

The Agromyzidae of New Zealand (Insecta: Diptera)

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Abstract

The 16 species of Agromyzidae hitherto known in New Zealand and the subantarctic islands have been revised, all further material has been examined and 19 new species are described: *Melanagromyza senecionella*, *Hexomyza coprosmae*, *Cerodontha sylvesterensis*, *Liriomyza oleariae*, *L. wahlenbergiae*, *L. craspediae*, *L. watti*, *L. plantaginella*, *L. hebae*, *L. vicina*, *L. penita*, *L. homeri*, *Phytoliriomyza cyatheae*, *P. bicolorata*, *P. huttenensis*, *P. convoluta*, *P. tearohensis*, *Phytomyza improvisa*, *P. lyalli*. Two additional undescribed species are recorded. The genus *Hexomyza* Enderlein and the subgenus *Icteromyza* Hendel of the genus *Cerodontha* Rondani are recorded for the first time in New Zealand. Of the 41 species discussed below, 34 are endemic; it is considered that these have evolved from 17 immigrant ancestors which reached New Zealand by long-distance dispersal from Australia in 16 cases, while one group of three species appears to be of South American origin.

INTRODUCTION

Agromyzidae in New Zealand have hitherto been poorly known and inadequately collected. Watt (1923, 1924) made an excellent start in studying leaf-mines and, from the material he bred, 11 new species were accurately diagnosed and described in his two papers; he also recorded *Phytomyza albiceps* (= *syngenesiae*) and, from the Auckland Islands, *Agromyza australensis* Mik, 1881. The latter is now not accepted as an Agromyzid and the type cannot be traced.

Little further work on the family was done during the next 45 years. Harrison (1959) produced a valuable revision of the Acalypterates, describing two further Agromyzids, updating the generic position of Watt's species and recording two more—one correctly as the species described in Australia, *Cerodontha australis*, the other as *Melanagromyza aeneoventris* (a European species representing a misidentification of *senecionella* sp.n described below). At this time the total recorded was 16.

The present paper is based primarily on the results of my own collecting from early December 1974 to mid-February 1975. During this period I travelled nearly 10,000 km, through North and South Islands and also visited Stewart Island. My actual route starting and ending at Christchurch was as follows:

NORTH ISLAND (Christchurch – Picton) Wellington – Palmerston North – Hawera – Mount Egmont – Rotorua – Hamilton – Auckland – Whangarei – Kaikohe – Waipoua Forest – Kaitaia – Auckland – Thames – Coromandel – Te Aroha – Hamilton – National Park – Wanganui – Wellington.
SOUTH ISLAND Nelson – Cobb River Valley – Murchison – Arthur's Pass – Franz Josef – Fox Glacier – Wanaka – Mount Cook – Queenstown – Te Anau – Milford Sound – Invercargill – (Stewart Island) – Dunedin – Christchurch.

STEWART ISLAND Oban – Freshwater River.

Over 500 specimens were collected and among these all but one of the species previously known in New Zealand were represented. Leaf-mines were found on 47 different hosts (see list below). Twenty-one new species are now recorded, of which 19 are described here. Three were discovered by J. S. Dugdale; two others are certainly distinct but are not formally described.

Records of Agromyzidae in the sub-antarctic islands have recently been given by Harrison (1976), including the description of two new species from Antipodes Islands and Snares Islands. It is suprising that of six species known in these islands two should be endemic and one is only known elsewhere in Australia. A similarly high degree of endemism has been detected in a number of other groups of insects (cf. Gressitt 1971).

The total number of species now known in New Zealand and the sub-antarctic islands is thus 41.

My intensive collecting has shown that the Agromyzidae are better represented in New Zealand than had been believed. Leaf-mines of further undescribed species are recorded below and it is thus certain that a number of additional species await discovery, particularly in the mountains of the South Island. However, the generic pattern is now clearly established and additional species will mainly prove to be in the largest genus, *Liriomyza*.

The present composition of the family in New Zealand is shown in the following table.

GENUS	PREVIOUSLY KNOWN	NEW TO NEW ZEALAND	NEW	ENDEMIC	TOTAL
<i>Melanagromyza</i>	1 (misidentified as <i>aeneoventris</i>)		1	1	1
<i>Hexomyza</i>			1	1	1
<i>Cerodontha</i>					
<i>Icteromyza</i>		1			1
<i>Cerodontha</i>	2		1	2	3
<i>Liriomyza</i>	9	1	10	20	22
<i>Phytoliriomyza</i>	1	1	5	6	7
<i>Phytomyza</i>	3	1	2	4	6
	16	4	20	34	41*

* Two not formally described.

The 85% rate of endemism is closely comparable to that of New Zealand plants and other groups of insects. Analysis of the affiliations of the 34 endemic species shows that these include a number of species-groups with closely-related species resulting from relatively recent and rapid speciation and it is suggested that the 34 are derived from 17 immigrant ancestors, which in 16 cases have reached New Zealand by long-distance dispersal from Australia; one group of three species appears to be of South American origin.

As all Agromyzidae are plant-feeders and in most cases are restricted in their hosts to a single plant genus, their establishment in New Zealand has clearly been intimately linked with the colonization and speciation of their hosts. The earliest assemblages of plants resulting from direct overland migration when New Zealand was still connected to Antarctica some 80 million years ago have no relevance to the present distribution of Agromyzidae, whose origin is certainly very much more recent. In his discussion of the origin of the New Zealand insect fauna, Tillyard (1924) correctly emphasizes past land connections, although many of his postulates have proved inaccurate in the light of modern advances in the theory of plate tectonics. He also completely ignores the great significance of long-distance dispersal over wide water gaps. Hennig (1966) in his detailed review of the

possible relationships between the Diptera of New Zealand and of South America via Antarctica finds no evidence to suggest such relationships in the Agromyzidae or other related cyclorrhaphous families.

It is now accepted that the ancestors of a high proportion of New Zealand plants reached the country by long-distance dispersal, mainly from Australia, during mid- or late Tertiary or even in the Pleistocene, and the Agromyzidae must necessarily have followed the same pattern. In most cases there will have been a significant time lag between the colonizations, frequently with subsequent speciation of the host-plants and that of the Agromyzidae which arrived after them. Accurate dating of the arrival in New Zealand of the individual ancestral Agromyzidae and their subsequent speciation is not possible and must remain to a considerable degree speculative. However, the hosts are known of 21 of the 34 endemic species, and with the recent advances in our knowledge of palaeobotany resulting from pollen analysis, some inferences as to probable timing can be made. Several of the newly-described species are certainly restricted to sub-alpine habitats and the origin of the existing topography of New Zealand is now well understood. This also helps in assessing the probable dating of the evolution of certain species.

Some remarks on species-groups and speciation are given below under individual genera but it seems convenient to provide here a general assessment of the representation of the family in New Zealand with further detailed comment on each genus.

Melanagromyza Hendel

It is puzzling that only a single species should be present, with 27 known in Australia. However, the genus is predominantly of tropical distribution, although it has just reached southwest Australia and Tasmania (the same single species in both areas). *M. senecionella* sp.n in New Zealand has diverged only slightly from its sister-species in Australia, *M. seneciophila*, and the ancestral immigrant probably arrived some time in late Pleistocene. It has now spread throughout the country in association with introduced ragwort.

Hexomyza Enderlein

The presence in New Zealand of a species in this gall-causing genus is of considerable interest. *H. coprosmae* sp.n is rigidly associated with *Coprosma* and occurs predominantly on *C. propinqua*. *Coprosma* is an ancient genus, reported from the Palaeocene (Raven and Axelrod 1972) and from Lower Miocene (Fleming 1962). *H. coprosmae* is clearly not a recent arrival in New Zealand. The male genitalia are highly differentiated, of a form not known elsewhere in the genus. The larval posterior spiracles are also apomorphic, each having an ellipse of eight bulbs, whereas in all other species the plesiomorphous condition of three is retained. The nearest known relatives are in South Africa and Japan.

Coprosma is present on Norfolk Island, and it is to be hoped that future collecting will reveal whether *H. coprosmae* also occurs there.

Cerodontha Rondani

The two species, *australis* Mall. and *sylvesterensis* sp.n, are obviously closely related and *sylvesterensis* represents a case of speciation during late Pleistocene. It was suprising to discover that in Australia, *australis* appears to be confined to the Sydney area, while it is the dominant species in New Zealand. It is postulated that *australis* has speciated in New Zealand from an Australian immigrant, with *milleri* Spencer as its sister-species in Australia. The presence of *australis* around Sydney (the type locality) could presumably be explained by a recent introduction from New Zealand.

The third species present in New Zealand, *angustipennis*, cannot be associated with any known species in Australia. It must be derived from an early, pre-Pleistocene immigrant which presumably reached Australia from the eastern Palaearctic via intervening mountain areas in Southeast Asia. A recognisable

relative may await discovery in Australia; alternatively, the *robusta* Malloch group (Spencer, in press) may represent a divergent line from the original ancestral species, though this group cannot now be directly associated with *angustipennis*.

Icteromyza triplicata is accepted as a recent immigrant from Australia (recent in this context being between 50,000 and 500,000 years). There is evidence of incipient speciation between the North Island and South Island populations which rules out introduction by man.

Liriomyza Mik

This is by far the largest genus in New Zealand, with over 50% of known species. Of the 22 confirmed species, 19 are endemic and these comprise five natural groups, as discussed below. There is irrefutable evidence of recent speciation, with the following species groups:

<i>umbrina</i> group	.....	.....	.....	.....	.....	5
<i>clianthi</i> group	.....	.....	.....	.....	.....	7
<i>flavocentralis</i> group	.....	.....	.....	.....	.....	3
<i>citreifemorata</i> group	.....	.....	.....	.....	.....	3

In addition, *oleariae* sp.n. represents an isolated species with no detectable affiliations.

The first three groups can only have evolved from an Australian ancestor but with Australian species still inadequately known, detailed ancestral relationships cannot be postulated at this time. Evidence so far available indicates considerable divergence from forms known in Australia. The relationship of the *citreifemorata* group appears to be with *huidobrensis* (Blanchard 1926) in South America. This fact is recorded but no explanation can be offered as to how an ancestral South American species might have reached New Zealand early enough to have produced three modern species feeding on three different hosts—certainly long before the arrival of Polynesian man.

The almost total melanism, with antennae, legs and scutellum entirely black, found in all species in the *umbrina* group and in three in the *clianthi* group is without parallel elsewhere.

The recent confirmation of two endemic species in the subantarctic islands, on Snares Islands and Antipodes Islands, probably indicates relatively rapid speciation in small, isolated populations. However, the possibility that one or both species may be present, undiscovered, on the South Island cannot be excluded.

At the present time only 18 *Liriomyza* species are known in Australia (although more can be expected with further collecting); only the semicosmopolitan *L. brassicae* is known in Tasmania. It is certainly remarkable that there should be more species in New Zealand than in Australia.

Phytoliriomyza Hendel

Of the seven New Zealand species, six are endemic. These belong to at least five separate groups and have evolved from five separate ancestors from Australia. Although 18 species are now recorded in Australia (Spencer, in press), the host is only known of two and probable affiliations of the New Zealand species can only be inferred from the male genitalia. Their diverse origin, with relationships which can be traced to species in Australia, New Guinea and Europe, indicates arrival in New Zealand of the ancestral species at differing times going back at least to late Tertiary. Three of the seven species are leaf-miners on ferns and these hosts would certainly have been available for early colonization in New Zealand.

The obvious relationship of *tearohensis* sp.n. with *pteridii* Spencer in Europe (see below) is of considerable significance. Dispersal of ancestral species from Europe (or eastern Asia) to New Zealand must indicate an ancient lineage which conservatively can be considered as late Tertiary. Given this timing, the similarity in both external morphology and in genitalia which has been maintained over this period

indicates great genetic stability, probably reflecting comparable stability in the fern-hosts.

The discovery in the Auckland Islands of a species previously known only in New South Wales is a striking example of long-distance dispersal, possibly direct from Australia.

Phytomyza Fallén

It is noteworthy that the four endemic species are all feeders on Ranunculaceae, three on *Ranunculus* and one on *Clematis*. The three species *costata* Harrison, *improvisa* sp.n and *lyalli* sp.n have clearly evolved from a single immigrant ancestor. This speciation is of particular significance, as one of the species, *lyalli*, and almost certainly *improvisa* also, are primarily internal stem-boring species and from these has evolved a purely leaf-mining species, *costata*. The shift to leaf-mining is clearly indicated in *lyalli*, whose larvae occasionally make true mines (Fig. 99), mainly but not exclusively, formed near the junction of the petiole with the leaf blade.

The genitalia of this group have remained typical of some Ranunculaceae-feeders elsewhere (cf. *P. clematidicolla* Spencer 1963: fig. 64). In contrast, *clematadi* Watt has highly differentiated genitalia which almost certainly indicate a long period of isolation in New Zealand; no sister-species can at the moment be detected. Despite this, its biology, host and larval characters confirm its relationship with Australian and northern hemisphere species feeding on *Clematis*.

This analysis clearly indicates the differing time of origin of many of the endemic species.

Summarizing, it appears that pre-Pleistocene ancestors have given rise to species in the genera *Hexomyza*, *Cerodontha*, *Phytoliriomyza*, and possibly *Phytomyza* (*clematadi*). All others could have evolved from immigrants from Australia (in one case South America) which reached New Zealand at varying times throughout the Pleistocene. The most recent arrivals prior to species introduced by man are *Icteromyza triplicata* and *Phytoliriomyza* sp. (Auckland Is.) which still show no significant differentiation from populations present in Australia.

Fox (1973) has summarised information on records from recent years of Australian Lepidoptera arriving in New Zealand. Such records relate exclusively to known migratory species. Strong westerlies blow not infrequently for several days in succession from Australia to New Zealand and small Diptera could easily be carried across the Tasman on such winds. After arrival in New Zealand, a suitable host-plant has to be available and found for successful colonization. The chances of such colonization are obviously slight, but nevertheless precisely this has occurred on at least 17 occasions to account, with subsequent speciation, for the present composition of the 34 endemic New Zealand species.

A more detailed account of the meteorological conditions necessary for the initial uplift of insects in Australia, their subsequent transport to New Zealand, and their final descent is given by Tomlinson (1973). The frequency of such conditions is conservatively estimated at 21 per year. Even if the earliest arrival in New Zealand was only 5 million years ago, it follows that the 17 successful colonizations which have occurred are the meagre result of 105 million occasions when conditions were suitable, that is one in 6 million. At least 10 arrivals might be necessary for the discovery of the right or at least an acceptable host-plant. On this basis the New Zealand Agromyzidae fauna has evolved from one colonization per 600,000 possibly suitable opportunities.

Comparison of the Agromyzidae of New Zealand with those of the primary source area, Australia, confirms the substantially better representation in Australia. Australia has double the number of genera (though not *Hexomyza*) and nearly three times the number of species (Spencer, in press). *Agromyza* Fallén, which is a large, widespread genus, particularly in the northern hemisphere, is present in Australia with three species (Spencer, in press). It is noteworthy that this has not

yet reached New Zealand. More surprising is the absence of *Ophiomyia* Braschnikov, which is well represented in New Guinea with eight species (Spencer 1976) and in Australia with 15 species (Spencer, in press). *Phytobia* Lioy, which is now accepted as consisting exclusively of internal tree-boring species, and is considered as probably the most primitive genus in the family, has five species in Australia and has reached Lord Howe Island (Spencer, in press). The absence of these three genera from New Zealand could indicate their recent arrival in Australia and this might possibly apply to *Agromyza* which is only known in the north and east (on the southward migration route from New Guinea). *Ophiomyia*, on the other hand, is widely distributed, with numerous species and its absence is a confirmation of the chance pattern of dispersal which has applied to successful colonization in New Zealand. Even *Ophiomyia lantanae* appears to be lacking in New Zealand. It has been deliberately introduced in many areas in an attempt to control *Lantana* (Spencer 1973a) but also appears on occasions to have been introduced inadvertently with *Lantana* (the larvae feed in the seeds). Colonies of *Lantana* were examined at three areas where it is established in the North Island—Whangaroa, at the roadside immediately north of the Rawene ferry, and on the coast near Opononi—but I could find no trace of *Ophiomyia lantanae*.

New Zealand and Australia have only seven species in common. Two of these, *Phytomyza plantaginis* and *P. syngenesiae*, represent recent introductions from Europe. *Liriomyza brassicae* is widespread throughout the Pacific; it may have spread naturally but has more probably been introduced both to New Zealand and to Australia. *Liriomyza chenopodii* is an Australian species which has almost certainly been introduced to New Zealand in association with its vegetable hosts, beet and spinach. *Cerodontha australis* is widely distributed throughout New Zealand and outlying islands but in Australia appears to be restricted to the Sydney area of New South Wales. Only two species—*Cerodontha* (*Icteromyza*) *triplicata* and *Phytoliriomyza* sp. (Auckland Is.)—are accepted as having reached New Zealand independently and sufficiently recently to be still indistinguishable from the ancestral Australian populations.

Distribution of the Agromyzidae within New Zealand is uneven. The family is represented from the extreme north of North Island (Te Pahi) to Stewart Island and the subantarctic islands in the south (Snares Islands, Auckland Islands and Antipodes Islands). However, the main centre of the family is the South Island, where 36 species occur. Only *L. hebae* is restricted to North Island, which has a total of 27 species. The number is reduced substantially in Stewart Island where only seven are known, although a few further species may be present. The reduction is even greater in the sub-antarctic islands, with three on Snares Islands, two each on Antipodes Islands and Auckland Islands.

It is surprising to find two species apparently restricted to the Snares (*Liriomyza lepidii*) and Antipodes Islands (*Liriomyza antipoda*). It is of course possible that both species may be found with further collecting in the South Island. If they are really endemic, they can only have evolved from South Island ancestral immigrants. The Snares and Antipodes Islands were never fully glaciated during the Pleistocene, and there has been ample time for speciation to have taken place, even at the slow rate which is normally expected in areas with long, cold winters and short summers. *Liriomyza antipoda* is closely related to other members of the *clianthi* group (see below) and speciation could have occurred relatively recently during late Pleistocene. *Liriomyza lepidii* shows little differentiation in the genitalia from the two other members of the *citreifemorata* group but the striking colour pattern of the mesonotum (Fig. 57) is unique among New Zealand *Liriomyza* species (although present in a few species in Europe, North and South America). It is impossible to decide whether this represents a case of long isolation or rapid morphological change.

Host Plants of New Zealand Agromyzidae (see list below)

This seemingly arbitrary colonization of suitable host genera is further evidence of the random immigration which has provided the basis of the modern New Zealand Agromyzid fauna.

