclude that the larval stage occupies two, if not more, seasons.

The Mine. (Plate 25.)

Commencing in the region of the tip of the leaf, the gallery, at first about ½ mm. in width, gradually assumes its markedly zigzag character,

Mines of *C. iridoxa* in leaves of *Astelia montana*. (About natural size.)

Face p. 328.]

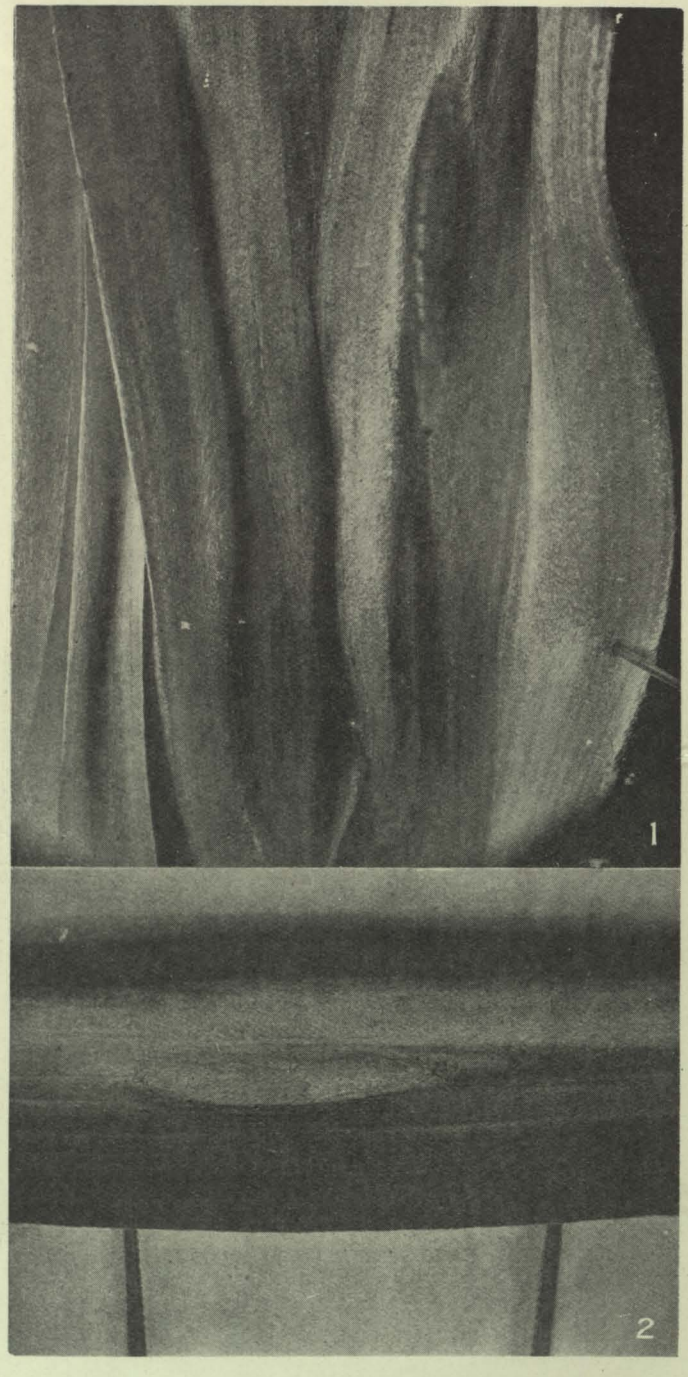


FIG. 1.—Full-grown larva of *C. iridoxa* exposed, just prior to last moult before constructing cocoon. (Enlarged about $1\frac{2}{3}$; the dotted line indicates the track of the larva.)

FIG. 2.—Cocoon of *C. iridoxa*. (Slightly enlarged, showing transverse line.)

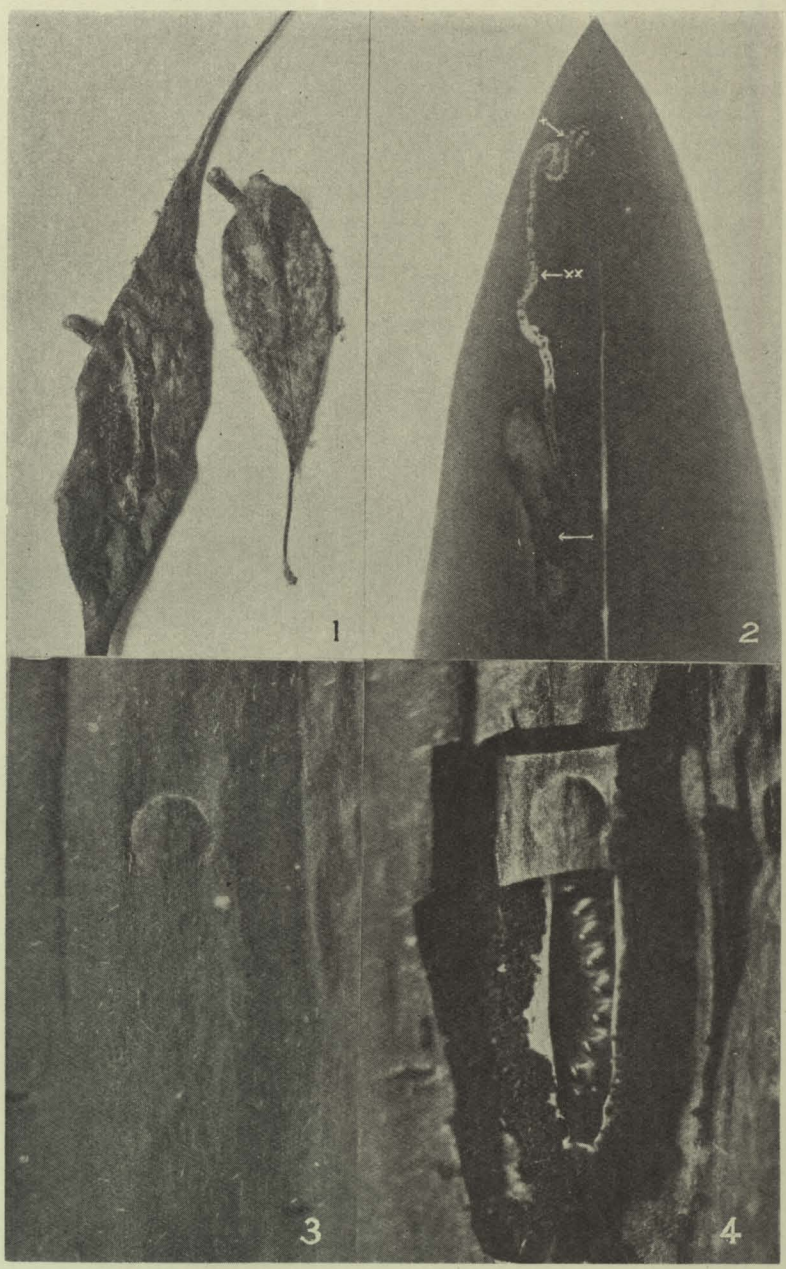


FIG. 1.—Leaves of *Polypodium serpens*, one with the upper cuticle in part removed to disclose the cocoon of *P. polypodii*; showing dehiscence. (About natural size.)