[illegible]

Melanagromyza Hendel, 1920: 120; 1931: 156; Spencer, 1966: 3-60

Only the single species described below is known in New Zealand. This had previously been misidentified as the European species, *aeneoventris* (Fall.), by Harrison (1959).

The genus occurs widely throughout the world and is dominant in both the Old and New World tropics, with the number of species diminishing significantly towards more temperate areas in both the northern and southern hemispheres. In Australia 27 species are now known, including 17 which will be described shortly (Spencer, in press); as might be expected the genus is best represented in northern tropical and subtropical areas, and only one species is so far known in Tasmania.

Melanagromyza consists of stout, mainly black species but frequently with conspicuous metallic, greenish colouration of mesonotum and abdomen. The larvae are internal borers in stems and in a few cases also in flower heads. Host specificity is highly developed with many species restricted to their own genus in larger families such as Compositae and Umbelliferae. A wide range of families serve as hosts.

Melanagromyza senecionella Spencer, sp.n (Figs. 1-3)

Robust, greenish-black species, with wing length up to 3.1 mm.

Head: frons broad, twice width of eye, distinctly projecting above eye in profile; 2 ors, 2 ori, the upper ors reclinate, sometimes curving slightly outwards, the lower and the 2 ori slightly incurved; orbital setulae numerous but minute, in several rows, mainly reclinate but a few in front proclinate; jowls $\frac{1}{4}$ height of eye, cheeks forming narrow ring below eye; third antennal segment round or slightly broader than long, arista only finely pubescent.

Mesonotum: 2 or 3 dc (3 in 13 of 23 specimens seen), the third is normally post-sutural but in one case pre-sutural; acr irregularly in 8 rows.

Wing: length in male 2.4 mm, in female up to 3.1 mm, last section of vein M 3 + 4 two-thirds penultimate, first cross-vein at mid point of discal cell.

Colour: frons mat black, ocellar triangle and orbits weakly shining; mesonotum moderately shining, black with faint greenish or coppery undertone; abdomen shining greenish or coppery; squamae grey, margin and fringe black (in 12 fresh specimens) or (in older specimens) margin more brownish and fringe ochrous; halteres brownish-black.

Male genitalia: aedeagus as in Figures 1, 2; ninth sternite with greatly extended hypandrial apodeme (Fig. 3); surstyli broadly rounded with a fringe of short bristles at end, a fully developed internal flap within epandrium, with a single short bristle at end.

Host plant/Biology: *Senecio jacobaea*, *S. minima*, and probably other native *Senecio* spp; larva boring in stem and pupating internally; the puparium is straw-coloured, with the posterior spiracular plates separated by up to their own diameter, each with an ellipse of 15-18 pores surrounding the black central horn. There is at least a partial second generation. Adults associated with *Senecio minima*, and larval mines in inflorescence stalks were found at Fortrose and Tautuku Forest, Southland, in early February, 1976 (J. S. Dugdale, pers. comm.).

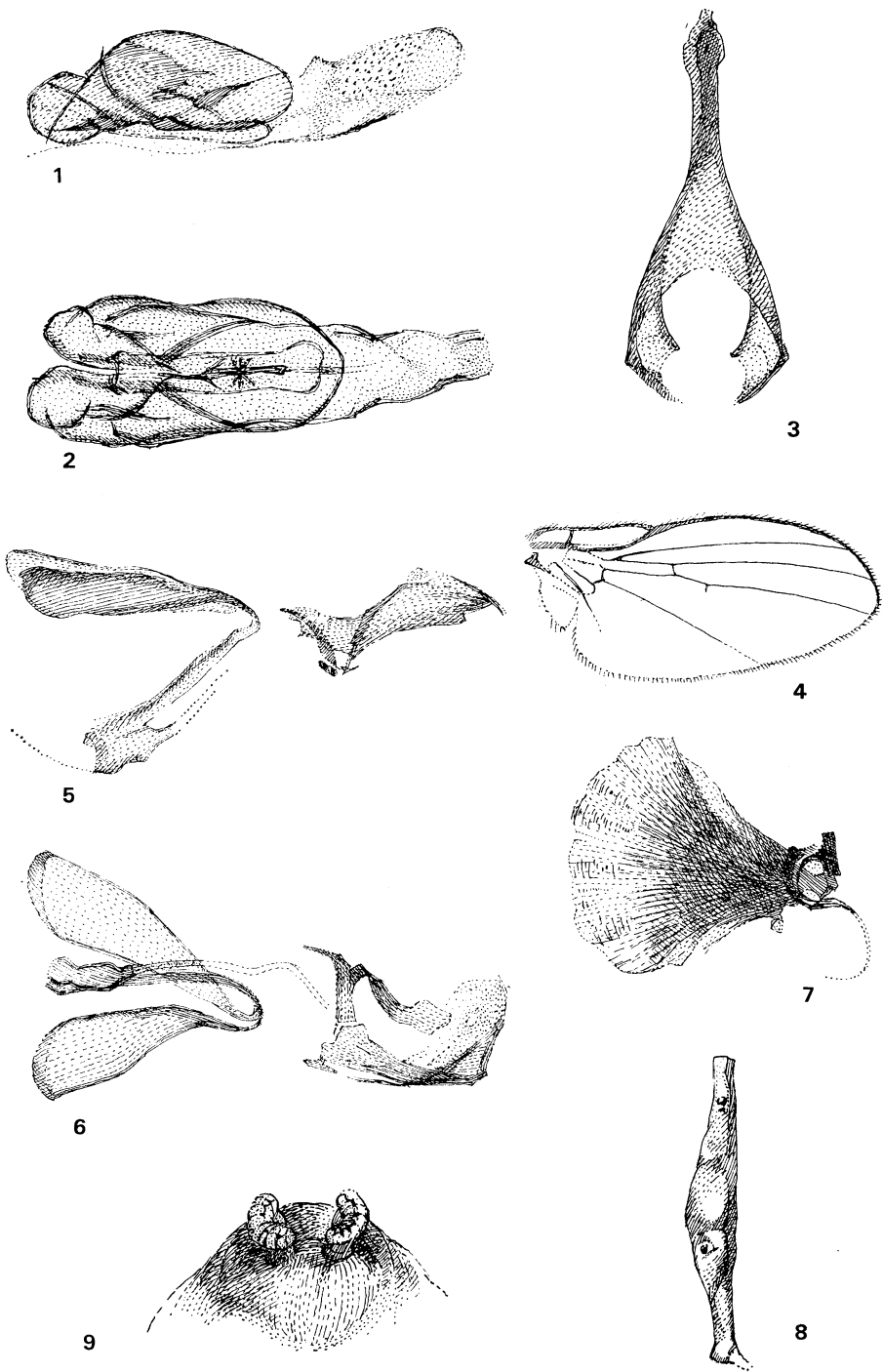
Type locality: South Is.: Murchison.

HOLOTYPE: ♂, South Is.: Murchison, emerged 16.i.75 from puparium coll. 2.i. (K.A.S.) in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

PARATYPES: 1♀, same data as holotype; Hollyford, 1♂, 2♀, emerged 12-25.vii.75 (forced), from puparium coll. 25.i.75; Waiho, 1♀, 17.i.22 (A. Tonnoir); 2♂, 1♀, Fortrose, Southland, 1.ii.76; 4♀♀, Tautuku Forest, Southland, 1.ii.76 (J.S.D.) North I.: Rotorua, Lake Tikitere, 1♀, 14.xii.74, on ragwort (K.A.S.); Coromandel Forest Park, near Thames, 1♂, emerged 2.i.75, 1♂, 16.i.75, 1♀, 26.xii.74, 2♀, July 1975, all ex puparia in ragwort coll. 26.xii.74 (K.A.S.); 2♂, 1♀, Mangapehi, 16.ii.38 (No. 178), also 1 puparium mounted separately; Rangiora, 4♀ (2 with puparium), 1.vi.43 (No. 830), "in ragwort"; Palmerston North, Experimental Area, 2♀, 8.iv.30, "Ex ragwort" (W. Cottier). Stewart I.: Oban, 1♀, July 1975, ex puparium coll. 22.i.75.

REMARKS: This species has been recorded by Harrison (1959: 307) and elsewhere in New Zealand literature as the European *M. aeneoventris* (Fallén). It closely resembles *aeneoventris* but the male genitalia of the two are entirely distinct and show that they are not related.

M. senecionella is in fact of Australian origin and is clearly the sister-species of *M. seneciophila* Spencer, 1963, known from the Sydney area with *Senecio vagus* F. Muell. as host. The primary hosts of *senecionella* are wide-ranging native *Senecio* spp. such as *S. minima* (Poir) Drury, and ragwort has been colonized since its introduction by early settlers. It appears to be present wherever ragwort occurs and larvae were found near Haast, in the Cascade-Hollyford area, at Te Anau, between Invercargill and The Bluff, and on Stewart Island; they were particularly common



FIGS. 1-3.—*Melanagromyza senecionella* sp.n.; 1, aedeagus, side view; 2, same, ventral view, 3, ninth sternite. FIGS. 4-9.—*Hexomyza coprosmae* sp.n.: 4, wing; 5, aedeagus, side view; 6, same, ventral view; 7, ejaculatory apodeme; 8, galls on *Coprosma propinqua*; 9, posterior spiracles of puparium.

in the Oban area. It was interesting and unusual to find adults emerging while the host-plants were still relatively young and fresh, representing a partial second generation.

Differences between the New Zealand and Australian species are slight but I am satisfied that the two are distinct. The aedeagus of *seneciophila* is illustrated by Spencer (in press); the asymmetry characteristic of *senecionella* is similar but the detail differs. In the limited material seen of *senecionella* there are only 2 dc and the squamal fringe is pale.

The differing colour of the squamal margin and fringe in the fresh specimens of *senecionella*—uniformally black—and the older specimens in the D.S.I.R. collection obtained between 1922 and 1943—margin brownish, fringe ochreous—is difficult to explain, although it could possibly be due to fading.

Genus *Hexomyza* Enderlein

Hexomyza Enderlein, 1936: 182; Spencer, 1966: 38

Type of genus: *Melanagromyza sarothamni* Hendel, 1923: 143

This small genus is represented in Europe, Japan, North America and South Africa. Only one species, described below, is known in New Zealand.

In his European Monograph, Hendel (1931-36) included *Hexomyza* species in *Melanagromyza* from which they cannot be satisfactorily distinguished on external characters. However, all species are gall-causers on woody twigs of bushes or trees and this distinctive feeding habit, combined with characteristic larval characters and male genitalia, justifies segregating them in a separate genus. Hendel (1936: 570) rejected Enderlein's genus *Hexomyza*, but this was revived in a revision of European species by Spencer (1966: 38-46).

Hexomyza coprosmae Spencer sp.n. (Figs. 4-9)

Medium-sized black species with second cross-vein normally only partially developed.

Head: frons broad, twice width of eye; orbits conspicuously differentiated, predominantly raised above frons; 2 ors, 2 ori, orbital setulae numerous, in several rows, reclinate; jowls broad, 1/3 height of eye, cheeks forming prominent ring below eye; eye small, upright; third antennal segment small, rounded; arista fine, bare.

Mesonotum: 2 + 0 dc, acr numerous, in some 8 rows.

Wing (Fig. 4): length from 2.4 mm in male to 2.6 mm in female; costa extending to vein M 1 + 2, last and penultimate sections of M 3 + 4 equal when second cross-vein present but this normally only partially developed, rarely entirely absent.

Legs: mid-tibiae without lateral bristles.

Colour: frons sooty black, ocellar triangle entirely mat, appearing somewhat brownish viewed from front; orbits largely mat black but brown for a short distance in area of lower ori; mesonotum strongly shining black, abdomen similar, without any metallic colouration; legs black, squamae grey, margin and fringe black.

Male genitalia: aedeagus greatly simplified, as in Figures 5, 6; ejaculatory apodeme unusually large, triangular (Fig. 7); ninth sternite pointed but without extended hypandrial apodeme; surstyli extending inwards, with some six long hairs on inner corner.

Host-plant/Biology: *Coprosma* spp., mainly *C. propinqua* but also *C. acerosa*, larva forming oval twig gall (Fig. 8), pupating in the gall and emerging through a circular exit hole prepared by the larva. Fragments of puparia extracted from old galls are typical of the genus. The colour is pale, straw-coloured, tending towards pale grey, with conspicuous "scar-bands"—areas of dark pigmentation—around the segment boundaries (cf *Hexomyza sarothamni*, Spencer, 1966: fig. 69). No front segments have been seen but the posterior spiracles are closely adjoining, on a roughly circular area of black chitinization, each on a slender stalk, with an ellipse of 8 minute bulbs (Fig. 9).

Type locality: South I.: Kohatu, Motueka Valley.

HOLOTYPE: ♂, South I.: Kohatu, Begg's Corner, Motueka Valley, ex *Coprosma propinqua*, coll. 15.viii.68, emerged 7.x.68 (J. S. Dugdale); in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

PARATYPES: 2 ♂, 2 ♀, same data, 1 ♂, 1 ♀, emerged 10.x.68; 1 ♀, Kohatu, other data lacking; Waiho, 1 ♂, 15.i.22 (A. Tonnoir); North I.: Wanganui Beach, 6 ♀, coll. 28.x.68, emerged 20.xi.68, ex *C. acerosa* (all J. S. Dugdale). Galls were common on *Coprosma propinqua* at

REMARKS: This species is typical of other gall-causers in the genus *Hexomyza*. *H. simplicoides* (Hendel) shows a similar tendency to the loss, partial or complete, of the second cross-vein (cf. Spencer 1966: 44). Of the 16 specimens of *coprosmae* seen, the second cross-vein is fully developed in 6, completely lacking in 1 and rudimentary as illustrated in 9. In all cases there is complete symmetry between the two wings.

With no members of this genus known in Australia it is difficult to explain the presence of this species in New Zealand. The divergent genitalia indicate long isolation.

Genus **Cerodontha** Rondani

This is a large genus of world-wide distribution with approximately 150 species but with its greatest representation in the northern hemisphere. In Europe 77 species are known, in Canada 33.

Four species are discussed below, of which one, *Cerodontha sylvesterensis*, is described as new, and one, *Icteromyza triplicata*, represents the first record of the sub-genus in New Zealand.

1.	Third antennal segment with spine (Fig. 17); scutellum with one pair of bristles (sub-genus <i>Cerodontha</i>)	2
	Third antennal segment rounded; scutellum with two pairs of bristles	
2.	Mesonotum and scutellum deep black; 2+1 dc	<i>Icteromyza triplicata</i> (Spencer)
	Mesonotum and scutellum grey; 3+1 dc	<i>angustipennis</i> Harrison
3.	Femora bright yellow, unmarked; notopleural area grey	3
	Femora yellow with irregular black striations; notopleural area yellow.	<i>australis</i> Malloch
		<i>sylvesterensis</i> sp.n.

Hendel, 1931: 18 (sub-genus of *Dizygomyza*). Type species: *Agromyza geniculata*
 Fallén, 1823a: 6 (Europe).

Distinctive characters of this sub-genus are the extended ocellar triangle, with the apex frequently reaching the lunule and the widely separated antennae; the frons can vary from yellow to totally black, with the lunule always yellow; the third antennal segment is round in both sexes.

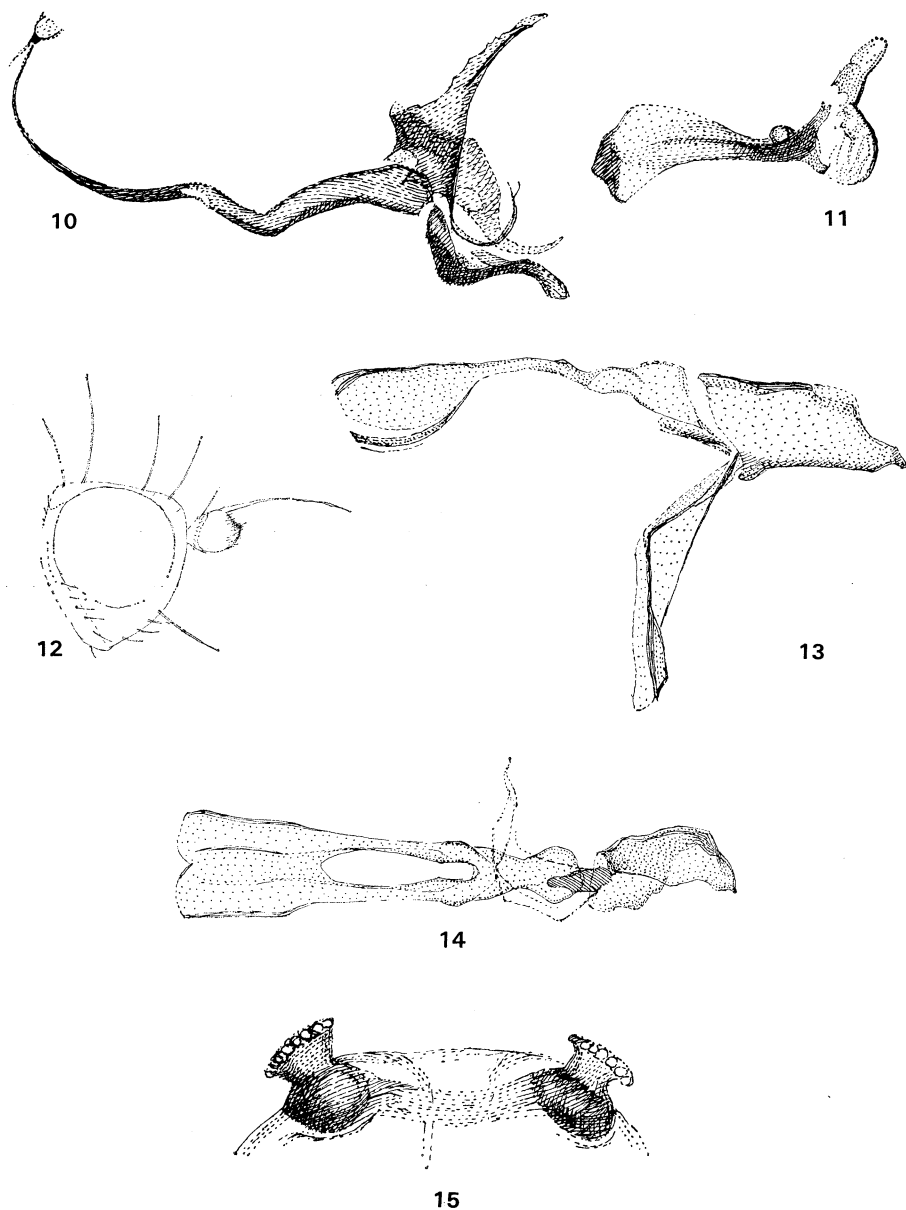
The male genitalia confirm the close relationship of *Icteromyza* and *Cerodontha*, despite the significant differences in external characters between the two sub-genera. Only 15 species are known.