FIG. 2.—Mine of *A. melanombra* in leaf of *Celmisia*; photo by direct contact with negative and transmitted light. × = position of first moult; ×× = position of second moult; the third arrow points to the cocoon. (About natural size.)

FIG. 3.—Trap-door of cocoon of *A. melanombra* in a *Celmisia* leaf. (× about 10.)

FIG. 4.—The same, with portion of the cuticle of the leaf and roof of cocoon removed, showing larva and cocoon. Note the frass attached to the sides of the cocoon. (× about 10.)

proceeding downwards between the midrib and the outer margin of the leaf; it never crosses the former barrier. As the mine descends, the angles of the zigzag increase in size. All mining is carried on in the bulb of the plant at or just below the surface of the ground: and as the leaves grow the gallery is stretched and elongated, and mostly loses resemblance to a typical mine, since the extremely thin outer cuticle is torn and in most places lost, excepting in the most recent portion of the gallery. The zigzag formation of the mine is necessitated by the situation of the larva in the bulb, and its extent is dependent on the rate of leaf-growth: during fast growth the successive angles will be large, while slow growth will cause the transverse portions of the gallery to be almost parallel to one another. Occasionally one will find a length of mine fairly straight for an inch or so, parallel to the long axis of the leaf and most usually close against the midrib; the reason for this may be found on careful search of this portion of the gallery—a cast skin adhering to the wall shows that a moult has taken place here, and while the larva was laying up for the purpose the leaf grew sufficiently to allow it later to mine normally parallel to the long axis till again arrested in the bulb and forced once more to zigzag.

Frequently in old leaves the mines may be found to terminate abruptly, or several inches may be missing; examination of the plant will reveal the continuation of the mine, or the missing portion, on some other leaf, and further examination will show that both leaves, at the time of the change, had been in close apposition to one another in the bulb, the larva having mined from one into the other, and perhaps later back again. One may find not a mine, but only a very faint and slight impression of one, on the surface of an otherwise sound leaf; this is due to the pressure caused by the larva mining in the leaf next against it while in the bulb. Never more than one larva will be found to be mining in one half of a leaf, but both halves of the same leaf may be mined by separate larvae. In such cases there is, as one would expect, a direct parallelism in the course of the mines. Occasionally very short blind branches or ends may be found at the angles of the mine, the midrib or outer edge of the leaf, however, preventing farther progress in that direction.

The mine is usually on the under-side of the leaf, and is there very conspicuous; when appearing on the upper surface it is, as a rule, not so marked. The colour varies, with age, from green to dark brown. Frass is almost negligible; it is deposited in a fluid or semifluid state at intervals in small amounts, and tends to stain the leaf-substance brownish.

In the next to last larval stadium the larva, practically mature, ceases mining (the gallery is now some 3–4 mm. wide), and, leaving the gallery, forces its way, no longer downwards, but straight up for about 1½–2 in., till just below where the two contiguous leaves begin to separate; here, lying with the head uppermost and parallel to the axis of the leaf, it rests awhile; its body becomes much distended with clear fluid, and within it can be seen the next stadium larva about two-thirds the length of the old distended skin. When ready it bites a hole in the side of the old skin and emerges from it, the cast skin being flattened against the surface of the leaf, to which it may adhere for many months. The larva is now in its final stadium, the whole of which is occupied in the preparation of the cocoon, and lasts eight to fourteen days. Total length of the mine, possibly 3–4 ft.

The Cocoon. (Plate 26, fig. 2.)

This is constructed in rather a peculiar way. The larva, having moulted as above between two applied leaves, makes a transverse cut of about 3–4 mm. in the outer (under) cuticle of the inner leaf, and, working upwards, insinuates itself under the cuticle; then, turning, it repeats the performance downwards, forming a shallow somewhat elliptical-shaped cavity between the cuticle and remainder of the leaf. The transverse cut extending across its middle is now repaired with silk on the inside, and in the completed cocoon is difficult to find. The thin outer cuticle receives a liberal strengthening of silk on the inside, but the remainder of the cocoon-cavity receives little or none. As the leaf grows in length it carries the cocoon up with it, and in a few months it is some little distance above the ground, and so offers no difficulty to the emerging imago. The exposed cocoon is by no means conspicuous; externally, it is usually covered by the larval skin cast prior to the last stadium. It is shallow, elliptical, its ends somewhat pointed and depressed into the leaf; its long axis is parallel to that of the leaf; average size about 15 mm. by 3 mm. Owing to pressure by the larva while the leaves are still closely applied to one another, the leaf on the outside of the cocoon receives a hollow depression. The pupal stage lasts six to seven months, from February till mid-August.

The Pupa. (Plate 31, figs. 1–3.)

The pupa lies in the cocoon in an upright position, its ventral surface innermost. Colour at first pale creamy white, becoming later light brown, darker on dorsum, to black with pale markings on wings prior to emergence. It is somewhat compressed dorso-ventrally, the ventral surface being more or less keeled or prominent along the mid-line, so that a transverse section about the fourth abdominal segment would be broadly triangular in shape. The shape of the pupa is frequently influenced and even slightly deformed by external pressure caused while the cocoon is still in the bulb.

Male. The head as seen in profile from before or behind is square-shaped, due to the lateral prominence of the basis of the antennae; viewed from the side it is bluntly rounded. Ventral view: Front broad, roughened; fronto-clypeal suture represented by a shallow transverse depression; labrum small, on either side of it a small rounded area possibly representing the mandible; eyes relatively large, soon become dark brown to black, the eye-cap, that portion of the antenna covering the hinder part of the eye, rather prominent and roughened with small transverse rugae; labial palpi ill-developed, short, constricted at $\frac{1}{4}$, slightly bulbous caudad, only about two-thirds the length of maxillae; maxillae short and broad, do not quite reach antennae laterad, they meet in the mid-line below labial palpi; coxae have a narrow origin above between maxilla and antenna and first leg, otherwise about one-fourth as broad as long; the first legs meet in mid-line for their lower third; the second legs together with antennae extend to about mid-point of pupa; appearing from beneath the former are the third legs, more or less covered laterad, especially above, by a portion of hindwings, which here appear from beneath anterior margins of forewings; all three structures terminate about the level of junction of segments 4 and 5. Dorsal view: The vertex is narrow in its mid-third, being somewhat expanded laterad against antennae; the front is broad and head devoid of cutting-plate or other specialized structure of like nature; the prothorax is much expanded against antennae, but in its mid-third is very

narrow; mesothorax is prominent and large; metathorax about half as long as mesothorax, all three thoracic segments and vertex possess a median longitudiual sutural line; the hindwings pass beneath forewings to about level of spiracle on third abdominal segment. Abdominal segments of about equal length from 1 to 7 inclusive, 4 and 5 being if anything slightly larger, in width they become successively smaller from 5 to 10, this latter being small and bluntly rounded; on dorsum of each segment 2–8 inclusive are two pairs of shallow depressions; there are no tubercles or setae; no tubercular scars, spines, or cremaster; there is apparently no movement. The spiracles on segments 2–8 inclusive are small, circular, dark brown, and are conspicuously situated on large flattened slightly-raised eminences. The genital aperture is prominent ventrad between 9 and 10. The entire body is slightly roughened with fine transverse rugae, these being somewhat coarser on the thoracic segments and appendages.