***Icteromyza triplicata* (Spencer, 1963), comb. nov.**

New to New Zealand

Phytobia (*Icteromyza*) *triplicata* Spencer, 1963: 328

Diagnosis: frons yellowish in front, variably darkened, brownish, behind; lunule higher than a semicircle, yellow; ocellar triangle extended at least in outline towards margin of



FIGS. 10, 11.—*Cerodontha* (*Icteromyza*) *triplicata*: 10, aedeagus; 11, ejaculatory apodeme (Waipoua). FIGS. 12-15.—*Cerodontha* (*Cerodontha*) *angustipennis*: 12, head; 13, aedeagus; side view; 14, same, ventral view; 15, posterior spiracles of puparium.

lunule; jowls, face and palps yellow; third antennal segment rounded, black, first and second yellowish; mesonotum and scutellum mat black, acr in 4 rows; sides of thorax black, only mesopleura with narrow yellow upper margin; legs black but all knees conspicuously yellow; squamae grey, margin and fringe black; wing length from 2 mm in male to 2.5 mm in female, sections of vein M 3+4 variable, either equal or last longer, in ratio up to 22 : 17 with penultimate; male genitalia: aedeagus as in Figure 10; ejaculatory, apodeme (Fig. 11) with blade well developed.

REMARKS: This species is now recorded for the first time in New Zealand and has now been found at three separate localities in both North and South Islands.

The host of this species is unknown, but at two localities it was noted that *Juncus effusus* was present. *Juncus* is known as the host of one species in North America and suspected as host of one European species. This can therefore certainly be considered as one possible host of *triplicata*.

Ict. triplicata was described from a number of localities in New South Wales and one near Canberra, A.C.T. Recently 20 further specimens have been seen from Australia, with the range extending northwards to Queensland. The species appears to be widespread but local in New Zealand, extending from Waipoua in the North Island to the Waiho River on the West Coast of the South Island near Fox Glacier.

The aedeagus itself is identical in New Zealand and Australian specimens. However, there are other slight differences in the genitalia. In Australian specimens the ninth sternite is distinctly elongate, with lightly chitinated sidearms and the ejaculatory apodeme is narrower, almost linear. In males examined from both the North and South Island populations the ninth sternite is shorter, with broader, darker sidearms, and the ejaculatory apodeme has the blade more developed. These differences indicate that the species is not a recent introduction but has reached New Zealand by over-water dispersal from Australia. However, I do not consider that at this stage they justify treating the Australian and New Zealand populations as distinct species.

Material Collected:

NORTH ISLAND

8 km east of Waimamaku, north of Waipoua, 3♂, 21.xii.74; Coromandel, 2♂, 1♀, 26.xii.74.

SOUTH ISLAND

Doherty's Creek, nr. Waiho River, 3♂, 3♀, 7.i.75. Whatamongo Bay, Q. Charlotte Sound, Marlborough, 1♂, 1♀, 5.ii.76 (J.S.D.).

Sub-genus *Cerodontha* Rondani

The three species present in New Zealand are immediately recognisable by the spine on the third antennal segment (Fig. 17) and the presence of only two scutellar bristles. Two, *angustipennis* and *sylvesterensis*, are endemic, while the third, *australis*, is present in Australia and also on Norfolk, Chatham and Snares Islands.

The sub-genus is represented in Australia by 7 species (Spencer, in press) but surprisingly has not been recorded in New Guinea.

Cerodontha angustipennis Harrison, 1959 (Figs. 12-15)

Cerodontha angustipennis Harrison, 1959. 311

The colour of this species is distinctive and it is immediately distinguishable from *australis* by the deep black mesonotum and mesopleura and the contrasting yellow notopleura. Other important characters are: frons basically yellow but normally darkened centrally from apex of ocellar triangle to lunule; third antennal segment (Fig. 12) black, normally with short spine but in up to 20 percent of specimens seen this can be rudimentary or entirely lacking, first and second segments yellow; mesonotum and scutellum black but varying from mat to brilliantly shining; legs entirely bright yellow; abdomen black, tergites at most narrowly yellow-bordered; in female, ovipositor sheath densely grey-dusted.

The aedeagus, shown in Figures 13, 14, is unusual in having the terminal processes of the distal tubules greatly enlarged and entirely fused but the tubules behind are widely separated.

No hosts of *angustipennis* have hitherto been recorded but it was known that the larvae must be grass-feeders. The original host or hosts must have been endemic species but it is clear that introduced species have been colonized. Several specimens and also puparia obtained at Stewart Island from *Holcus lanatus* (Yorkshire Fog) are present in the Watt Collection, together with a sheet of Watt's collecting data (M.14.); males were found between November and January in 1958, 1960, and 1961. Watt apparently recognised the species as undescribed but had ceased detailed work on the Agromyzidae at this time and refers to it as the "Fog-grass fly miner". The puparium is pale, straw-coloured, usually slender, with deep segmentations; the posterior spiracles have a regular ellipse of about 8 minute bulbs (Fig. 15).

C. angustipennis is not closely related to the other two species present in New Zealand. The entirely different colour, the reduction in the number of dorso-central bristles, the differing form of aedeagus and larval characters all indicate its isolated position, and no obvious relative is known in Australia or anywhere in Southeast Asia; it is possibly related to the *affinis*-group in Europe (cf. Nowakowski 1973).

Harrison (1959) records *angustipennis* from 10 localities in both North and South Islands. My own collecting confirms that it is widespread and frequently occurs together with *australis* but it is more local and less numerous. It is present even at relatively high altitudes, on the summit of Mt Te Aroha and also on the "Alpine Garden" at Fox Glacier.

Material Collected:

NORTH ISLAND

Mt Te Aroha, 915 m, 3 ♀, 27.xii.74; Rotorua, Paradise Springs, 5 ♀, 13.xii.74; Mt. Egmont, 3 ♂, 2 ♀, 10.xii.74.

SOUTH ISLAND

Christchurch, Riccarton Bush, 1 ♀, 3.xii.74; Fox Glacier, "Alpine Garden" 1220m, 2 ♂, 1 ♀, 8.i.75; Doherty's Creek, South of Waiho River, 1 ♀, 7.i.75.

STEWART ISLAND

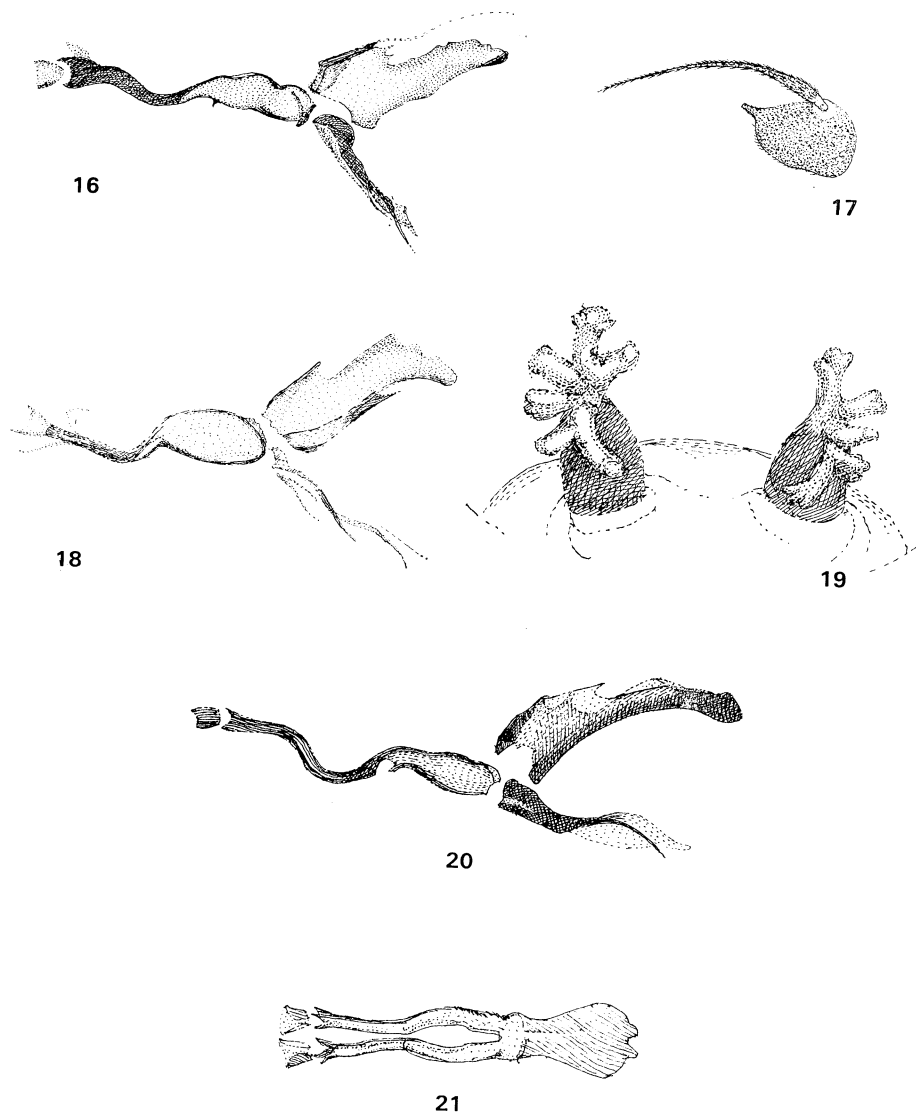
Freshwater River, 1 ♀, 25.i.75.

***Cerodontha (Cerodontha) australis* Malloch, 1925 (Figs. 16-19)**

Cerodontha australis Malloch, 1925: 89

In the past there has been confusion about the status of this species in New Zealand, where it was misidentified as the Palaearctic species, *denticornis* (Pz.) by local workers, until its true identity was established by Spencer (1973a: 289). The distinctive aedeagus is shown in Figure 16 and the third antennal segment in Figure 17. As Malloch rightly noted in his description, *australis* is differentiated from *denticornis* by the invariable presence of at least some acrostichals; the scutellum is also always grey, never partially yellow, as frequently in *denticornis*. This is without question the commonest Agromyzid in New Zealand, occurring in large numbers in meadows and at roadsides throughout the North and South Islands. Harrison (1959: 309) also gives records for Burgess Island, Little Barrier Island, Mayor Island and Pitt Is. (Chatham Islands). It is also present on Snares Islands (Harrison 1976). The species was described from Sydney, N.S.W., and in Australia it appears to be limited to this area.

C. australis is present on Norfolk Island but a population on Lord Howe Island has been found to represent *C. milleri* Spencer, 1973a, described from N.S.W. and this, not *australis*, is the common and widespread species in southeast Australia. These two species are not reliably distinguishable on external characters, but the aedeagus is quite distinct (cf. Spencer 1973a: fig. 468). *C. milleri* is not known in New Zealand.



FIGS. 16-19.—*Cerodontha* (*Cerodontha*) *australis*: 16, aedeagus; 17, third antennal segment; 18, aedeagus (Waitakere); 19, posterior spiracles of puparium in *Poa anceps*, Oaro. FIGS. 20, 21—*Cerodontha* (*Cerodontha*) *sylvesterensis*: 20, aedeagus, side view; 21, distiphallus, ventral view.

C. australis is immediately distinguishable from *angustipennis* (with which it overlaps in distribution) by the grey rather than black mesonotum and the grey, not yellow, notopleural area. It closely resembles *sylvesterensis* sp.n known only from Lake Sylvester, Nelson, but in this species the notopleural area is yellow, the femora are darkened and the aedeagus is larger and with different curvature (Fig. 20). A single male from "Dreamlands" (now Waitakere Lodge) in the Waitakere Ranges near Auckland, 27.xii.50 (K. P. Lamb), is indistinguishable from *australis* but the aedeagus is significantly different (Fig. 18). I found *australis* to be common in this area on 17.xii.74 but the aedeagus was of the typical form. Without further evidence therefore I do not consider it justified to treat Lamb's specimen as distinct; possibly it represents merely an unusual aberration.

The hosts of *australis* are exclusively grasses. The introduced species *Hordeum vulgare*, *Lolium perenne*, and *Triticum aestivum* have previously been confirmed as hosts, and I also found mines on *Dactylis glomerata* and on one native grass, *Poa anceps*. The elongate brownish puparium remains in the mine. The posterior spiracles each have 5 or 6 irregularly branching "bulbs" (Fig. 19) and this will enable larvae or puparia to be distinguished from those of *angustipennis* in which there is a regular ellipse of 8 minute, unstalked bulbs (Fig. 15).

The possible economic significance of *australis* has been discussed by Morrison (1938) and by Cumber and Harrison (1959), in both cases as *denticornis*. A paper by Hamilton (1947) is misleading, as the illustrations given are those of *dorsalis* (Loew) in the United States, copied from a paper on this species by Luginbill and Urbahns (1916).

Material Collected:

In view of the enormous numbers of *australis* present virtually throughout New Zealand only small samples were taken from the different localities I visited.

NORTH ISLAND

Takahue, near Kaitaia, 1♂, 1♀, 23.xiii.74; Mangamuka Gorge, 1♂, 3♀, 24.xii.74; Whangaroa, 1♂, 20.xii.74; Kaikohe, 1♀, 19.xii.74; Waimamaku, near Waipoua, 2♂ 2.xii.74; Waipoua Forest, 1♀, 21.xii.74; Waitakere Range, 12♂, 2♀, 17.xii.74; Coromandel, 1♀, 26.xii.74; Mt Te Aroha, 2♂, 1♀, 27.xii.74; Cambridge, 2♂, 2♀, 15.xii.74; Rotorua, Lake Tikitere, 3♂, 14.xii.74; Paradise Springs, 2♂, 2♀, 13.xii.74; Mt Ruapehu, 3♂, 1♀, 28.xii.74; Tongariro National Park, 3♂, 1♀, 29.xii.74; Mt Messenger, 1♂, 12.xii.74; Mt Egmont, 7♂, 8♀, 11.xii.74; Wellington Botanical Gardens, 1♀, 30.xii.74.

SOUTH ISLAND

Lake Sylvester, Nelson, 3♂, 2♀, 1.i.75; Oaro, 1♀, emerged 20.xii.74 ex *Poa anceps* coll. 3.xii; Christchurch, Riccarton Bush, 1♂, 3♀, emerged 14.xii.74 ex *Dactylis glomerata* coll. 2.xii.74; Mt Hutt, 1680 m, 1♂, 1.i.75; Fox Glacier, "Alpine Garden", 1220 m, 2♂, 8.i.75; Mt Cook, Hermitage area, 2♂, 2♀, 13-14.i.75; Wanaka, 1♂, 10.i.75; near Mt Aspiring, 1♂, 1♀, 11.i.75; Crown Range, 1♂, 1♀, 20.i.75; Hollyford Valley, 2♂, 22.i.75.

STEWART ISLAND

Freshwater River, 2♂, 1♀, 25.i.75.

Cerodontha sylvesterensis Spencer sp.n (Figs. 20, 21)

Head: frons broad, twice width of eye, distinctly projecting above eye in profile; 2 widely-spaced, reclinate ors, the upper slightly stronger, 2 incurved ori, the lower weak; orbital setulae sparse, 2 on one side, 3 on the other; lunule higher than a semicircle; jowls deepest at rear, $\frac{1}{4}$ height of eye; third antennal segment elongate, with short spine at upper corner.

Mesonotum: 3 + 1 dc, 3rd and 4th equal; acr present, with 2 pairs at level of 3rd dc.

Wing: length in male 1.75 m., last section of vein M 3+4 marginally shorter than penultimate, in ratio 15 : 18, first cross-vein at midpoint of discal cell.

Colour: frons brownish-yellow, orbits and lunule paler, yellow hind-margin of eye black to base of vte; jowls, face and palps yellow; third antennal segment black, first and second yellow; mesonotum and scutellum uniformly mat, brownish-grey; sides of thorax largely black but upper margin of mesopleura, rear of humerus and notopleural area yellow; legs: coxae on p_1 yellow, on p_2 and p_3 largely black; femora basically bright yellow but darkened with irregular black striations; squamae yellow, margin and fringe black; halteres bright yellow.

Male genitalia: aedeagus as in Figures 20, 21.

Type locality: South I., Lake Sylvester.

HOLOTYPE: ♂, South I.: Nelson Prv., Lake Sylvester, 1310 m, 1.i.75 (K.A.S.), in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

REMARKS: Although this species closely resembles *australis*, the colour differences of the thorax and legs, combined with a distinct difference in the aedeagus, justifies treating the unique specimen as representing a distinct species. Specimens of *australis* were also found at Lake Sylvester, and in these the aedeagus is typical of the species.

Genus *Liriomyza* Mik

Liriomyza Mik, 1894: 284. Type of genus *Liriomyza urophorina* Mik

The traditional diagnosis of *Liriomyza* was based on three essential characters: orbital setulae reclinate, scutellum yellow and costa extending to vein M 1 + 2. In

the great majority of species the frons and antennae are bright yellow. The few species with the third antennal segment black known mainly in Europe have recently been found to belong to *Phytoliriomyza*; conversely, it has been found that two species in Europe with the scutellum entirely dark do correctly belong in *Liriomyza* (Spencer, in press). Von Tschirnhaus (1971) discovered that a well-defined stridulating mechanism is present in the males of *Liriomyza*, with a "scraper"—a sharp, strongly chitinized ridge—present on the hind-femora and a "file" along the connecting membrane between the abdominal tergites and sternites consisting of a line of chitinized scales. This is an important character for defining the monophyly of the genus, but nevertheless I believe it cannot be applied with 100 percent rigidity, as its secondary loss in individual cases cannot be excluded.

Harrison (1959) included 5 species in *Liriomyza*; four species having the scutellum dark were placed in *Phytobia* Lioy. However, it has now been found that three of these, *umbrina* Watt, *umbrinella* Watt and *flavolateralis* Watt correctly belong in *Liriomyza*, while the fourth, *flavopleura* Watt, belongs in *Phytoliriomyza*. In view of the absence of the second cross-vein, Watt, followed by Harrison, placed *chenopodii* in *Haplomyza* but this is also a true *Liriomyza*. A further species, *brassicae* (Riley), has been known in New Zealand for several years but has never been formally recorded. An undescribed species bred by Watt from *Olearia* was discovered when I studied his collection in the National Museum, Wellington, and I was able to confirm two species as new on Snares Islands and Antipodes Islands which have now been described by Harrison (1976). My own collecting resulted in the discovery of seven undescribed species, and as this paper was nearing completion I received from J. S. Dugdale a further undescribed species which he bred from *Plantago raoulii* in South Island. The number of species known in the genus in New Zealand is thus now 21. One further apparently undescribed species from Sumner, near Christchurch, is also briefly discussed.

Near the summit of Mt Hutt I found leaves of *Gentiana corymbifera* (det. H. Wilson) showing clear feeding punctures of an Agromyzid, and puparia from this host have since been found in the Mount Cook area (J. Sweney) but no adults have yet been obtained. Mr Dugdale found mines on *Hydrocotyle novaezealandiae* at a streamside at Simonin Creek, 945 m and from *Schizeilema* sp. in rock clefts, Tempest Ridge, West Olivine Range, 1370-1465 m, Red Mountains, South I., 2.ii.75. The mine largely follows the margin of the leaf and the larva pupates externally, forming a pale yellow puparium, 1.5 mm long. These mines on *Gentiana*, *Hydrocotyle*, and *Schizeilema* are probably both produced by undescribed species, but the latter two might prove to represent *penita* sp.n described below from Fox Glacier.

The 19 endemic New Zealand species can be divided into five natural groups:

1. The *umbrina* group consisting of the black *Hebe* feeders + *plantaginella* sp.n.
2. The *clianthi* group consisting of 7 species: *clianthi* (Watt), *homeri* sp.n., *penita* sp.n, *vicina* sp.n, *antipoda* Harrison + *flavolateralis* (Watt) and *urticae* (Watt).
3. The *flavocentralis* group, with *flavocentralis* on *Hebe* + *lepidii* Harrison on *Lepidium* and *watti* sp.n. (host unconfirmed).
4. An isolated species, *oleariae* sp.n.
5. The *citreifemorata* group, with *citreifemorata* (Watt) and *craspediae* sp.n. + *wahlenbergiae* sp.n.

Watt (1923) correctly diagnosed four species feeding as leafminers on *Hebe*. One further *Hebe* feeder, *hebae* sp.n, was discovered at three localities in North Island. The relationships between these five species are clearly indicated by their male genitalia. *L. umbrina* and *umbrinella* are sister-species, and it is interesting that of the five only these two pupate within the mine. *L. umbrosa* and *hebae* are probably a further pair of sister-species. On the other hand *flavocentralis*, which is the commonest and most widespread of the *Hebe*-feeders, is not directly related to the other four and forms a separate group with *watti* sp.n., whose host is unknown

but which was found exclusively on foliage of *Tropaeolum*, and with *lepidii* Harrison, known only from *Lepidium oleraceum* on Snares Islands.

L. plantaginella is included in the *umbrina* group as it lacks the projecting, paired processes within the distiphallus, although it has the strong chitinization of the aedeagus common to five of the *clianthi* group. The close relationship of the Plantaginaceae and the Scrophulariaceae (*Hebe*) also supports the inclusion of *plantaginella* with the black *Hebe*-feeders; a comparably close relationship between species feeding on *Plantago* on the one hand and genera of the Scrophulariaceae on the other is known in Europe in the genus *Phytomyza*.

The largest group may be referred to as the *clianthi* group. The close relationship of *clianthi*, *homeri*, *penita*, *vicina*, and *antipoda* Harrison from Antipodes Islands is obvious from the male genitalia (see Figs. 22-23); *flavolateralis* and *urticae* are tentatively placed in this group but diverge somewhat from the other five.

Three species having a conspicuous gap between the medial and distal sections of the aedeagus and with the distal section characteristically divided, form the *citreifemorata* group. The close relationship of *craspediae* sp.n on *Craspedia* (Compositae) and *wahlenbergiae* sp.n on *Wahlenbergia* (Campanulaceae) causes no surprise, as individual species in Europe in two different genera are known with precisely these two families as favourite hosts. However, the host of *citreifemorata*, *Myoporum laetum* (Myoporaceae), is two sub-classes removed from the hosts of the other two species (Cronquist 1968) and there has been a significant jump in host selection at the time of speciation of *citreifemorata* and *craspediae* + *wahlenbergiae*, which are themselves with little doubt sister-species.

L. oleariae sp.n is an isolated species and at the moment I know of no species with which it can definitely be associated in Australia or elsewhere. *L. chenopodii* almost certainly represents an introduction from Australia with vegetables; it occurs commonly on beet and spinach, in addition to wild hosts such as *Cerastium*. *L. brassicae* is common in eastern Australia and is present on most Pacific islands; it has recently been found on Tonga and the Cook Is. by J. S. Dugdale.

Of the 22 species in New Zealand, significantly only *brassicae* and *chenopodii* have the primitive larval character of 3 bulbs on each posterior spiracular process. All others have an ellipse of 6-15 bulbs (Fig. 39) representing a derived condition which is present only in a small minority of species elsewhere in the world. *L. plantaginella* is unique in the genus in having the spiracular bulbs irregularly "stalked" (Fig. 50). The *citreifemorata* group appear to be related to *huidobrensis* Blanchard which is the dominant species in temperate areas (higher altitudes or higher latitudes) in South America from Venezuela to Chile (cf. Spencer 1973a: figs. 316, 317). How or when *huidobrensis* or an ancestral species may have reached New Zealand from South America is a matter of speculation which it is not proposed to pursue further here.

The totally black species in the *umbrina* group and the three largely black species in the *clianthi* group, *homeri*, *penita*, and *vicina*, are without parallel in the genus. A tempting explanation is that these species show retention of the primitive dark coloration of original ancestors which must have been largely black. However, *Hebe* is unknown in the fossil record prior to the Pleistocene, and its derivation from the predominantly Eurasian genus *Veronica* is fully accepted. This group probably did not reach Australasia before late Pliocene (Raven 1973). *Plantago* first appeared in the fossil record in early Pleistocene (Fleming 1962: 86). This suggests a date for *plantaginella* substantially later, in mid- or late Pleistocene. With the hosts of these black species, *Hebe* and *Plantago*, so relatively recent it is illogical and implausible to treat them as ancient and primitive. The alternative explanation must therefore be assumed, that their dark colour represents a secondary development of melanism, based on a mutation which has arisen possibly connected with

the abnormally high rainfall on the western mountain slopes in the South Island (Salmon 1954; Kettlewell 1973). No comparable species are known in Australia.

Liriomyza is essentially a temperate, northern hemisphere genus, with a world total of some 250 described species. In the Old World tropics, representation is drastically reduced, but there is some proliferation of species in South America. It is noteworthy that only two species have been found in New Guinea (Spencer 1976); one of these is *brassicae*, while the other, *mikaniae* Spencer, 1976, is also present in Malaysia and Singapore. Only 18 species are known in Australia but more certainly await discovery there.

KEY TO NEW ZEALAND *Liriomyza* SPECIES
(including 3 *Phytoliriomyza* species)

- | | | |
|--|---------------------------------------|----|
| 1. Second cross-vein lacking | <i>chenopodii</i> (Watt) | |
| Second cross-vein present | | 2 |
| 2. Mesonotum yellow adjoining scutellum | | 3 |
| Mesonotum dark to margin of scutellum | | 5 |
| 3. Mesonotum divided into black and yellow bands (Fig. 57) | | 4 |
| Mesonotum with small oval yellow patch adjoining scutellum | <i>Phytoliriomyza bicolorata</i> sp.n | |
| 4. Last section of vein M 3 + 4 $3\frac{1}{2}$ times length of penultimate; small species, wing length 2.3 mm | <i>lepidii</i> Harrison | |
| Last section of M 3 + 4 only slightly longer than penultimate; larger species, wing length 2.5 to 2.9 mm | <i>Phytoliriomyza cyatheae</i> sp.n. | |
| 5. Third antennal segment black or at least partially darkened, brownish | | 6 |
| Third antennal segment yellow or orange | | 18 |
| 6. Third antennal segment entirely black | | 7 |
| Third antennal segment darkened, but paler, brown or yellowish on inside | | 14 |
| 7. Scutellum black | | 8 |
| Scutellum yellow centrally | | 12 |
| 8. Frons entirely dark, black or brown | | 9 |
| Frons orange-yellow in front; large species, wing length 2.4-2.8 mm | <i>hebae</i> sp.n. | |
| 9. Humerus and notopleural area entirely black; small species, wing length 1.6-2.5 mm | <i>umbrinella</i> (Watt) | |
| At least humerus partially yellow | | 10 |
| 10. Both humerus and notopleural area yellow | <i>umbrina</i> (Watt) | |
| Only humerus faintly yellowish | | 11 |
| 11. Wings darkened; acr in 4 rows | <i>umbrosa</i> (Watt) | |
| Wings clear; acr sparse, in 2 rows | <i>homeri</i> sp.n. | |
| 12. Third antennal segment bare; minute species, wing length in male 1.5 mm | <i>penita</i> sp.n. | |
| Third antennal segment with long whitish pubescence | | 13 |
| 13. 3 + 1 dc; acr in 4 rows | <i>plantaginella</i> sp.n. | |
| 2 + 1 dc; acr in two rows | sp. (Sumner) | |
| 14. Mesonotum brilliantly shining black | <i>craspediae</i> sp.n. | |
| Mesonotum mat black or grey | | 15 |
| 15. Femora black, with all knees yellow; wing length in female up to 2.5 mm | <i>urticae</i> (Watt) | |
| Femora yellow, at most with brownish striations; smaller species, wing length from 1.4-1.75 mm | | 16 |
| 16. Mesonotum pale grey, entirely mat | <i>oleariae</i> sp.n. | |
| Mesonotum black or darker grey | | 17 |
| 17. Mesonotum mat greyish-black; wing length in male 1.4 mm; last section of vein M 3+4 from $2\frac{1}{2}$ to 3 times penultimate | <i>wahlenbergiae</i> sp.n. | |

	Mesonotum deeper black, largely mat but with distinct subshine; wing length in male 1.6 mm; last section of M 3+4 twice length of penultimate	.....	.....	.....	.....	.....	.....	.....	<i>vicina</i> sp.n.	
18.	Femora dark, black or brown, at most with yellow knees	.....	.....	.....	.....	.....	.....	.....		19
	Femora basically yellow, with or without brownish striations	.....	.....	.....	.....	.....	.....	.....		21
19.	Scutellum greyish-black, at most faintly yellowish viewed from rear	.....	.....	.....	.....	.....	.....	.....	<i>flavolateralis</i> (Watt)	
	Scutellum yellow, at least centrally	.....	.....	.....	.....	.....	.....	.....		20
20.	All knees bright yellow; last section of vein M 3+4 about $1\frac{1}{2}$ times length of penultimate; in female basal cone of ovipositor brilliantly shining; large species, wing length from 2.2 mm in male to 3 mm in female	.....	.....	.....	.....	.....	.....	.....	<i>flavocentralis</i> (Watt)	
	Only fore-knees yellow; last section of M 3+4 from 2 to $2\frac{1}{2}$ times length of penultimate; in female basal cone of ovipositor entirely grey-dusted; small species, wing length from 1.75 mm in male to 2 mm in female	.....	.....	.....	.....	.....	.....	.....	<i>watti</i> sp.n.	22
21.	Mesonotum distinctly black	.....	.....	.....	.....	.....	.....	.....		
	Mesonotum mat grey; mesopleura variably black below, yellow in upper half; acr extending almost to 1st dc; discal cell small, last section of M 3+4 from $2\frac{1}{2}$ to 3 times length of penultimate	.....	.....	.....	.....	.....	.....	.....	<i>clianthi</i> (Watt)	
22.	Mesopleura entirely black	.....	.....	.....	.....	.....	.....	.....	<i>antipoda</i> Harrison	
	Mesopleura at most black on lower and front margins	.....	.....	.....	.....	.....	.....	.....		23
23.	Large species, wing length 2.3-2.9 mm	.....	.....	.....	.....	.....	.....	.....		24
	Smaller species, wing length 1.25-1.75 mm; mesonotum brilliantly shining black	.....	.....	.....	.....	.....	.....	.....	<i>brassicae</i> (Riley)	
24.	Orbital setulae reclinate	.....	.....	.....	.....	.....	.....	.....		25
	Orbital setulae upright or proclinate	.....	.....	.....	.....	.....	.....	.....	<i>Phytoliriomyza cyatheae</i> sp.n.	
25.	Scutellum yellow	.....	.....	.....	.....	.....	.....	.....	<i>citreifemorata</i> (Watt)	
	Scutellum black	.....	.....	.....	.....	.....	.....	.....	<i>Phytoliriomyza flavopleura</i> (Watt)	

The *clianthi* Group

The aedeagus of *clianthi* indicates its close relationship with *homeri* sp.n., *penita* sp.n., *vicina* sp.n., and *antipoda* Harrison, and probably also with *flavolateralis* and *urticae*. These seven species are referred to as the *clianthi* group.

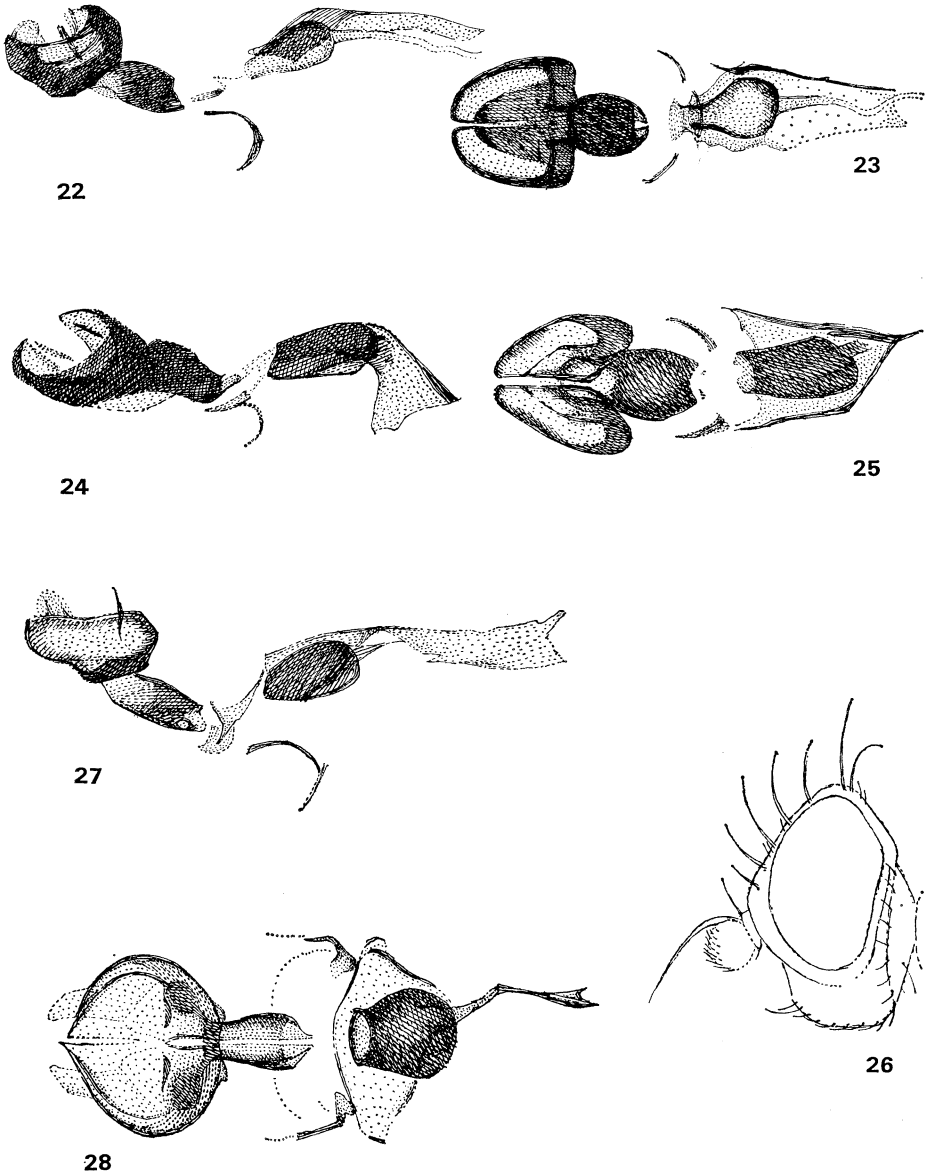
Liriomyza clianthi (Watt, 1923) (Figs. 22, 23)

Agromyza clianthi Watt, 1923: 479

Liriomyza clianthi, Harrison, 1959: 322

This is a typical *Liriomyza* with the third antennal segment and scutellum yellow. The distinctive aedeagus is shown in Figures 22, 23. Other important characters are: mesonotum mat grey, acr irregularly in 4 rows extending almost to 1st dc; sides of thorax predominantly yellow but mesopleura variably black in lower half; scutellum bright yellow with only small black patches at sides; femora almost completely yellow, with at most faint brownish striations, on p_3 black at base; squamal margin and fringe black; wing length from 1.75 mm in male to 2.25 mm in female, last section of vein M 3+4 from $2\frac{1}{2}$ to almost 3 times length of penultimate.

The only host hitherto has been *Clianthus puniceus*. However, mines found on *Carmichaelia williamsii* at Auckland (J. S. Dugdale) and on *C. grandiflora* at Milford Sound by the author have been confirmed beyond doubt as belonging to *clianthi*. Wise's (1953) reference to this species attacking *Sophora* may have been based on a misidentification of the lepidopterous miner, *Nepticula sophorae*, which is commonly found on Kowhai (*Sophora tetraptera*).



FIGS. 22, 23.—*Liriomyza clianthi*: 22, aedeagus, side view; 23, same, ventral view. FIGS. 24, 25.—*Liriomyza antipoda*: 24, aedeagus, side view; 25, same, ventral view. FIGS. 26-28.—*Liriomyza homeri*: 26, head; 27, aedeagus, side view; 28, same, ventral view.

The larva forms a narrow linear mine, in its most typical form commencing at the edge of the leaf and following the margin around the apex and gradually widening into the centre of the leaf blade. Frass is in two lines of conspicuous black strips. Pupation takes place externally; the puparium is yellowish-brown; the posterior spiracles each have four bulbs and midway towards the anus there is a slightly raised protuberance on each side, each with two small projections.