AVERAGE MEASUREMENTS OF PUPA.

Measurement at	Length from Extreme Front.	Transverse Diameter.	Ventro-dorsal Diameter.
	Mm.	Mm.	Mm.
Bottom of labrum	0·59	1·52	1·13
Bottom of labial palpi	0·93	1·70	1·20
Bottom of maxillae	1·17	2·00	1·24
Bottom of first legs	3·49	2·55	1·39
Bottom of second legs	4·49	2·50	1·39
Bottom of antennae	4·55	2·45	1·35
Bottom of wings	5·38	2·45	1·28
Bottom of third legs	5·51	2·35	1·24
Extreme length	9·34	..	..

Dehiscence.

This takes place within the cocoon, the pupa not being extruded. The moth forces its way through the upper end, the outer covering of the cocoon here being only lightly bound around its edge. In the pupa splitting takes place transversely along the epicranial suture, and vertically downwards on either side behind antennae from epicranial suture above for a short distance between antenna ventrad, and vertex, prothorax, and a small portion of forewing dorsad. There appears to be no further splitting, and there is no detachment of any of appendages.

(25.) Apatetris melanombra Meyr. (The Akeake-moth). (Plate 27, figs. 2–4; Plate 29, figs. 1–8; Plate 30, figs. 1–4.)

Apatetris melanombra Meyr., *Trans. N.Z. Inst.*, vol. 54, p. 165, 1923.
Epiphthora melanombra Meyr., *Trans. N.Z. Inst.*, vol. 47, p. 206, 1915; vol. 20, p. 77, 1888: Fereday, *Trans. N.Z. Inst.*, vol. 30, p. 363, 1898: Hutton, *Index Faunae Novae Zealandiae*, p. 118.
Gelechia sparsa Philp., *Trans. N.Z. Inst.*, vol. 50, p. 128, 1918.

The Imago. (Plate 29, fig. 1.)

Meyrick's Original Description.—See *Trans. N.Z. Inst.*, vol. 20, p. 77, 1888.

Type in Mr. Meyrick's collection.

A much paler form occurs in Dunedin; it was described by Mr. Philpott as *Gelechia sparsa*, poor specimens accounting for the mistake in the genus. I have been able to observe and rear a long series of both forms; the pale variety does not appear to occur in the North Island, whereas in Dunedin both forms have been reared from the same food-plants, the lighter variety being by far the commoner. Mr. Philpott's description appears in *Trans. N.Z. Inst.*, vol. 50, p. 128, 1918.

To his description may be added that the costal half of the forewing is far more densely irrorated with brown than the dorsal half. The size of the moth varies considerably according to the amount of food available. Examining all the stages and characteristics in the life-history of these two forms, I could find no points of difference whatever, and conclude that the pale form is only a southern variation of the dark species. I understand Mr. Meyrick has come to the same conclusion without any reference to the early stages.

Distribution.

The first specimens discovered were reared at Christchurch in November (1886 ?), by Mr. R. W. Fereday, from mines in *Olearia avicenniaefolia*, and were reported common. The moth appears to be well distributed through New Zealand, having been found on Mount Egmont at 3,500 ft. (North House), common, 20th December, 1917; Wanganui, common, larvae and pupae in September; Wellington, common, larvae in June and October, many pupae in December, the imagos emerging early in January; Governor's Bay, exceedingly common; Dunedin, so common as to have become almost a pest in some localities. There are probably two, if not three, generations; larvae, pupae, and imagines may be found throughout the summer months, though the best time to collect mines for rearing purposes is towards the end of November.

Food-plants.

Olearia furfuracea, *O. Traversii* (akeake), *O. arborescens*, *O. divaricata*, *O. macrodonta*, *O. Colensoi* (tupare), *O. avicenniaefolia*, *O. lacunosa*, *O. Cunninghamii* (akeake, heketara), *Celmisia verbascifolia* (mountain-daisy), *Celmisia Dallii*.

The Ovum.

Class, flat. Colour pale yellow, empty shells grey. Shape, as seen from above, slightly elongated oval, sides slightly flattened, micropylar end slightly flattened and wider than its nadir, which is bluntly rounded. Sculpture, none. Shell roughened, shiny, very strong. After the larva is hatched the empty shell becomes filled with frass-granules, and may remain attached to the leaf for many weeks.

Average dimensions: Length, 0·40 mm.; greatest width, 0·24 mm.; greatest height, 0·22 mm.

Egg-laying.

Eggs laid singly and firmly attached to upper surface of leaf, generally in close proximity to midrib or one of the coarser veins. Ova relatively large and easily found by the naked eye. Numbers of ova may be found on some leaves, but are presumably not all deposited by the one parent;

later this will result in serious overcrowding and the last larvae to hatch will not reach maturity. On hatching, the larva burrows directly through the shell into the leaf-substance, the empty shell becoming filled with frass and firmly retaining its position.

The Mine. (Plate 27, fig. 2; Plate 29, fig. 2.)

The chief characteristics of the mine are: Firstly, the preliminary 6 or 7 millimetres of the gallery are closely convoluted, vermiform, or spirally wound round the point of entrance; secondly, a narrow gallery of 2 in. to 3 in. length; thirdly, an irregular expanded blotch of varying size, usually about ½ square inch in area. Hatching is revealed by the dark discoloration of the leaf-substance under the ovum. The mine throughout its length is close beneath the upper cuticle of the leaf, and is very conspicuous; there is very little sign of it on the under-surface. In the second part of the mine the gallery increases evenly in width; its borders are more or less even, depending chiefly, however, on the nature of the leaf, as also does the general course of the mine. In the North Island akeake (*O. Cunninghamii*) the coarse network of veins causes the direction of the gallery to become tortuous, and the margins very irregular, whereas in *Celmisia verbascifolia*, with its almost parallel veins, the gallery is in almost all cases comparatively straight, occasionally looped back upon itself either on the same or the other side of the rib that it is following; here, too, the margins of the gallery are uniform and even. There is rarely any tendency to the formation of blind branches. The midrib, except in its terminal part, forms an effectual barrier to the young larva. In its terminal part the mine expands into an irregularly shaped blotch. Where several larvae are mining in the same leaf their mines do not tend to cross one another or coalesce unless or until the available leaf-substances become scarce; in such cases one may find several larvae working in a common blotch produced by the coalescence of the several galleries. The cuticle over the mine when fresh is sufficiently transparent for the grey frass to be seen within the mine, but it rapidly dies and dries, becoming dark brown and very conspicuous, the more so since the leaf-substance in close proximity to the gallery becomes at first paler in colour; later all the leaf-substance that has been cut off from its direct sap-supply by the mine dies and becomes almost indistinguishable from the mine itself, exaggerating the size of the mine. Mined leaves usually die and fall shortly after the emergence of the imagines. Frass is finely granular, and more or less fills the gallery.