This species appears to be widespread with its hosts from Auckland in the north to Invercargill in the south. As Mr Dugdale suggested to me in correspondence,

the original hosts were probably *Carmichaelia* spp., with subsequent colonization of *Clianthus* which is now widely cultivated as an ornamental shrub.

Material Collected:

SOUTH ISLAND: Christchurch, Riccarton, 1♂, 5♀, emerged 14.xii.74 from mines coll. 1.xii. on *Clianthus puniceus*; 15♂, 11♀, 1.xii.74 on same host; Milford Sound, 2♂, 4♀, 21.i.75, on *Carmichaelia grandiflora*; larvae also found but most mines empty; Dunedin, 1♂, 28.i.75, on *Hebe* sp.; Falls Creek, roadside Cascade—Homer Tunnel, 1♀, on *Hebe salicifolia*, 23.i.75.

***Liriomyza antipoda* Harrison, 1976 (Figs. 24, 25)**

Liriomyza antipoda Harrison, 1976: 138.

Small species with head and scutellum yellow and mesopleura black.

Head: (frons collapsed, measurements not possible) 2 strong ors, 2 ori, the lower half length of upper; orbital setulae well-developed, reclinate; jowls approx. 1/3 height of eye; third antennal segment small, round.

Mesonotum: 3+1 dc, the anterior two distinctly weaker, acr sparse in 2 rows; only between 3rd and 4th dc.

Wing: length in male 1.5 mm, last section of vein M 3+4 twice length of penultimate.

Colour: frons, jowls, face and antennae yellow; hind-margin of eye black, vti on black ground; mesonotum black, only weakly shining; rear of humerus and notopleural area bright yellow; mesopleura entirely black; scutellum only narrowly yellow centrally; legs: coxae and femora bright yellow, tibiae and tarsi yellowish-brown; squamae yellow, margin and fringe black; halteres yellow.

Male genitalia: aedeagus as in Figures 24, 25; surstyli with a single stout spine at end; ejaculatory apodeme with narrow stalk and large blade, the whole longer than broad, and weakly chitinated, flattened base.

Distribution: Antipodes Island: holotype ♂, examined, Reef Point 10.ii.69, "sweeping" (G. Kuschel).

REMARKS: The male genitalia indicate a close relationship between this species and *clianthi* (cf. Figs. 22, 23). However, the two are well differentiated on external characters, particularly in the colour of the mesonotum and pleura.

***Liriomyza homeri* Spencer sp.n (Figs. 26-28)**

Small, dark species with both antennae and scutellum black.

Head (Fig. 26): frons broad, twice width of eye, distinctly projecting above eye in profile; three reclinate ors (on one side an additional bristle further removed from eye margin than other three); 2 inclined ori, the lower weaker; orbital setulae sparse, reclinate; jowls deep, 1/3 height of eye; cheeks forming conspicuous ring below eye; eye only sparsely pilose; third antennal segment small, round.

Mesonotum: 3+1 dc, 3rd and 4th weak, equal; acr sparse, only isolated hairs present.

Wing: length in male 2 mm, last section of vein M 3+4 twice length of penultimate.

Colour: frons dull black; lunule, jowls, face, antennae and palps black; mesonotum conspicuously mat black centrally up to margin of scutellum, with brilliantly shining black bands between the line of the dc and the supra-alar, and also along the line of the supra-alar and post-alar; scutellum shining black; pleura largely shining black, only a circle round the base of the humerus and upper margin of the mesopleura dull yellow; legs black, only fore-knees faintly and narrowly yellowish; abdomen shining black; squamae, including margin and fringe, black; halteres dull yellow.

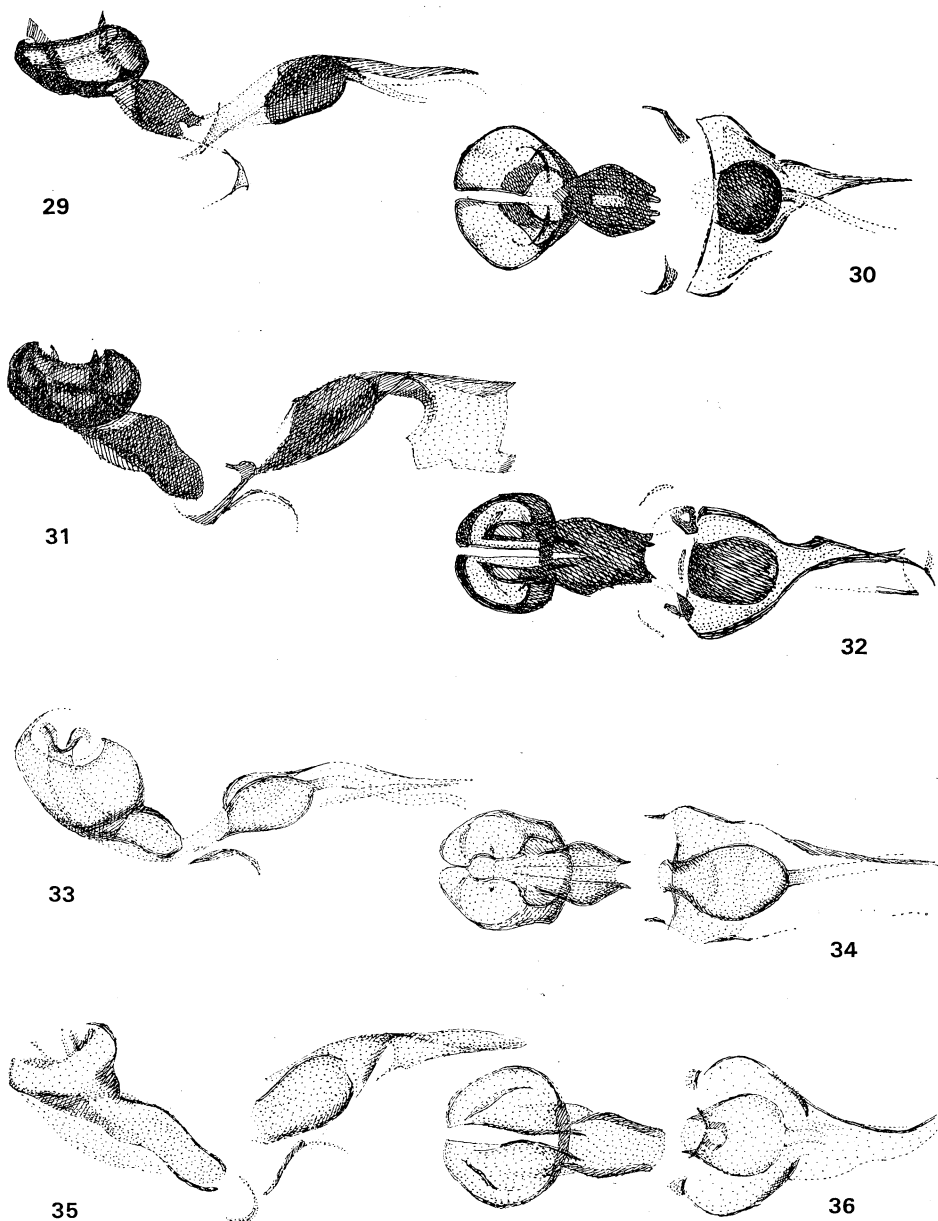
Male genitalia: aedeagus as in Figures 27, 28; ejaculatory apodeme with distinct stalk and large blade; surstyli with 2 stout bristles at end.

Type locality: South I., Homer Tunnel.

HOLOTYPE: ♂, South I.: Homer Tunnel, on scree above east entrance, 915 m, 23.i.75 (K.A.S.), in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

REMARKS: The male genitalia of this unique specimen confirm the close relationship of this species with *penita* sp.n from the sub-alpine area south of Fox Glacier. However, *homeri* is distinctive in the coloration of the mesonotum and in having acr in at most 2 rows.

The species is named in honour of W. H. Homer, who first discovered the saddle where the tunnel to Milford Sound was subsequently constructed, without which I would not have been able to visit the type locality.



FIGS. 29, 30. *Liriomyza penita*: 29, aedeagus, side view; 30, same, ventral view. FIGS. 31, 32.—*Liriomyza vicina*: 31, aedeagus, side view; 32, same, ventral view. FIGS. 33, 34.—*Liriomyza flavolateralis*: 33, aedeagus, side view; 34, same, ventral view. FIGS. 35, 36.—*Liriomyza urticae*: 35, aedeagus, side view; 36, same, ventral view.

***Liriomyza penita* Spencer sp.n. (Figs. 29, 30)**

Small dark species with black third antennal segment and scutellum yellow centrally.

Head: frons broad, twice width of eye, orbits pronounced, distinctly projecting above eye in profile; 2 equal, reclinate ors; 2 ori, the lower weaker and incurved; orbital setulae well-developed, reclinate; jowls broad, $\frac{1}{3}$ height of eye in centre, cheeks forming distinct ring below eye; eye conspicuously pilose; third antennal segment small, round.

Mesonotum: 3 + 1 dc, pre-sutural weak; acr irregularly in 4 rows in front, not extending beyond 2nd dc.

Wing: length in male 1.5 mm, last section of vein M 3 + 4 twice length of penultimate.

Colour: frons dark ochrous behind, more brown in front, orbits greyish-brown; jowls brown, face, palps and all antennal segments black; mesonotum black, faintly grey, largely mat but with distinct subshine; rear of humerus, notopleural area and upper margin of mesopleura yellow, pleura otherwise black; scutellum largely black but dull yellow centrally; legs largely black, with only fore-knees distinctly yellowish; squamae grey; margin and fringe black; halteres dull yellow.

Male genitalia: aedeagus as in Figures 29, 30.

Type locality: South I., Fox Glacier.

HOLOTYPE: ♂, South I.: Fox Glacier, "Alpine Garden", 1200, m, 8.i.75 (K.A.S.), in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

REMARKS: The male genitalia of the unique specimen indicate a close relationship between this species and others in the *clianthi* group, particularly *homeri* sp.n.

***Liriomyza vicina* Spencer sp.n. (Figs. 31, 32)**

Minute species with darkened third antennal segment, yellow frons and scutellum.

Adult: Closely resembling *wahlenbergiae* with following points of difference: third antennal segment darker, black on outside, yellowish only on lower, inner side; mesonotum black, largely mat but with distinct subshine; mesopleura darker, solidly black on lower two-thirds; wing length 1.6 mm in male, last section of vein M 3 + 4 twice length of penultimate.

Male genitalia: aedeagus as in Figures 31, 32.

Type locality: South I., Crown Range.

HOLOTYPE: ♂ South I.: Crown Range, south side, roadside at 760 m, 20.i.75, on *Verbascum thapsus* (K.A.S.), in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

PARATYPE: 1 ♂, same data as type.

REMARKS: Despite the remarkable similarity of this species to *wahlenbergiae*, the male genitalia show that the two are not closely related. *L. vicina* clearly belongs to the *clianthi* group (cf. Figs. 22-30). Its presence on *Verbascum*, together with *craspediae*, can be accepted as fortuitous and there is no evidence as to its host.

***Liriomyza flavolateralis* (Watt, 1923), comb. nov. (Figs. 33, 34)**

Agromyza flavolateralis Watt, 1923: 471.

Phytobia flavolateralis, Harrison, 1959: 320.

The male genitalia (Figs. 33, 34) confirm the correct generic position of this species in *Liriomyza*. Important characters are: frons and antennae yellow; mesonotum mat grey, scutellum largely concolorous, at most faintly yellow viewed from rear (sometimes appearing more brownish-yellow in old specimens); sides of thorax bright yellow above, including rear of humerus, notopleural area and upper front corner of mesopleura; legs: femora dark brown, knees only faintly yellow, tibiae and tarsi yellowish; wing length from 1.75 to 2.25 mm, last section of M 3 + 4 about twice length of penultimate.

This species is monophagous on *Melicytus* (Violaceae), occurring most commonly and possibly exclusively on *M. ramiflorus* (whitey-wood). The larva forms a conspicuous white mine, pupating externally; many mines are frequently found on the same tree and several even in a single leaf. The puparium is pale brown, with posterior spiracles each having an ellipse of 6 to 8 bulbs.

The only recorded localities are Wanganui and Wellington. I found mines at four further localities in the North Island, and Dr and Mrs Kuschel found mines common at Nelson, in the South Island.

The palest form of *flavolateralis*, with perhaps a trace of yellow on the scutellum, might be confused with the darkest form of *flavocentralis*, with the scutellum almost completely dark. However in *flavocentralis* the knees are always conspicuously bright yellow and the mesopleura are darker, black except for the narrow yellow upper margin. These two species are not in fact related and the genitalia of

flavolateralis indicate relationship with *urticae* and other members of the *clianthi* group.

Material Collected:

NORTH ISLAND

Mangamuka Gorge, 1♀, 24.xii.74, on *Melicytus*; also many mines; Waipoua Forest, many leaf-mines, mostly empty, 22.xii.74; Auckland, Whatipu, leaf-mines, 17.xii.74; Coromandel Forest Park, near Thames, leaf mines, 26.xii.74.

***Liriomyza urticae* (Watt, 1924) (Figs. 35, 36)**

Agromyza urticae Watt, 1924: 685.

Lyrimyza urticae, Harrison, 1959: 326.

This is a typical *Liriomyza*, and the aedeagus is shown in Figures 35, 36.

Important characters are the brownish-black third antennal segment, the broadly yellow sides of the thorax, the mat black mesonotum and the yellow scutellum; the femora are black, with all knees yellow. It is distinguishable from *craspediae* sp.n. by the less shining mesonotum and the darker femora.

Empty leaf-mines were found on *Urtica ferox* in the bush above Governor's Bay, 6.i.75, and a single female was caught on its host on the same occasion. It has hitherto been believed that *U. ferox* was the only host, but I also found mines with larvae on *U. incisa* at Hawea, near Wanaka, 10.i.75, which clearly represent the same species. The larvae failed to form healthy puparia and no adults were obtained. The puparium is brown, and the posterior spiracles each have an ellipse of six bulbs, one being extended, hook-like (as frequently found in *Liriomyza* species).

This interesting species has not previously been recorded from South Island. It is the only confirmed *Liriomyza* known in the world to feed on *Urtica*. Leaf-mines with larvae were found by the author on *Phenax* sp. (Urticaceae) at Rancho Grande, Aragua, Venezuela, in 1972; these might possibly represent a *Liriomyza* but are more probably a *Calycomyza* sp.

Despite superficial similarity of *urticae* with *craspediae*, the genitalia show that the two are not related. *L. urticae* is possibly most closely related to *flavolateralis* and these two species are included in the *clianthi* group.

The *umbrina* Group

The four black *Hebe*-feeders, including *hebae* sp.n. described below, form a compact monophyletic group, with *umbrina* and *umbrinella* representing one pair of sister-species and *umbrosa* and *hebae* probably another. *L. plantaginella* sp.n. is also tentatively assigned to this group.

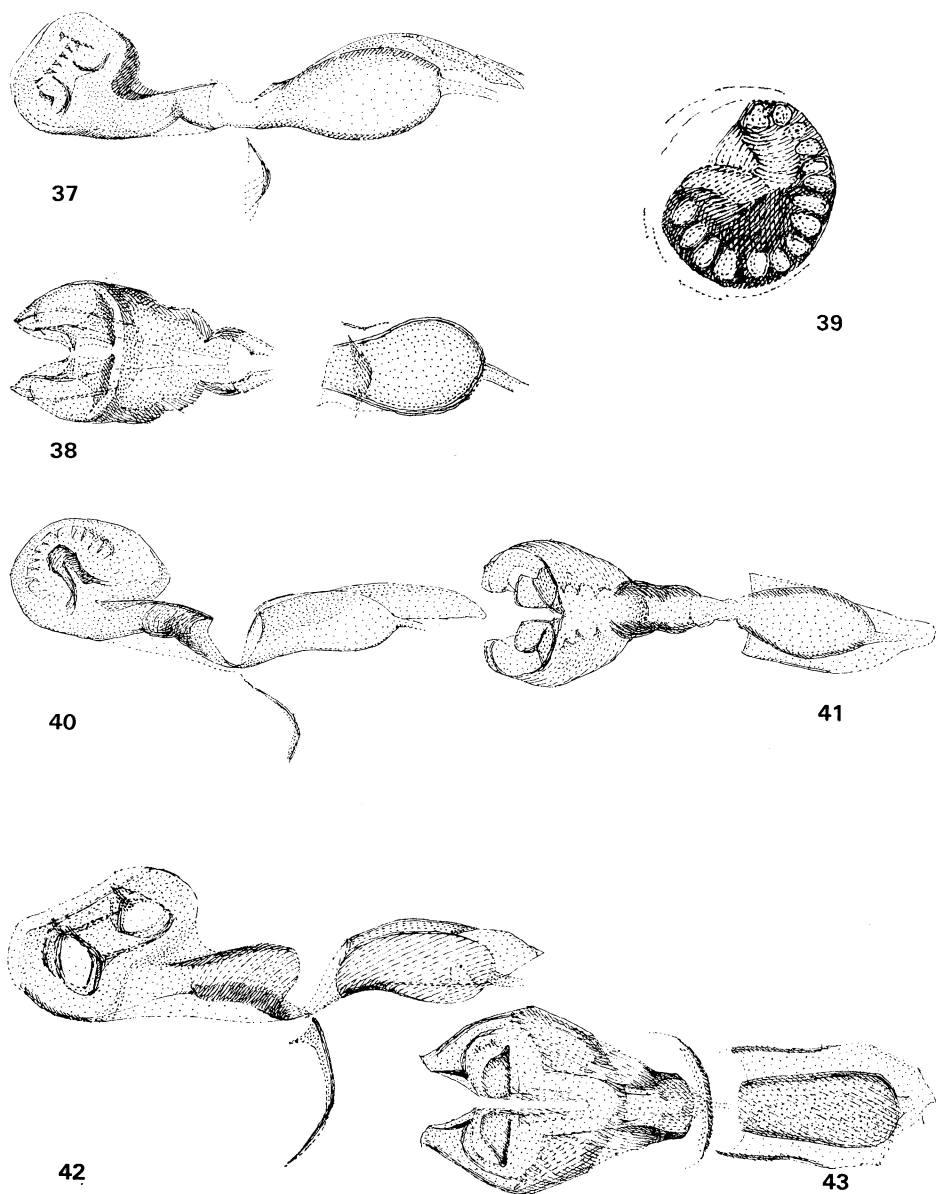
***Liriomyza umbrina* (Watt, 1923), comb. nov. (Figs. 37-39)**

Agromyza umbrina Watt, 1923: 467

Phytobia umbrina, Harrison, 1959: 318

This is larger than the two other black *Hebe*-feeders known hitherto and is similar in size to *hebae* described below; the wing length ranges from 2.1-2.5 mm in the male to 2.1-2.9 mm in the female. The frons is always black on the lower half but may be more brownish above. The normal arrangement of dorso-centrals is 2 + 1 (21 specimens) but in four I found 3 + 1 and in four others a small 3rd is indicated between the 2nd and the pre-sutural. The humerus and notopleural area are always distinctly yellow and this immediately distinguishes *umbrina* from the other *Hebe* feeders. The aedeagus is shown in Figures 37, 38.