Habits of the Larva.

The first moult takes place where the first part of the gallery joins the second—that is to say, after the first moult the larva mines n a more set direction. The duration of the first stadium is subject to much variation owing to climatic conditions, and may be any time from a fortnight or even less in summer to several months in winter. The second moult occurs about 25–30 mm. beyond the first; the increase in the width of the gallery becomes more marked from this point on. The position of the moult is generally disclosed by a short diverticulum on the lateral margin of the gallery, within which will be found the cast larval head-piece. It is the obstruction by the cast headpiece that causes the larva

to mine to one side of it. Duration of the second stadium, about three weeks. The positions of the moults can easily be found in old mines by removing the leaf-cuticle under a dissecting microscope and searching for the easily-found cast head-capsules. The larva ceases feeding for two or three days prior to each moult. The third and final moult takes place within the cocoon at the time of pupation. Duration of third stadium, about four weeks. The transition from gallery to blotch in the third stadium is quite gradual, not abrupt, the blotch being only the expanded terminal part of the gallery. This is best seen in mines in the leaves of the *Celmisia*, for in *Olearia* the coarse network of veins causes the blotch to be composed of incorporated portions of the earlier gallery.

Average length of larva at end of first stadium, 3 mm.; at end of second stadium, 5 mm.; when fully grown, 8 mm. The final act of the larva is to construct the cocoon within the blotch. Larvae appear to hibernate during their first instar, or else within the cocoon before pupating. Larvae are most plentiful in January, August, and November.

The Larva. (Plate 29, figs. 3–8.)

Full-grown, 8–12 mm. Cylindrical, slightly flattened dorso-ventrally, greatest transverse diameter at prothorax, abdominal segments gradually tapering caudad. Head retractile, very dark grey to black. Prothorax possesses a black dorsal shield only lightly chitinized along mid-line; it also possesses a pair of small black ventral plates. Abdominal segments full and rounded, last segment possessing four small black areas around venter. True legs and prolegs absent and replaced by fleshy protrusible swellings at dorso-lateral and ventro-lateral margins of all thoracic segments and abdominal segments 1 to 7 inclusive; on thoracic segments the ventral swellings possess each a small incomplete chitinous ring within which are situated three minute setae. Colour grey with darker mid-dorsal stripe; before pupating the larva becomes much lighter in colour; in all stages the ground-colour is darker on dorsal and ventral surfaces. Spiracles small, circular, inconspicuous. Skin covered with minute thickened chitinous plates, these are largest on dorsal and ventral surfaces, and are absent over apices of segmental protuberances; on dorsum of each segment the skin between these plates is more chitinized than elsewhere, apparently in minute ridges radiating out from the plates; this extra thickening occupies a definite saddle-shaped area on dorsum directly between protuberances, behind which there is a narrow extension downwards. Setae microscopic.

The head-capsule and its structure are shown in the figures; all are camera-lucida sketches.

The chaetotaxy is very difficult to determine, owing to the minuteness of the setae; in the figure these are greatly exaggerated. Alpha is placed below beta in prothorax, but in all other segments beta appears to have been pushed directly ventrad to alpha by the fleshy protrusion before mentioned; epsilon is above rho on the prothorax, mesothorax, and metathorax, below it but still above the spiracle in the abdominal segments, absent in 9; eta is closely associated with kappa on all segments excepting 9; nu is placed at a distance from pi in the thoracic segments pi is normal, tau is a minute seta in front of the leg-swelling on the thoracic segments and abdominals 1–7; sigma is normal; there are a number of minute subsidiary setae as shown in the figure, but the

importance of these cannot be estimated till other species of this and closely allied genera have been observed.

The Cocoon. (Plate 27, figs. 3, 4.)

An oval structure of white silk constructed within blotch-mine. It is attached to both roof and floor of mine, over which surfaces the silk is not so thickly deposited as elsewhere. Circumference is usually thickly covered with frass-granules. Average length, 7 mm.; width, 3 mm. The final act of the larva prior to pupating is to prepare a small circular trap-door for the time of emergence; this is generally in floor of cocoon, but may sometimes be in roof towards anterior end; occasionally there are two trap-doors, one at either end. The trap-door is kept shut by several strands of silk, its average diameter being 1·5 mm. Construction of the cocoon occupies three to four days.

The Pupa. (Plate 30, figs. 1–4.)

Cylindrical in shape, slightly flattened laterad, extremities bluntly rounded. Head possesses no specialized structures and is devoid of sculpture; labrum well up between eyes; mandibular areas small; maxillary palpi apparently absent; labial palpi either not shown or only a minute portion to be seen directly caudad to labrum in a slight V between maxillae; maxillae broad above, but much constricted in caudal half, extending as far as mid-point of pupa slightly beyond first legs; have a slight transverse wrinkling; antennae narrow, meet in mid-line at about their middle and extend to about lower level of seventh abdominal segment in female, and as long as forewings in male; show no distinct segmentation. First legs occupy all space between antenna and maxillae below eye and extend not quite so far caudad as maxillae, slight transverse wrinkling; second legs occupy short interval between antennae and first legs, they do not extend so far caudad as the latter; slight transverse wrinkling; forewings firmly soldered down to ventral wall and occupy about half ventral aspect of pupa, they meet in mid-line below antennae and extend as far as lower extremity of eighth segment in female and caudal extremity of pupa in male, are sculptured with rather coarse transverse rugae; third legs not seen; only a very short strip of hind-wings to be seen dorso-laterally as far as second segment. Prothorax somewhat expanded against antennae but practically lost in mid-third; it bears two pairs of short setae—one dorsal, one lateral. Mesothorax forms a prominent hump in dorsal profile, possesses a slight medio-dorsal ridge, and is sculptured with fine transverse rugae; possesses four minute setae on either side. Metathorax small, it also has four minute setae on either side of caudal extension of mesothorax. Pupal skin covered with minute thickenings of cuticle as in larva. Abdominal segments possess minute setae, segments 4–8 inclusive having one dorsal to spiracle on either side and two closely approximated and ventral close against dorsal wing-margin; segments 1, 2, and 3 all possess dorsal setae, but wing covers ventral pair except in 3 where one of the setae is free; 9 and 10 possess no setae. On dorsum of all abdominal segments excepting last two is slight transverse ridge caudad. Apparently no movement once pupal skin has hardened. Spiracles small, circular, dark brown, slightly elevated, those of segment 1 overlaid by the dorsal wing-margins. No cremaster. Colour of pupa golden brown. Average duration of pupal stage about thirty days.

AVERAGE MEASUREMENTS OF PUPA.