The only recorded hosts are *Hebe salicifolia* and *H. speciosa*; in the North Island I found *umbrina* to be common also on *H. stricta* and *H. macrocarpa*. The larva forms a brownish blotch mine at the apex or margin of the leaf, pupating internally. The puparium is reddish-brown, with the posterior spiracles each having



FIGS. 37-39.—*Liriomyza umbrina*: 37, aedeagus, side view; 38, same, ventral view; 39, posterior spiracles of puparium. FIGS. 40, 41.—*Liriomyza umbrinella*: 40, aedeagus, side view; 41, same, ventral view. FIGS. 42, 43.—*Liriomyza umbrosa*: 42, aedeagus, side view; 43, same, ventral view.

an ellipse of some 15 minute bulbs (Fig. 39) on a large but low rounded protuberance. There is also a large rounded protuberance ventrally towards the anus but no anal projections (as in *flavocentralis*).

Material Collected:

NORTH ISLAND

Waitakere, 5 ♂, 17.xii.74 (K.A.S. and J.S.D.); Coromandel Forest Park, near Thames, 1 ♂, 2 ♀, 26.xii.74; Tongariro National Park, 1 ♂, 27.xii.74.

SOUTH ISLAND

Arthur's Pass, 1 ♂, 5.i.75; Mount Cook, Park HQ, 3 ♂, 16-17.i.75; Unwin Hut, 4 ♂, emerged 19-20.i.75 ex mines on *Hebe salicifolia* coll. 14.i.75; roadside Franz Josef/Fox Glacier, 1 ♀, emerged 26.i.75 ex mine on *H. salicifolia* coll. 9.i.; 1 ♀, 9.i.75; Fox Glacier, Park HQ, 1 ♂, 1 ♀, emerged 11 and 15.i.75 ex mines on *H. salicifolia* coll. 8.i.75; roadside Cascade-Hollyford, 2 ♀, emerged 4.ii.75 ex mines on same host coll. 21.i.75.

***Liriomyza umbrinella* (Watt, 1923), comb. nov. (Figs. 40, 41)**

Agromyza umbrinella Watt, 1923: 469

Phytobia umbrinella, Harrison, 1959: 316

This is the smallest of the three black species feeding on *Hebe*, with the wing length ranging from 1.6-2.1 mm in the male to 2.25 mm in the female. Is is also the darkest of the three, with the humerus and notopleural area being almost completely black. There are always only 2 + 1 dc, with the acr in 4 rows. The male genitalia (Figs. 40, 41) confirm its correct position in *Liriomyza* and also its close relationship to *umbrina* and *umbrosa*.

The only host recorded by Watt is *Hebe colensoi*. I found numerous mines and adults on a large bush at the side entrance to the Museum in Great King Street, Dunedin, tentatively identified as *Hebe strictissima* by Dr L. Moore. This species of *Hebe* only occurs naturally at restricted localities on the Banks Peninsula, Christchurch. I was shown these plants by a Mr Hugh Wilson, but there was no evidence of *umbrinella*. Presumably it has been colonized in Dunedin from its other host or hosts in the area. A further host is *Hebe odora* (J. S. Dugdale).

Watt obtained his type series from the Woodhaugh Gardens, Dunedin, and records one further locality, Mt Ruapehu, on both the north and south sides at 915-1525 m. I have also confirmed one male from North Peak, Big South Cape Island, 150 m, xi.68 ex *Hebe odora* (J.S.D.).

The larva in the first instar forms a narrow lower surface linear mine, later moving to the upper surface where a brownish blotch is formed. The shining black puparium remains within the mine; empty pupal cases may appear more brownish, particularly when old. The posterior spiracles lie scarcely raised on the anal segment, each with ellipse of some 8-10 minute bulbs. There is no trace of an anal projection.

Material Collected:

DUNEDIN:

Museum, Great King Street, 1 ♂, emerged 3.i.75 from leaf-mine on *Hebe strictissima* coll. 28.i.; 17 ♂, 13 ♀, 28.i.75, caught on host; Botanic Gardens, 5 ♂, 2 ♀, 30.i.75, caught on *Hebe* sp.

***Liriomyza umbrosa* (Watt, 1923) (Figs. 42, 43)**

Agromyza umbrosa Watt, 1923: 476

Liriomyza umbrosa, Harrison, 1959: 325

Harrison (1959: 325) transferred this species from *Agromyza* to *Liriomyza* but, in view of its largely black colour, remarked: "The position of this species in *Liriomyza* is not certain." In fact, the male genitalia (Figs. 42, 43) immediately confirm that it is a true *Liriomyza*, and the stridulating mechanism is present.

The frons is brownish-black, all antennal segments, mesonotum and legs are entirely black; the sides of the thorax are largely black but only the rear of the humerus is consistently paler, brownish-yellow. The scutellum is also largely black but can appear faintly brownish centrally when viewed from the rear; the wings are distinctly infusate. There are normally 3 + 1 dc but in one of the four specimens I obtained at Mount Cook the arrangement is 2 + 1; acr are present in 4 rows; the wing length ranges from 2 to 2.25 mm.

The darkened wings differentiate this species from the two other black *Hebe*-feeders, *umbrina* and *umbrinella* and also from *homeri* sp.n.

The only host is apparently *Hebe subalpina* (= *Veronica monticola* of Watt). The larva forms a linear mine, but in the small leaves where it feeds normally in the apical section a brownish secondary blotch is formed, which can fill an entire leaf. Pupation takes place externally; the puparium is brown (the arrangement of the posterior spiracles is unfortunately not known).

Watt described *umbrosa* from the Botanic Gardens, Dunedin. There is now no record of the origin of the plant(s) where Watt found the mines, but there is still an extensive "Alpine Garden"; it is believed that *umbrosa* must have been brought there in the larval stage in the leaves of the host, which was doubtless collected in some subalpine area, probably Mount Cook, where it is common in the Hooker Valley and elsewhere. Dunedin was the only locality known to Watt for this species. Harrison (1959: 326) also records a male from Auckland, but this is based on a misidentification of a male of *flavocentralis* with darkened antennae. I found the mines to be common on *Hebe subalpina* at Mount Cook, in the Hooker Valley before the first swing bridge and near the Ball Hut, 13-15.i.75.

Material Collected:

MOUNT COOK

Ball Hut, 1 ♀, 13.i.75; Hooker Valley, 3 ♂, 15.i.75, all on *Hebe subalpina*.

***Liriomyza hebae* Spencer sp.n. (Figs. 44-46)**

Large, mainly black species, with frons partially yellowish.

Head: frons slightly less than $1\frac{1}{2}$ times width of eye, not projecting above eye in profile; two strong reclinate ors, 2 incurved ori, the upper similar to ors, the lower only slightly weaker; orbital setulae numerous, short, reclinate; jowls extended at rear, $\frac{1}{4}$ height of eye; third antennal segment small, round, arista distinctly swollen at base, not conspicuously pubescent.

Mesonotum: 3 + 1 strong dc the pre-sutural little weaker than the 3rd; acr irregularly in four to five rows in front, extending in at least two rows to first dc, those between first and second dc inclined inwards.

Wing: length from 2.4 mm to 2.85 mm in female, last section of vein M 3 + 4 twice length of penultimate.

Legs: mid-tibiae without lateral bristles; scraper of stridulating mechanism clearly detectable on hind-femora.

Colour: frons brownish-yellow behind, gradually becoming paler, more distinctly yellow in front; lunule and jowls yellow; face, palps and all antennal segments black; mesonotum and scutellum mat, greyish-black; humerus behind bristle and entire notopleural area yellow, pleura otherwise black; legs, abdomen, squamae and fringe black; halteres yellow.

Male genitalia: aedeagus as in Figures 44, 45; surstyli narrow, with single strong spine at end; ejaculatory apodeme greatly enlarged, with shallow, cup-shaped base.

Type locality: Scenic Drive, Waitakere Range, Auckland, North I.

HOLOTYPE: ♂ North I: Auckland, Waitakere, roadside near side road to Waitakere Lodge, 17.xii.74, on *Hebe macrocarpa* (K.A.S. and J.S.D.), in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

PARATYPES: 3 ♂, 2 ♀, same data (all K.A.S. and J.S.D.); Wellington: Botanical Gardens, 1 ♀, 7.xii.74, on *Hebe aff. albicans*, Otari Plant Museum, 1 ♀, 7.xii.74, on *Hebe* sp.

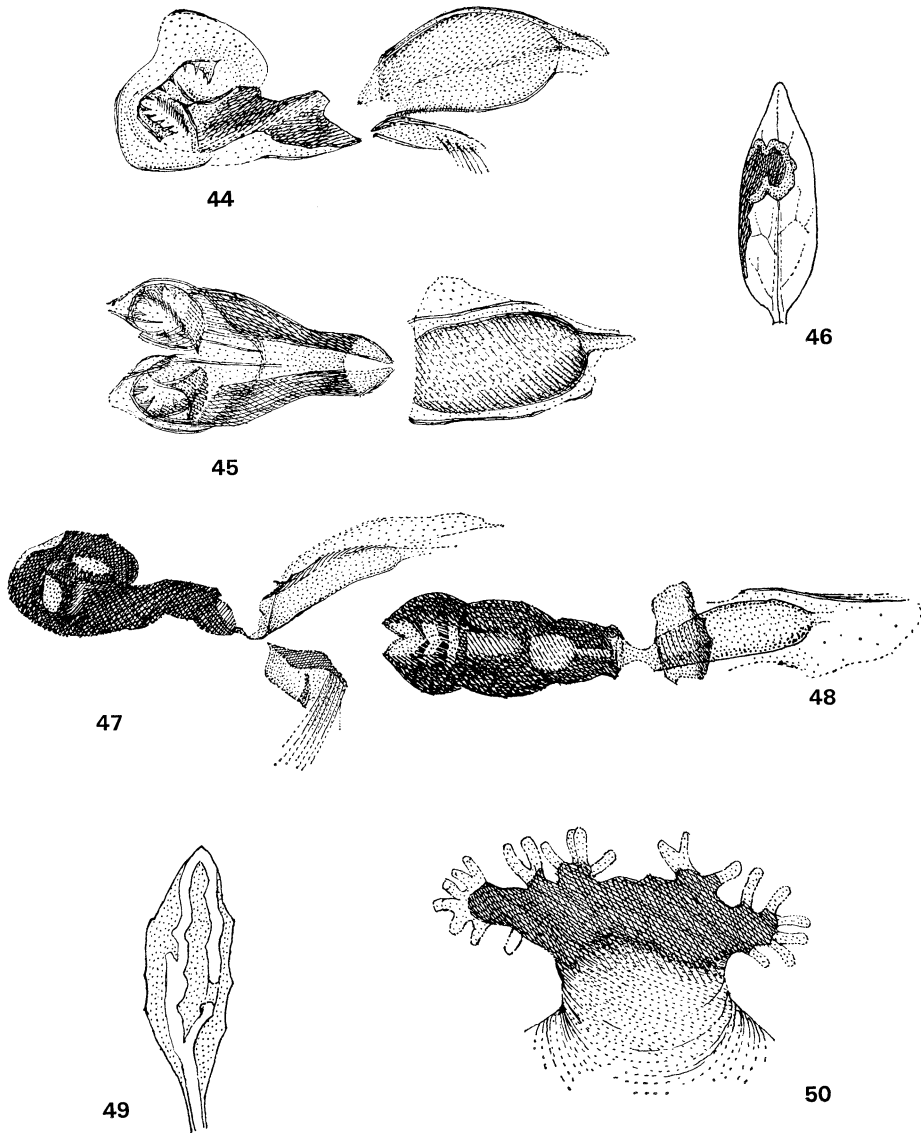
REMARKS: This is a large species, comparable in size to *umbrina*, but immediately distinguishable by the combination of black antennae and scutellum and partially pale frons. Although no specimens have been bred, I am satisfied that the characteristic mines (Fig. 46) found both in Auckland and Wellington are referable to this species. The larva feeds forwards and backwards to form a compact secondary blotch, leaving the mine for pupation through an upper surface exit slit.

***Liriomyza plantaginella* Spencer sp.n. (Figs 47-50)**

Largely black species with frons dark brown and scutellum yellowish centrally.

Head: frons broad, twice width of eye, not projecting above eye in profile; orbits broad, distinctly widening at base of antennae, two ors, two strong ori, slightly longer than ors orbital setulae sparse, reclinate; jowls broad, extended at rear, $\frac{1}{4}$ height of eye; third antennal segment round, finely pubescent, arista strong, appearing virtually bare.

Mesonotum: 3 + 1 strong dc, pre-sutural equal to 3rd; acr in 4 rows



FIGS. 44-46.—*Liriomyza hebae*: 44, aedeagus, side view; 45, same, ventral view; 46, leaf-mine on *Hebe macrocarpa*, Waitakere, AK. FIGS. 47-50.—*Liriomyza plantaginella*: 47, aedeagus, side view; 48, same, ventral view; 49, leaf-mine on *Plantago raoulii*; 50, posterior spiracles of puparium.

Wing: length in male 2.25 mm, last section of M $3 + 4$ slightly less than $1\frac{1}{2}$ times length of penultimate, discal cell thus large.

Colour: frons uniformly dark brown, orbits contrasting black, moderately shining; jowls ochrous-yellow; face, all antennal segments and palps black; mesonotum mat black, scutellum dull yellow centrally; rear of humerus and notopleural triangle dull yellow, sides of thorax otherwise black; fore-knees narrowly yellow, legs otherwise black; abdomen black, squamae dark grey, margin and fringe black; halteres yellow.

Male genitalia aedeagus as in Figures 47, 48; ejaculatory apodeme with blade asymmetrical, wider than long, in ratio 25 : 18 (including stalk).

Host-plant/Biology: leaf-miner on *Plantago raoulii*, mine narrow, linear, somewhat irregular (Fig. 49), pupation externally; the puparium is dark brown, with the anterior

spiracles each with a "fan" of 10 bulbs, the posterior spiracular processes are widely separated each on a stout conical protuberance, having two distinct arms each with some 10-12 irregular, elongate bulbs (Fig. 50).

Type locality: South I., Olivine Range.

HOLOTYPE: ♂, South I.: Simonin Creek, 975 m West Olivine Range, ex mine in *Plantago raoulii* (J. S. Dugdale), in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

REMARKS: The male genitalia of the unique specimen of this interesting species suggest its close relationship with the four black *Hebe*-feeders, *hebae*, *umbrina*, *umbrinella* and *umbrosa*, rather than with the species in the *clianthi* group, despite the greater chitinization of the aedeagus.

The proliferation of bulbs on the posterior spiracles and their distinctive elongation (Fig. 50) is unique in the genus, but a somewhat similar development is found in some species in the closely related genus *Metopomyza* in Europe.

Plantago raoulii is widespread in both North and South Islands, and it will be of interest to discover whether *plantaginella* has a similar distribution or is restricted to higher altitudes comparable with the type locality.

The *flavocentralis* Group

The male genitalia indicate the closer relationship of *flavocentralis* with *lepidii* and *watti* than with the four black *Hebe*-feeders. These three species are treated as the *flavocentralis* group.

Liriomyza flavocentralis (Watt, 1923) (Figs. 51-56)

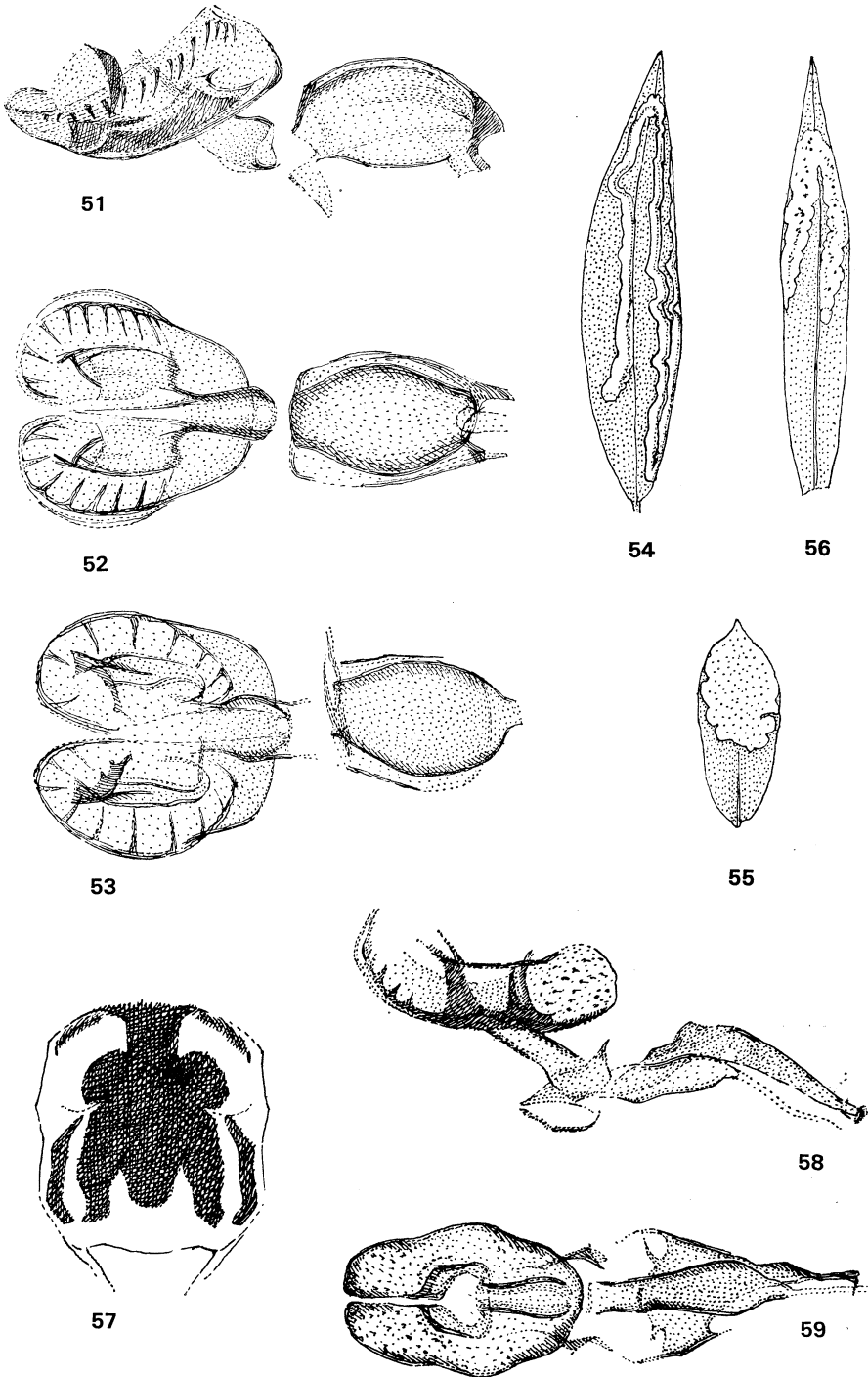
Agromyza flavocentralis Watt, 1923: 474

Liriomyza flavocentralis, Harrison, 1959: 321

The aedeagus of this typical *Liriomyza* is shown in Figures 51, 52. Essential characters are: frons, jowls and palps yellow; third antennal segment normally bright yellow but darkened, brownish, in some specimens in South Island in the Mount Cook area and westwards at Franz Josef and Cascade-Hollyford, also a single male seen from Auckland with all antennal segments black; mesonotum mat, greyish-black; scutellum narrowly yellow centrally; rear of humerus and notopleural area bright yellow, pleura otherwise black; legs black but all knees yellow; in female basal cone of ovipositor entirely shining black; wing length from 2.2 mm in male to 3 mm in female; discal cell large, last section of vein M 3 + 4 normally about $1\frac{1}{2}$ times length of penultimate.