Measurement at	Length from Extreme Front.	Transverse Diameter.	Ventro-dorsal Diameter.
	Mm.	Mm.	Mm.
Bottom of eyes	0·53	1·00	1·00
Bottom of first legs	2·41	1·24	1·47
Bottom of second legs	2·12	1·24	1·47
Bottom of maxillae	2·59	1·24	1·47
Bottom of antennae	4·47	0·53	0·55
Extreme length	4·53	..	..

Dehiscence.

Pupa not extruded from cocoon. Transverse splitting occurs along epicranial suture. Maxillae, eye-pieces, labrum, mandibles, clypeus, and front remain in one piece, are detached above but remain fixed to puparium caudad. Legs and antennae on either side become detached from wing-margins above. Medio-dorsal splitting through prothorax and mesothorax. Further transverse splitting occurs between prothorax and vertex, vertex thus becoming wholly detached; it, however, generally has one or two slips of integument holding it to puparium.

(26.) **Philocryptica polypodii** Watt (The Polypodium-moth). (Plate 27, fig. 1; Plate 28; Plate 30, figs. 5–8; Plate 31, figs. 4–11.)

Harmologa polypodii Watt, *N.Z. Jour. Sci. & Tech.*, vol. 4, p. 257, 1921. *Philocryptica polypodii* Meyr., *Trans. N.Z. Inst.*, vol. 54, p. 164, 1922.

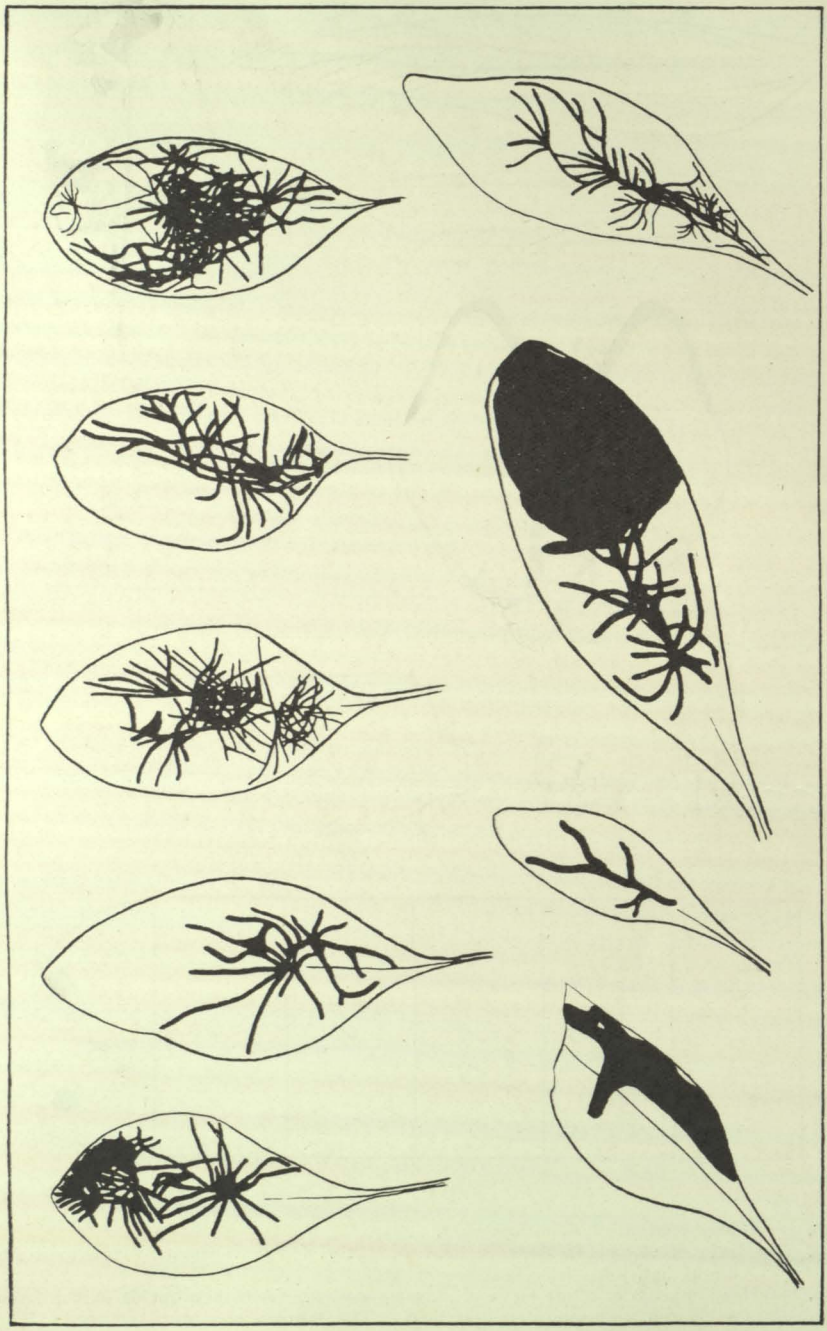
The Imago.

A pretty little moth having an average expanse of 14 mm. Forewings in female light brown in ground-colour, with a conspicuous dull-reddish outwardly-oblique band near apex, and inner third of costa clothed with dark-bluish scales, the remainder of wing with small darker-brown markings principally along dorsum, with a diffuse area of dark-bluish, black, and brown scales at tornus; hindwings brown. Male differs in that forewings are almost entirely dull-bluish excepting for small apical area beyond oblique bar which is almost black; average expanse, 12 mm.

The original description appears in *N.Z. Jour. Sci. & Tech.* above quoted.

General Notes.

This moth was first discovered in 1919, when reared from mines obtained in the Botanical Gardens, Wellington. Its coloration and markings give it excellent protection when resting amongst the dead or dying leaves of its food-plant, and it is possibly due to its inconspicuousness that it has not been taken before, since its mines are common in a locality worked very thoroughly by expert entomologists. In the resting position the wings are folded tent-wise over the body and the apices have the appearance of being pinched together. When disturbed the moth runs about actively with frequent momentary pauses, and when on the wing flight is rapid and erratic. I have never seen the imago in the field, but Mr. Hudson tells me he has taken two this last season. No parasites have as yet been obtained.



Mines of *P. polypodii* in leaves of *Polypodium serpens*. (Exact tracings, natural size.)

Face p. 336.]

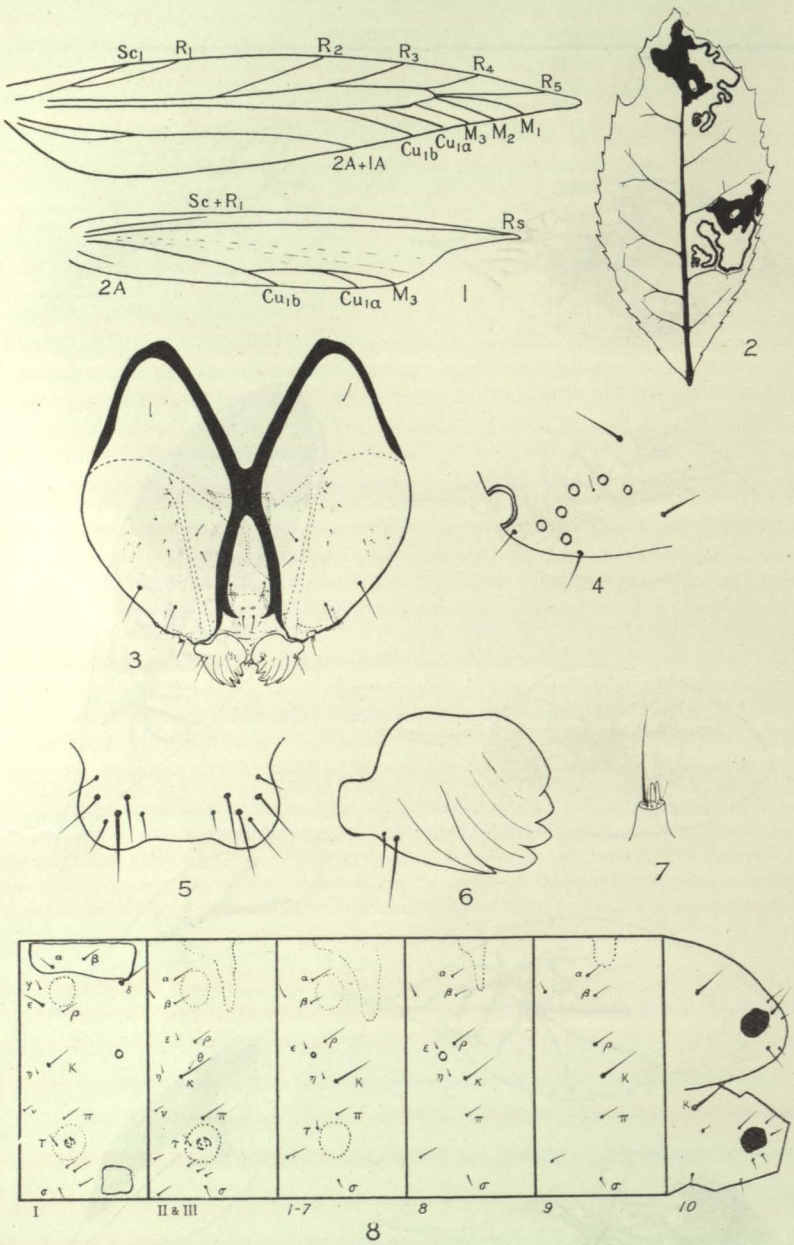


FIG. 1.—Wing-venation of *A. melanombra*.

FIG. 2.—Mines of *A. melanombra* in leaf of *Olearia Cunninghamii*. (Reduced to about half.)

FIG. 3.—Head-capsule of adult larva of *A. melanombra*. (A camera-lucida sketch from a cleared and mounted specimen. The labrum has been removed. The dotted lines indicate the structure of the ventral surface and its setae, and the internal skeleton.)

FIGS. 4–7.—*A. melanombra* larva: Arrangement of the eyes (4), labrum (5), mandible (6), and antenna (7).

FIG. 8.—Setal map of adult larva of *A. melanombra*. (This also applies to the second instar.)