Host plants are restricted to large-leaved *Hebe* species and mines are found most frequently on *H. salicifolia* (South Island and Stewart Island), *H. stricta* and *H. macrocarpa* (North Island), also on *H. elliptica* and *H. speciosa*. Watt correctly noticed the variability in the mines. They can remain narrow and largely linear (Fig. 54) but normally, after the first instar, widen to 5 or 6 mm; in some cases they develop into a distinct secondary blotch. In the smaller leaves of *Hebe elliptica* similar mines were found at three localities—Allan's Beach Road, Dunedin; The Bluff; and Glory Bay, Stewart Island. In all cases, the mine is an irregular, secondary blotch (Fig. 55). The normal arrangement of frass is in a distinct line which may be almost unbroken or loosely divided. At Mount Cook (where specimens with the third antennal segment darkened were most common) the frass is deposited quite differently, in discrete lumps (Fig. 56). Both at Lake Tikitere, near Rotorua, and at Hollyford, both types of frass arrangement were found on plants in close proximity.

Watt (1923: 476) bred adults from both types of mines and was unable to find any differences between them. Unfortunately I was not able to associate adults with the differing mine types or frass arrangement but the male genitalia of five specimens examined all appear essentially similar; there is some variation in the size and shape of the distiphallus (Fig. 51, paratype, Dunedin; Fig. 53, Auckland, third antennal segment black) but this cannot be associated either with geographical distribution or with the darkening of the third antennal segment. There is certainly



FIGS. 51-56.—*Liriomyza flavocentralis*: 51, aedeagus, side view; 52, same, ventral view (para-type) Dunedin; 53, ventral view (Auckland); 54, leaf-mine on *Hebe stricta*, Rotorua; 55, leaf-mine on *Hebe elliptica*, Allan's Beach Road, nr. Dunedin; 56, leaf-mine on *Hebe salicifolia*, Mt. Cook. FIGS. 57-59.—*Liriomyza lepidii*: 57, mesonotum; 58, aedeagus, side view; 59, same, ventral view.

no justification with the material currently available for splitting this species but it does appear that strains may have developed, reflected in the adults by the variable colour of the third antennal segment and slight differences in genitalia, and in the larvae by the differing type of mine formed and the different arrangement of frass. Further detailed investigations of this complex are required before the exact status of the various populations can be clarified.

Pupation takes place outside the mine. The puparium is yellowish to darker brown; the posterior spiracles each have an ellipse of some 15 bulbs and there is a conspicuous conical anal projection only slightly smaller than that of the posterior spiracles.

Material Collected:

NORTH ISLAND

Mangamuka Gorge, 2 ♀, 24.xii.74; Waitakere Range on *Hebe macrocarpa*, 4 ♂, 4 ♀, 17.xii.74; Rotorua, Paradise Springs, on *H. stricta*, 1 ♂, 13.xii.74; Lake Tikitere, on *H. stricta*, 1 ♀, 14.xii.74; Mt Messenger, on *H. stricta*, 4 ♂, 2 ♀, 12.xii.74; Wellington, Otari Plant Museum, on *Hebe* sp., 1 ♀, 7.xii.74.

SOUTH ISLAND

Mount Cook, Park HQ area, 1 ♂, emerged 7.ii.75 ex *H. salicifolia* coll. 16.i.75; 2 ♂, 1 ♀, on same host, 14-16.i.75; Franz Josef, 1 ♂, 5 ♀, 21-22.i.75; Bluff, on *H. elliptica* and *H. salicifolia*, 4 ♂, 2 ♀, 24.i.75; Dunedin, Allan's Beach Road, 1 ♀, emerged 20.ii.74 ex *H. elliptica* coll. 29.i.75; 2 ♀, on same host, 29.i.75.

STEWART ISLAND

Oban, on *H. elliptica*, 2 ♂, 3 ♀, 25-26.i.75; Glory Bay, on same host, 1 ♀, 25.i.75.

Liriomyza lepidii Harrison, 1976 (Figs. 57-59)

Liriomyza lepidii Harrison, 1976: 138.

Head: frons $1\frac{1}{2}$ times width of eye, not significantly projecting above eye in profile; orbital bristles unusually stout, two ors, two ori; orbital setulae sparse, irregular, those above reclinate, those below more incurved; jowls deep, almost $\frac{1}{3}$ height of eye; third antennal segment small, round.

Mesonotum: 3 + 1 strong dc; acr sparse, in 2 rows.

Wing: length in male 2.3 mm, discal cell small, last section of vein M 3 + 4 $3\frac{1}{2}$ times length of penultimate; first cross-vein well beyond midpoint of discal cell, second conspicuously slanting.

Legs: scraper of stridulating mechanism present.

Colour: head entirely yellow; mesonotum (Fig. 57) broadly yellow adjoining scutellum, the dark area mat grey, divided, with 2 lateral bands each side of line of dc; scutellum largely yellow, with only small dark patches beyond basal scutellars; sides of thorax predominantly yellow, mesopleura with dark patch in lower front corner, sternopleura with normal dark triangle below; legs: femora largely yellow, with irregular dark striations, tibiae yellow adjoining femora, brown below, tarsi yellow; squamae yellow, margin and fringe dark.

Male genitalia: aedeagus as in Figures 58, 59; surstyli narrow with 1 strong spine at end; ejaculatory apodeme large, with long narrow stalk and circular dark blade.

Host plant/Biology: leaf-miner on *Lepidium oleraceum*, details of mine not recorded; the puparium is brown, with the posterior spiracles each having an ellipse of 6-8 bulbs.

Distribution: Snares I: 1 ♂ examined, East end of ridge, Southwest Promontory, 15.ii.72, "on *Lepidium oleraceum*" (D. S. Horning).

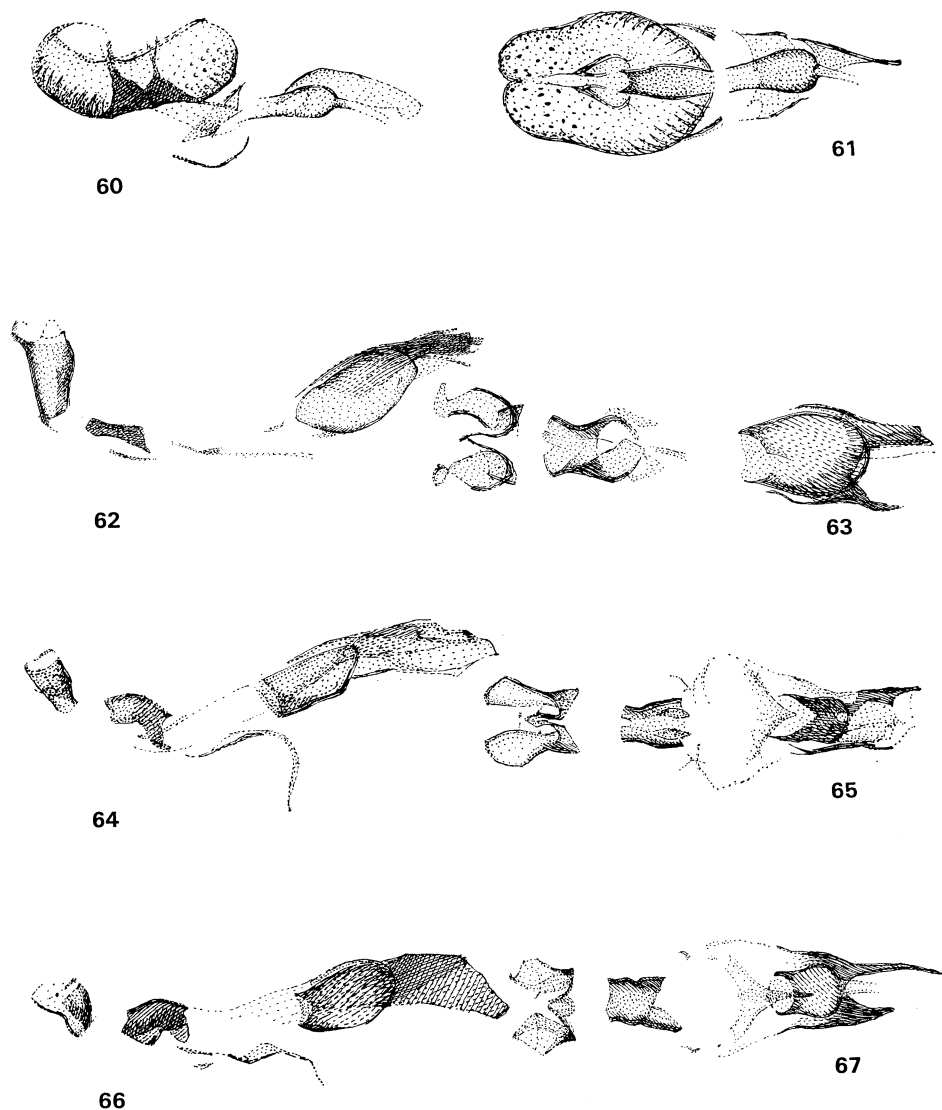
REMARKS: No other *Liriomyza* species is known in New Zealand with the dark area of the mesonotum divided into bands. However, *Phytoliriomyza cyatheae* sp.n is superficially similar but the dark area of the mesonotum is deep black and the discal cell is large, with the last section of vein M 3 + 4 only slightly longer than the penultimate (cf. key, couplet 4).

The genitalia indicate the close relationship of *lepidii* with both *flavocentralis* and *watti*. Its host is widespread, and it can be expected that *lepidii* will be found to occur in association with *Lepidium*, at least on South Island.

Liriomyza watti Spencer sp.n. (Figs. 60, 61)

Small species with yellow third antennal segment and scutellum and black femora.

Head: frons $1\frac{1}{2}$ times width of eye, not significantly projecting above eye in profile; two equal reclinate ors, two largely incurved ori; orbital setulae sparse, at most five hairs present, sometimes entirely absent; jowels $\frac{1}{3}$ height of eye; third antennal segment small, round.



FIGS. 60, 61.—*Liriomyza watti*: 60, aedeagus, side view; 61, same, ventral view. FIGS. 62, 63.—*Liriomyza citreifemorata*: 62, aedeagus, side view; 63, same, ventral view. FIGS. 64, 65.—*Liriomyza craspediae*: 64, aedeagus, side view; 65, same ventral view. FIGS. 66, 67.—*Liriomyza wahlenbergiae*: 65, aedeagus, side view; 67, same, ventral view.

Mesonotum: 3 + 1 well-developed dc, acr irregularly in four rows in front, normally only two at level of last dc, distinctly slanting inwards.

Wing: length from 1.75 mm in male to 2 mm in female; discal cell small, last section of vein M 3 + 4 from 2 to $2\frac{1}{2}$ times length of penultimate.

Colour: frons, orbits and jowls yellow; hind-margin of eye black, both vt on black ground, darkening sometimes extending to upper orbits; face yellowish-grey; third antennal segment yellowish-orange; palps yellow; mesonotum mat black, with slight tendency to greyish; rear of humerus and notopleural area yellow, sides of thorax otherwise almost completely black; legs black; with only fore-knees yellowish; scutellum conspicuously yellow centrally; abdomen black, in female basal cone of ovipositor entirely grey-dusted; squamae grey, margin and fringe black; halteres bright yellow.

Male genitalia: aedeagus as in Figures 60, 61; surstyli elongate, with one stout spine before end of inner face, ejaculatory apodeme long, equal to length of aedeagus, with narrow stalk and broad blade.

Type locality: Hamilton, North I.

HOLOTYPE: ♂ North I.: Hamilton, 15.xii.74, on *Tropaeolum* leaves (K.A.S.), in National Arthropod Collection, D.S.I.R., Auckland.

PARATYPES: 4♂, 10♀, same data; New Plymouth, 1♀, 11.xii.74; Auckland, Parau, 2♀, 17.xii.74; Maungatapere, 1♂, 2♀, 19.xii.74, all on leaves of *Tropaeolum*; Stewart I.: Oban, near church, 1♂, on *Hebe elliptica*, 26.i.75.

REMARKS: This species closely resembles *flavocentralis* but is distinctly smaller; other differences are the darker femora, with the knees yellow only on the fore-legs, the brighter yellow of the scutellum and the smaller discal cell. In the male genitalia the elongate distiphallus, with conspicuous bristles laterally and the enlarged, dark ejaculatory apodeme indicate evolutionary relationship with *flavocentralis* but the bladder partially enclosed by the basal sclerites (basiphallus) is small as in most species in the genus, not greatly enlarged as in *flavocentralis*.

The apparent association between *watti* and *Tropaeolum* is puzzling. Adults were found on *Tropaeolum* between 11 and 19 December at the four localities where the plants were examined in the North Island between New Plymouth and Maungatapere, northwest of Whangarei. They were not present at Whangaroa farther north, nor somewhat later in January at Nelson, Franz Josef, and Christchurch in the South Island. Mines were common on *Tropaeolum* in the four localities where *watti* was found, and it was at first believed that they were produced by this species. However, I am now satisfied that the mines were of *brassicae*. In any case, it seems certain that this new species, endemic to New Zealand, must have as its original and probably primary host an endemic New Zealand plant. *Tropaeolum* is known to have strong attractive properties to insects; although the possibility of *watti* actually feeding on it cannot be excluded, I now feel that it is more probable that the adults were merely exploring the plants. The discovery of a single male on *Hebe elliptica* at Oban is further evidence that *Tropaeolum* is not the host but cannot be taken as an indication that the species feeds on *Hebe*. The host thus remains to be discovered.

It gives me great pleasure to name this species after Dr Morris N. Watt, whose enthusiastic and meticulous studies of leaf-miners over 50 years ago provided a valuable and sound basis for later work on the New Zealand Agromyzidae.

The *citreifemorata* Group

The male genitalia clearly show the monophyly of *citreifemorata*, *craspediae*, and *wahlenbergiae*, and these three species can be conveniently referred to as the *citreifemorata* group.

Liriomyza citreifemorata (Watt, 1923) (Figs. 62, 63)

Agromyza citreifemorata Watt, 1923: 478

Liriomyza citreifemorata, Harrison, 1959: 323

This is a relatively large but otherwise typical *Liriomyza* with wing length from 2.3 mm in the male to 3.1 mm in the female. The aedeagus is shown in Figures 62, 63. Distinctive characters are: head almost completely yellow but hind-margin of eye narrowly black beyond base of vte, orbital setulae well-developed, reclinate; mesonotum deep black but only moderately shining, acr irregularly in four rows; sides of thorax largely yellow but humerus and lower and front margins of mesopleura black; scutellum broadly yellow centrally; femora entirely bright yellow, tibiae and tarsi more brownish; discal cell small, last section of vein M 3 + 4 twice length of penultimate.

The only host is *Myoporum laetum* (Myoporaceae), the larva forming a narrow linear mine, several frequently in the same leaf. Pupation takes place externally; the puparium is yellowish-brown (according to Watt, black) with the posterior spiracles each having an ellipse of 10-12 bulbs, anal projections undeveloped.

Distribution is probably widespread with the host, with records from Wanganui in the north to Dunedin in the south.

Superficially, *citreifemorata* somewhat resembles *brassicae* but is substantially larger, the mesonotum is less brilliantly shining and the hind-margin of the eye is more narrowly black. It also resembles the darkest form of *Phytoliriomyza cyatheae* but is most reliably distinguishable by the longer last section of vein M 3 + 4; in *cyatheae* the last and penultimate sections are equal.

***Liriomyza craspediae* Spencer sp.n. (Figs. 64, 65)**

Medium-sized species with darkened third antennal segment.

Head: frons $1\frac{1}{2}$ times width of eye, distinctly projecting above eye in profile; two reclinate ors, two at least partially inclined ori, orbital setulae sparse, minute; jowls deep, $\frac{1}{3}$ height of eye; eye distinctly slanting; third antennal segment slightly enlarged, broader than long.

Mesonotum: 3 + 1 strong dc, acr irregularly in four rows.

Wing: length from 1.75-2 mm in male to 2.4 mm in female, last section of vein M 3 + 4 twice length of penultimate.

Colour: frons, jowls, face and palps orange-yellow; upper orbits sometimes darkened, hind-margin of eye black to base of vti; first and second antennal segments yellow, third variably darkened, brown or more rarely black on outside, yellowish on inside, mesonotum brilliantly shining black; humerus and notopleural area yellow, mesopleura yellow above, variably black below. Legs: femora yellow, with brownish striations, tibiae and tarsi brownish-black; scutellum broadly yellow; abdomen either entirely black or tergites narrowly yellow-bordered; squamae grey, margin and fringe black; halteres yellow.

Male genitalia: aedeagus as in Figures 64, 65; surstyli with a small spine on inner face well before end; ejaculatory apodeme with narrow stalk, blade narrow, half as wide as long.