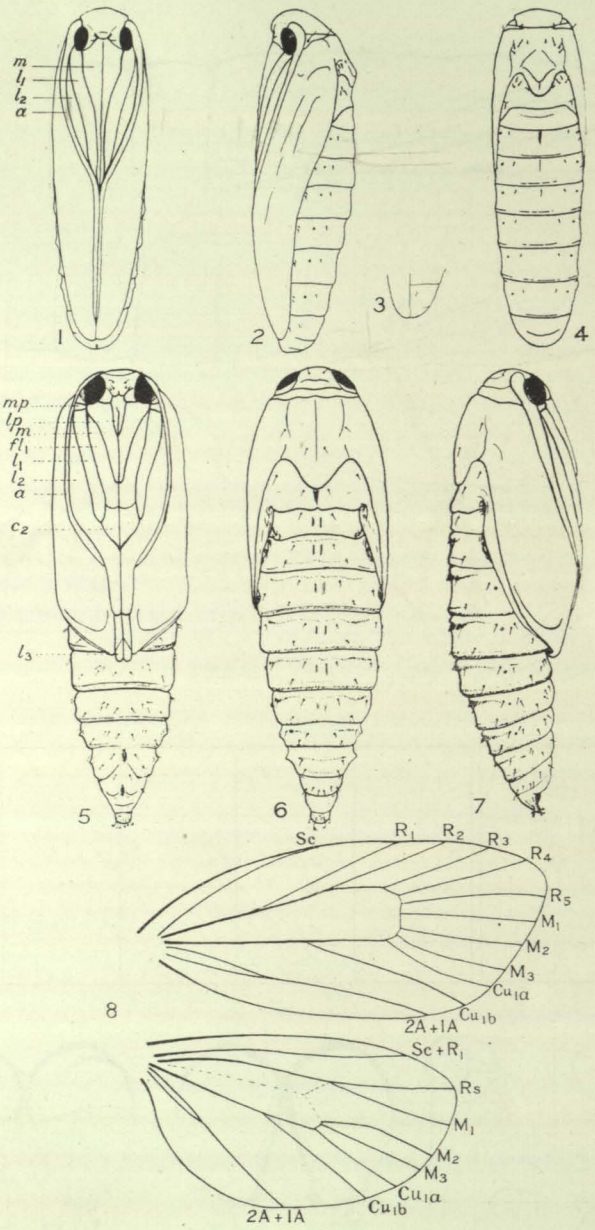


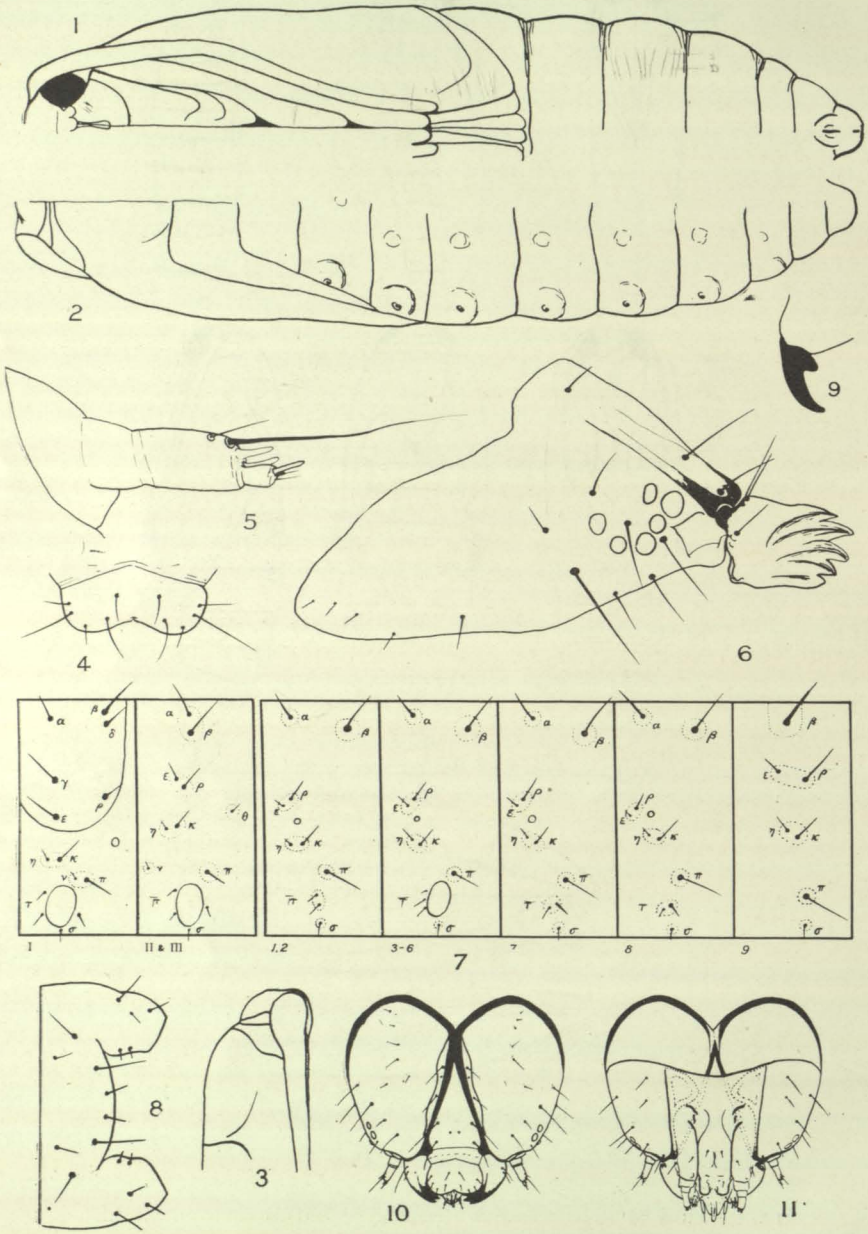
FIG. 1.—Pupa of *A. melanombra* (female), ventral aspect: *m*, maxilla; l_1, first leg; l_2, second leg; *a*, antenna.

FIGS. 2–4.—The same: lateral aspect (2); lateral aspect of last abdominal segments of male pupa (3); dorsal aspect (4),

FIG. 5.—Pupa of *P. polypodii*, ventral aspect: *mp*, maxillary palp; *lp*, labial palp; *m*, maxilla; fl_1, femur, first leg; l_1, first leg; l_2, second leg; *a*, antenna; c_2, coxa of second leg; l_3, third leg.

FIGS. 6, 7.—The same, dorsal and lateral aspects.

FIG. 8.—Wing-venation of *P. polypodii*.



FIGS. 1–3.—*C. iridoxa* pupa: Ventral aspect (1), dorsal aspect (2), lateral aspect of head (3).

FIGS. 4–11.—*P. polypodii* adult larva: Labrum (4); antenna (5); mandible and eyes (6); setal map (7); tenth abdominal segment spread dorsally (8); terminal claw of thoracic leg (9); head-capsule, dorsal aspect (10); head-capsule, ventral aspect (11).

Distribution.

First found as noted in the Botanical Gardens, Wellington. The larvae were obtained on 8th August, 1919, and commenced pupating during the first week of October, the imagines emerging from 20th October till 1st December, 1919. A plentiful number of mines and full-grown larvae were found at Wanganui on 26th September, 1921, and again at Wellington during the same week. I have received one doubtful specimen of the mine from Mr. Philpott at Nelson, 29th December, 1921.

Food-plant.

Polypodium serpens (*Cyclophorus serpens*), a small thick fleshy-leaved tree-climbing fern, common throughout New Zealand.

The Ovum and Egg-laying.

Nothing at present known.

The Mine. (Plate 28.)

The mine in its earlier stages is a narrow gallery, commencing as a rule near base of leaf and in general running along midrib. From this gallery a varying number of blind branch galleries of varying lengths are given off, frequently having a common origin and presenting a stellate appearance. These radiating galleries rarely give off secondary branches, and in earlier stages of larva seldom reach outer margin of leaf. The leaves being relatively small and the larva voracious, the mine with its branch galleries soon occupies major portion of leaf and causes it to wither, whereupon larva forsakes the old leaf and enters a fresh one, the mine still being a gallery with blind irregular branches. As larva grows the gallery increases in width up to about 1·5–2 mm. In many cases a larva may forsake a leaf after having mined but a very short distance, and in consequence a number of leaves may be attacked by a single larva. In later stages the width of gallery increases up to about 3 mm., and ends finally in an irregular blotch which may occupy entire leaf. The mine from beginning to end is close against upper cuticle of leaf, and there is little or no evidence of it to be found on under-surface. The galleries cross each other in all directions, and the cuticle covering them very soon becomes light brown in colour, that over the final blotch becoming dark brown to black; frequently the surrounding leaf-substance dies and blackens, and masks the actual size of the blotch. Margins of galleries are even and parallel. Central portion of leaf is always the most mined, and the midrib offers no barrier whatsoever. It is rare to find more than one larva in a leaf. Frass is coarsely granular, dark green or brown to black in colour according to age, and is irregularly distributed throughout mine.

The Larva. (Plate 31, figs. 4–11.)

Length when full-grown about 12–14 mm. Cylindrical; ground-colour bright green, head and prothoracic shield dark grey-brown; skin transparent, disclosing a bright-green alimentary canal and dorsal vessel. Tubercles small, green; setae light grey. Skin covered with minute pile except in vicinity of tubercles. Thoracic legs normally developed; prolegs on segments 3–6 inclusive and 10; ventral prolegs possess complete circles of 16–18 crochets each, the anal prolegs possess only a semicircle of 10–12 crochets each. Spiracles small, circular.

The head-capsule and its setae are shown in the figure; arrangement of eyes, antenna, labrum, and mandible are reproduced in Plate 31, figs. 4–6, and need no further comment.

Alpha is a small seta present on all segments except 9; beta is larger and placed caudad to and below alpha except on the prothorax where it is nearest the meson, and on the mesothorax and metathorax it is included in the same tubercular area as alpha but situated almost directly ventral to it; on segment 9 tubercular areas of beta are continuous across dorsum. In prothorax cephalic row on shield contains alpha, gamma, and epsilon, caudal row containing beta, delta just below it, and rho which is caudad to and between gamma and epsilon and above and cephalad to spiracle; on mesothorax and metathorax rho and epsilon occupy same tubercular area, the latter being a minute seta placed above and in front of rho, whereas in abdominal segments it is below rho, and both are above and somewhat in front of spiracle excepting in 8 where they are entirely in front; on 9 epsilon again rises above rho. The kappa group contains eta and kappa both in the common tubercular area situated below spiracle and well in front on prothorax where the minute seta eta is directly cephalad of kappa, on remaining thoracic segments it is somewhat below and on abdominal segments is slightly above kappa; the group on abdominal segments being immediately beneath spiracle. Theta appears in mesothorax and metathorax as a minute isolated seta between and caudad to kappa and rho groups. Mu is absent. Pi occurs on all segments, it is closely associated with the minute seta nu on prothorax, the two occupying a common tubercular area above and slightly behind base of leg; on mesothorax and metathorax nu is far cephalad, and is absent on abdominals. Tau contains two setae in front of base of leg on thoracic segments, two minute setae on segments 1, 2, 7, and 8, three on segments 3–6, and is absent on 9. Sigma is present on all segments. The chaetotaxy of segment 10 has not been attempted, but the map of the setae is given in Plate 31, fig. 7.

Habits of Larva.

The nomadic existence of the larva has already been noted. The exit from mine may be either through upper or lower cuticle—there would appear to be no special choice; but the entrance into a fresh leaf is always through lower cuticle. In any exceptions to the above it will be found that the upper surface has been closely covered by another leaf. As a preliminary to commencing a fresh mine in a new leaf the larva will spin a slight canopy of silk under which it may gain a certain amount of protection and support. Twelve hours will see the larva totally within the leaf, and in order to get under cover as soon as possible it can contract into a remarkably short length—from 1 cm. to 4 mm. Moulting takes place within the mine; the number of moults and duration of stadia are not known. When disturbed the larva exudes a black fluid from the mouth, and if shaken from a leaf while outside the mine will utilize a fine silken thread by means of which it may find its way back.

The Cocoon. (Plate 27, fig. 1.)

This is a cylindrical structure of thin white silk constructed within the final blotch-mine. Usually in central portion of mine, and from its anterior end to outer margin of leaf there extends a slightly-curved silken

tunnel. At margin of leaf a narrow slit is prepared by larva prior to pupating. This slit is 2–3 mm. long and is usually slightly on under-surface of leaf. Tunnel is about 1 cm. in length and 3–4 mm. in diameter; the slit at its termination is not protected by silk but remains naturally closed. Frequently the leaves containing the cocoons wither and fall to the ground. The cocoon proper is about 1 cm. in length and externally is closely invested with frass-granules; a slight curtain of silk separates anterior end from tunnel. In dead leaves containing cocoons, these and their tunnels can readily be detected from the exterior on both aspects of the leaf since the surrounding cuticle becomes shrunken and so leaves them in relief.

The Pupa. (Plate 30, figs. 5–7.)

Pupa small but stoutly built, bluntly rounded cephalad, abdominal segments becoming attenuated caudad and terminating in a bluntly-pointed cremaster. Lateral wing-margins relatively straight and parallel, ventral profile of thoracic appendages well rounded, most prominent at level of second abdominal segment.

Head—front situated more dorsad than ventrad, possessing a pair of short dorsal setae; vertex not very distinctly defined; clypeus possessing three pairs of minute setae as shown in Plate 30, fig. 5; labrum with a slight tendency to be bilobular; eye but little covered by antenna; mandibular area relatively large and clearly defined; maxillary palpi short, situated caudad to eye and occupying short interspace above first leg between antenna and maxilla; labial palpi short and narrow; maxillae broad above but constricted caudad, about twice as long as labial palpi; antennae of about equal width throughout, not markedly segmented, do not extend beyond second legs in either sex, and are slightly longer in male than in female; first legs short and stout and about half length of second, their caudal extremities separated by second coxae; between maxillae and first legs, but not extending beyond the latter, lie the femora of first legs; second legs have a narrow strip above, are widest in mid-third, and, meeting in mid-line, lie closely adjacent in their caudal third, terminating about central point of pupa; forewings extend as far caudad as fifth abdominal segment, below second legs they are separated in mid-line by a small strip of hindwings, appearing from beneath which are the caudal extremities of third legs, which extend just slightly beyond forewings; a narrow slip of hindwing appears caudad to forewings. Prothorax narrow, restricted in mid-dorsal region, and somewhat expanded laterad; mesothorax with distinct mid-dorsal suture which extends also into metathorax. Beyond a slight microscopical roughness or pitting there is no sculpturing. Spiracles small, circular, and slightly elevated, those of first abdominal segment covered by hindwings. Abdominal segments 2–8 inclusive possess two transverse rows of dorsal spines, anterior row being slightly waved and possessing a single line of small stout spines, posterior row straighter, extends slightly farther laterad than anterior, and its spines are more minute and more numerous; in second segment anterior row is very poorly developed, whereas posterior row is most poorly developed in segment 8; dorsal row is present on segment 9 in male only and is poorly developed. Cremaster flattened dorso-ventrally and bluntly rounded at apex, bears a small series of 6–8 slender hooklets, mostly situated ventrad. Genital aperture apparently situated on segment 8 in female and on segment 9 in male, well developed; anal aperture well marked on segment 10.

Head-setae have already been mentioned, abdominal segments possess minute setae on same plan as larva; alpha and beta are both present on the mesothorax and metathorax, beta being closer to the dorso-meson; in the abdominal segments alpha is nearest dorso-meson, is the only seta on segment 1; segment 2 bears alpha and beta only; rho appears in front of and dorsal to the spiracle in 3; kappa, eta, and mu appear in 4, and in segments 5–9 inclusive setae are the same as in larva; 10 has no setae; proleg-scars are absent. Limited movement can take place between segments 2–3, 6–7; free movement between 3–4, 4–5, 5–6. Colour at first green, the abdominal segments becoming brown and later dark grey, darker on the dorsum; dorsum of thoracic segments dark grey to black, wings black mottled with brown, eyes black, appendages mottled golden brown and black.

Pupa to be found during October and early November. Length of pupal existence under favourable conditions about four weeks.

AVERAGE MEASUREMENTS OF PUPA.

Measurement at	Length from Extreme Front.	Transverse Diameter.	Ventro-dorsal Diameter.
	Mm.	Mm.	Mm.
Labrum	0·45	1·20	1·00
Bottom of labial palpi	1·00	1·73	1·52
Bottom of maxillae	1·73	1·86	1·73
Bottom of first legs	2·24	1·86	1 86
Bottom of second legs	3·45	1·73	1·73
Bottom of third legs	4 00	1·40	1·40
Extreme length	6·00	..	..

Dehiscence.

The pupa forces its way along tunnel and is extruded from exit at margin of leaf as far as caudal extremities of forewings. Splitting occurs mid-dorsally through the whole length of mesothorax, prothorax, and dorsal head-piece. Transversely along epicranial suture, extending along entire hinder margins of antennae. Transverse splitting also occurs laterally between prothorax and mesothorax, and prothorax and dorsal head-piece, but these do not become wholly detached. The front, antennae, eye-pieces, and other head-structures all remain in one piece, but may become wholly detached from rest of puparium. Leg appendages on either side together with lower portions of eye-pieces are separated by mid-vertical splitting, and, becoming free from antennae laterad, form two plates entirely free below and only precariously attached above. Third legs remain attached to wing-cases and are not included in above.