Host plant/Biology: *Craspedia uniflora*, larva forming narrow linear mine, commencing on lower surface, changing to upper surface probably after first instar; puparium orange-brown, posterior spiracles widely separated, each on a conical projection with an unusually elongate ellipse of some 20 bulbs.

Type locality: Arthur's Pass, South I.

HOLOTYPE: ♂ South I., Arthur's Pass, emerged 26.i.75 from leaf-mine coll. 5.i.75 (K.A.S.), in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

PARATYPES: 4♂, 1♀, 22-27.i.75, otherwise same data as type; 2♂, 3♀, caught on host 5.i.75; Crown Range, north of Queenstown, below summit on north side, 6♂, 990 m, 1♂, 960 m, 20.i.75; south side, 760 m, 1♂, all on *Verbascum thapsus*; South Westland, Simonin Pass, West Olivine Range, 1006 m, 1♂, 30.i.75 ex *Craspedia uniflora* (J.S.D.).

REMARKS: The darkened third antennal segment and shining black mesonotum are distinctive characters of this species; it closely resembles *urticae* but this has the mesonotum distinctly mat black and the femora are predominantly black, with only the knees yellow. The genitalia, however, show that *craspediae* and *urticae* are not related and belong in different groups (cf. Figs. 35, 36; 64, 65). *L. craspediae* is certainly the sister-species of *wahlenbergiae*.

It at first appears puzzling that the series from the Crown Range were all found on leaves of introduced *Verbascum*. It seemed improbable that this could be the host, but I was unable to find any other plants which might be considered as possible hosts. The fact that only males were caught indicates that emergence had only recently commenced, at a time when no flowering stems of *Craspedia* had yet developed and the basal rosettes of leaves were presumably largely obscured beneath the grasses which formed the dominant vegetation. The newly emerged males were thus using *Verbascum* as a convenient dry resting place above the damp vegetation at ground level.

At Arthur's Pass and also beside the Wakefield Track in the Hooker Valley at Mount Cook a second leaf-miner was present on *Craspedia uniflora*. These mines were believed to be formed by a beetle, with broad, yellowish channels radiating up from the leaf base through which the larva may move to mine in succession two, three or more leaves. At Arthur's Pass such mines were in a number of cases present in the same leaves as *Liriomyza craspediae*, but at Mount Cook only the beetle mines were found. The specimen bred by Mr Dugdale from Simonin Pass was from a mine formed mainly along the midrib, but it agrees completely with the rest of the type series.

Liriomyza wahlenbergiae Spencer sp.n (Figs. 66, 67)

Minute species with darkened third antennal segment and yellow scutellum.

Head: frons twice width of eye, not significantly projecting above eye in profile; two equal ors, two inclined ori, the lower similar to upper or slightly weaker; orbital setulae sparse, reclinate; jowls extended at rear, $1/3$ height of eye; third antennal segment small, round.

Mesonotum: $3 + 1$ dc, post-sutural equal to 3rd; acr irregularly in 4 rows.

Wing: length in male 1.4 mm, discal cell small, last section of vein M $3 + 4$ from $2\frac{1}{2}$ to 3 times length of penultimate.

Colour: frons pale orange-yellow, orbits lemon yellow, hind-margin of eye black to base of vti; jowls bright yellow, face pale grey, palps dark brown; first and second antennal segments yellow, third brownish, slightly paler on inside; mesonotum dark grey, largely mat, with only weak subshine; rear of humerus and notopleural area bright yellow; mesopleura greyish-black on front, lower and hind-margins, yellow centrally and on upper margin; scutellum largely bright yellow, with only small dark patches outside basal scutellars; legs: coxae dark above, yellowish below; femora largely yellow, with brown striations, tibiae and tarsi brownish; abdomen greyish-black, with tergites narrowly yellow-bordered; squamae grey, margin and fringe black; halteres bright yellow.

Male genitalia: aedeagus as in Figures 66, 67, with wide gap between distiphallus and mesophallus.

Host-plant/Biology: *Wahlenbergia albomarginata*, larva forming whitish linear mine, which fills small leaves and develops into a secondary blotch; frass finely scattered. The puparium is brownish, the larva leaving the mine through an upper surface exit slit (arrangement of posterior spiracles not known, as only puparium obtained died and was lost during rearing). Mines were found both at Mount Cook, where the two type specimens were obtained, and also on the scree at the east entrance to the Homer Tunnel, 23.i.75.

Type locality: South I., Mount Cook.

HOLOTYPE: ♂, South I., Mount Cook, Hoophorn spur, 14.i.75; (K.A.S.), in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

PARATYPE: ♂, same locality as type, 18.i., both caught on grassy ground where *Wahlenbergia albomarginata* was growing.

REMARKS: The male genitalia confirm the close relationship with *L. craspediae* (cf. Figs. 64, 65), but this is substantially larger and the mesonotum entirely shining black. *L. wahlenbergiae* closely resembles *vicina* sp.n., but the genitalia (cf. Figs. 31, 32) show that the two are not closely related.

Isolated Species

Liriomyza oleariae Spencer sp.n. (Figs. 68, 69)

Yellow and grey species, with brown third antennal segment.

Head: two equal, reclinate ors, two inclined ori; orbital setulae minute, sparse; orbits pronounced, distinctly projecting above eye in profile (frons measurement not possible, as head partially shrunk in all specimens examined); jowls extended at rear, $1/3$ height of eye, third antennal segment small, round.

Mesonotum: $3 + 1$ strong dc, acr in 2 rows.

Wing: length from 1.55 mm in male to 1.75 mm in female, last section of vein M $3 + 4$ $2\frac{1}{2}$ times length of penultimate.

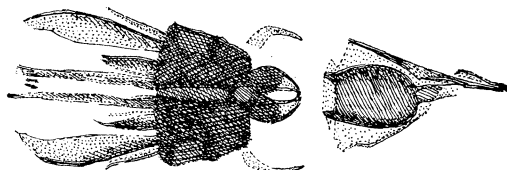
Colour: frons brownish-yellow, orbits paler yellow; jowls, face and palps yellow; third antennal segment brownish, first and second paler yellow; mesonotum conspicuously mat grey, scutellum narrowly yellow centrally; sides of thorax largely yellow; mesopleura with only narrow grey bar along lower margin; legs: femora yellow with brownish striations, tibiae and tarsi uniformly brownish-yellow; abdomen with all tergites yellow-bordered; squamae yellowish-grey, margin and fringe black; halteres yellow; in female basal cone of ovipositor shining at base, grey dusted at apex.

Male genitalia: aedeagus as in Figures 68, 69; ejaculatory apodeme with conspicuously narrow stalk; surstyli with small spine at end.

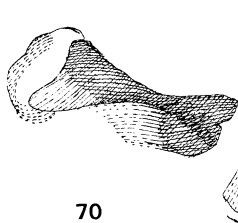
Host-plant/Biology: *Olearia virgata* var. *lineata*, also *O. hectori*; "All mines appear to commence near the tip of the leaf. Mine appears at first to be a very narrow gallery along the outer edge of the leaf but soon broadens to cross the midrib and include the whole width of the leaf, which is actually only approximately 1 mm wide. Total length of mine is about 1.5 cm. During mining the empty part of the mine appears to get blown up or distended with air and the mined portion of the leaf assumes a cylindrical shape. Colour of leaf over mined area becomes rapidly brown." (from Watt's mine notes, M.4 in National Museum, Wellington). Pupation takes place externally; the puparium is brownish-yellow, with the posterior spiracles each having an ellipse of about eight bulbs.



68



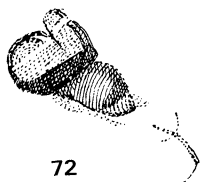
69



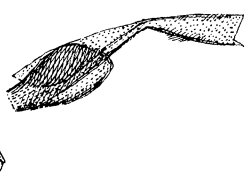
70



71



72



73

FIGS. 68, 69.—*Liriomyza oleariae*: 68, aedeagus, side view; 69, same, ventral view. FIGS. 70, 71.—*Liriomyza brassicae*: 70, aedeagus, side view; 71, same, ventral view. FIGS. 72, 73.—*Liriomyza chenopodii*: 72, aedeagus, side view; 73, same, ventral view.

Type locality: Dunedin, South I., on *Olearia* sp.

HOLOTYPE: ♂; South I., Dunedin, Opoho, Upper Gardens, emerged 7.xii.58 from leaf-mines found 8.xi.58 (M. N. Watt), in National Museum, Wellington.

PARATYPES: 2♂, 1♀, same data as type; 9.6 km northwest of Clinton at the farm "Strathearn" and vicinity of Wairuna Peak, 12 exx. emerged 17-30.xii.61 from leaf-mines on *O. hectori*, 24.xi.61 (J. Watt). Holotype and paratypes in National Museum, Wellington, one in author's collection.

REMARKS: This interesting species was found by the author in Watt's collection in Wellington. At the time the species was collected, Watt had ceased active work on the Agromyzidae, and no record of the species has been published.

There are apparently two or more generations, as Watt also refers to mines found by his son at Clinton in the last week of March, 1967, from which adults emerged in mid-May (mine notes, Sheet M.55).

This appears to be an isolated species and, as clearly shown by the genitalia, is not related to the other Compositae feeder, *L. craspediae*. The aedeagus retains the basic form characteristic of the genus but the distiphallus shows a high degree of differentiation, reflecting either great age or unusually rapid evolutionary change in this part of the structure.

Species of Australian/Pacific Origin

Liriomyza brassicae (Riley, 1884) (Figs. 70, 71)

Oscinis brassicae Riley, 1884: 322

Liriomyza brassicae, Spencer, 1963: 332; 1973a: 153

Among species in New Zealand with the frons and third antennal segment yellow, *brassicae* is immediately distinguishable from all by the brilliantly shining black mesonotum, small discal cell and relatively small size, with wing length from 1.25 mm in the male to 1.75 mm in the female. The distinctive aedeagus is shown in Figures 70, 71.

The larva forms an irregular whitish linear mine, which frequently begins with a number of small star-shaped offshoots. Pupation takes place externally; the puparium is yellowish-brown and the posterior spiracles each have three bulbs.

L. brassicae feeds on many genera of Cruciferae and can be a significant pest on cultivated *Brassica* crops (Spencer 1973a). Wild hosts include *Lepidium*, which is widespread in New Zealand, and a favourite host, particularly in Australia and New Zealand, is the ornamental, *Tropaeolum*. Mines on this host were seen at Maungatapere, Parau (Auckland), Hamilton, New Plymouth, Wellington, and Nelson. In Southeast Asia feeding also occurs regularly on the Capparaceae and mines are commonly found on the weed, *Cleome graveolens* Raf. *Pisum* is also occasionally used as a host.

Distribution of this species is probably the most truly cosmopolitan of any Agromyzid. It is widespread throughout the Pacific area and Old World tropics but is less common in northern temperate areas, being entirely absent from Britain and Scandinavia.

Material Collected:

NORTH ISLAND

Whangaroa, 2 ♀, 20.xii.74, on *Tropaeolum*.

SOUTH ISLAND

Nelson, 2 ♂, 6 ♀, emerged 12-13.i.75 from leaf-mines on *Tropaeolum* coll. 20.xii.74.

Liriomyza chenopodii (Watt, 1924) (Figs. 72, 73)

Haplomyza chenopodii Watt, 1924 683; Harrison, 1959: 327

Liriomyza chenopodii, Spencer, 1963: 333; 1973a: 135

Haplomyza imitans Malloch, 1934: 1; Kleinschmidt, 1970: 368

Small yellow and black species with second cross-vein lacking.

The male genitalia (Figs. 72, 73) confirm the correct generic position of this species in *Liriomyza*, despite the absence of the second cross-vein. In Australia seven species are known with a similar venation (Spencer, in press), and others are known in Europe.

Host-plants are restricted to genera in the two closely related families Caryophyllaceae and Chenopodiaceae. The original host has not been established. At the present time in New Zealand the species appears to feed most commonly on *Cerastium holosteoides* Fries (previously known as *C. vulgatum* L.) which was an early introduction from Britain and is now widespread even up to high altitudes (c. 1375 m) on Mt Ruapehu and also at the summit of Mt Te Aroha (945m).

L. chenopodii has also colonized cultivated beet and spinach, on which it can occur in large numbers as a minor pest (Wise 1953; Spencer 1973a).

The larva forms a narrow whitish linear mine but many mines can occur in a single leaf which is then completely eaten out. Pupation takes place externally; the puparium is yellowish-brown, with the posterior spiracles each having three bulbs.

L. chenopodii occurs widely in both North and South Islands and appears to have followed the distribution of its hosts. It is also present on Snares Islands (Harrison 1976). It is not closely related to other New Zealand species and has almost certainly been introduced from Australia in recent times with either spinach or beet.

Material Collected:

NORTH ISLAND

Mt Egmont, 885 m, 1 ♀, 10.xii.74; Tongariro National Park, Mt Ruapehu, 1375 m, 4 ♀, 29.xii.74; Mt Te Aroha, summit, 945 m, empty leaf mines on *Cerastium* sp., 27.xii.74.

SOUTH ISLAND:

Christchurch, Botanical Gardens, 1 ♂, 2 ♀, emerged 13.xii.74 from mines on *Cerastium holosteoides* coll. 1.xii; Mona Vale, 13 ♂, 11 ♀, emerged 13-14.xii. from mines on same host coll. 2.xii.

Liriomyza sp. (Sumner)

A single female from Sumner, 7.x.62 (D. Bigelow), in the Canadian National Collection appears to represent an undescribed species. Unfortunately it is in poor condition, and formal description seems undesirable until additional material becomes available.

Important characters are as follows: frons yellow, third antennal segment black, with conspicuous whitish pubescence; mesonotum mat black, with 2+1 dc, acr sparse in two rows; rear of humerus and notopleural area bright yellow, mesopleura largely black, only upper margin narrowly yellow; scutellum bright yellow centrally; legs: femora yellowish below but almost completely darkened with black striations above, tibiae and tarsi dark, brownish-black; wing length approximately 1.75 mm, venation not detectable.

This species most closely resembles *penita* and *plantaginella*; however, it is distinguishable from both by the presence of only 2 + 1 dc, from *penita* by the pubescence of the third antennal segment and from *plantaginella* by the sparser acrostichals. Without examination of a male, its exact affinities cannot be established.

Genus *Phytoliriomyza* Hendel

Phytoliriomyza Hendel, 1931: 203 (as sub-genus of *Liriomyza*).

Type of genus: *Agromyza perpusilla* Meigen, 1830

Hendel erected *Phytoliriomyza* as a sub-genus to include the single species *perpusilla*, which has the orbital setulae distinctly proclinate, as opposed to other species with the scutellum yellow, in which the orbital setulae are reclinate (or at most upright).

In recent years our knowledge of this group has greatly increased and the original concept has been expanded. Frick (1952: 410) first raised *Phytoliriomyza* to full generic rank. Nowakowski (1962: 97) erected *Pteridomyza* for the holarctic fern-feeder, *hilarella* Zetlerstedt; Spencer (1965) erected *Lemurimyza* for two species from Madagascar and Nepal with black halteres. However, genitalia studies of species now known from many parts of the world, including Brazil, Venezuela, Ceylon, New Guinea and Australia, in addition to Europe and North America, show that *Phytoliriomyza* is a diverse genus with some 50 species, which can be split into a number of monophyletic species-groups. Both *Pteridomyza* and *Lemurimyza* have been synonymised with *Phytoliriomyza*.

Six species are now recorded in New Zealand, including *flavopleura* Watt and five which are described below. Ancestral relationships are apparent with species

known from Australia, New Guinea and Europe. *P. convoluta* sp.n. is closely related to *australensis* Spencer, 1963, which is widespread in New South Wales; *huttensis* sp.n., with proclinate orbital setulae (only female known), is almost certainly in this group (referred to as *arctica* group). *P. bicolorata* sp.n. belongs to the *Lemurimyza* group, with species known in Australia (undescribed) and New Guinea (*biden-siphoeta* Spencer, 1976 and *sublima* Spencer, 1976). *P. tearohensis* sp.n. is almost certainly a fern-feeder, with the aedeagus showing a remarkable similarity with that of *pteridii* Spencer, 1973b, recently described from Europe, feeding as a leaf-miner on *Pteridium aquilinum* (bracken). The two known fern-feeders, *flavopleura* and *cyathea* sp.n, diverge considerably from *tearohensis*; even they themselves, although obviously related (cf. surstyli and epandrium, Figs. 84, 87) are certainly not sister-species and are derived from separate immigrant ancestors. The aedeagus of *flavopleura* (Figs. 85, 86) indicates close relationship with an undescribed species from Australia and with *spectata* Spencer, 1976: Figs. 43, 44 from New Guinea; that of *cyathea* cannot be closely associated with any known species.

The six New Zealand species thus appear to be derived from at least five separate immigrants, with only a single pair of possible sister-species, *convoluta* and *huttensis*, representing speciation in New Zealand.

NOTE: After completion of this manuscript a single male (lacking its head) was seen from Enderby Is., Auckland Islands, which proved to represent a *Phytoliriomyza* sp. in the *Lemurimyza* group apparently identical to an undescribed species from New South Wales (Spencer, in press).

KEY TO NEW ZEALAND *Phytoliriomyza* SPECIES

- | | |
|--|---------------------------|
| 1. Scutellum yellow centrally | 2 |
| Scutellum entirely dark, black or grey | 4 |
| 2. Mesonotum uniformly dark to margin of scutellum; minute species, wing length in male 1.4 mm | <i>tearohensis</i> sp.n. |
| Mesonotum yellow before scutellum; larger species, wing length 2.25-2.9 mm | 3 |
| 3. Mesonotum with oval yellow patch centrally adjoining scutellum | <i>bicolorata</i> sp.n. |
| Mesonotum divided into bands, dark areas greyish-black or if deeper black never fully shining | <i>cyathea</i> sp.n. |
| 4. Third antennal segment yellow | 5 |
| Third antennal segment largely or entirely black | 6 |
| 5. Mesonotum and scutellum grey; minute species, wing length 1.5-1.7 mm | <i>convoluta</i> sp.n. |
| Mesonotum and scutellum shining black; large species, wing length 2.5-2.9 mm | <i>flavopleura</i> (Watt) |
| 6. Legs black; third antennal segment with normal, short pubescence | sp. (Auckland Is.) |
| Femora yellow with darker striations; third antennal segment conspicuously pubescent | <i>huttensis</i> sp.n. |

P. arctica Group

Aedeagus with long, narrow paired tubules, normally coiled in rest position (cf. Spencer, 1969: fig. 364); surstyli and epandrium each with at most a single spine.

The two species *convoluta* and *huttensis* belong to this group.

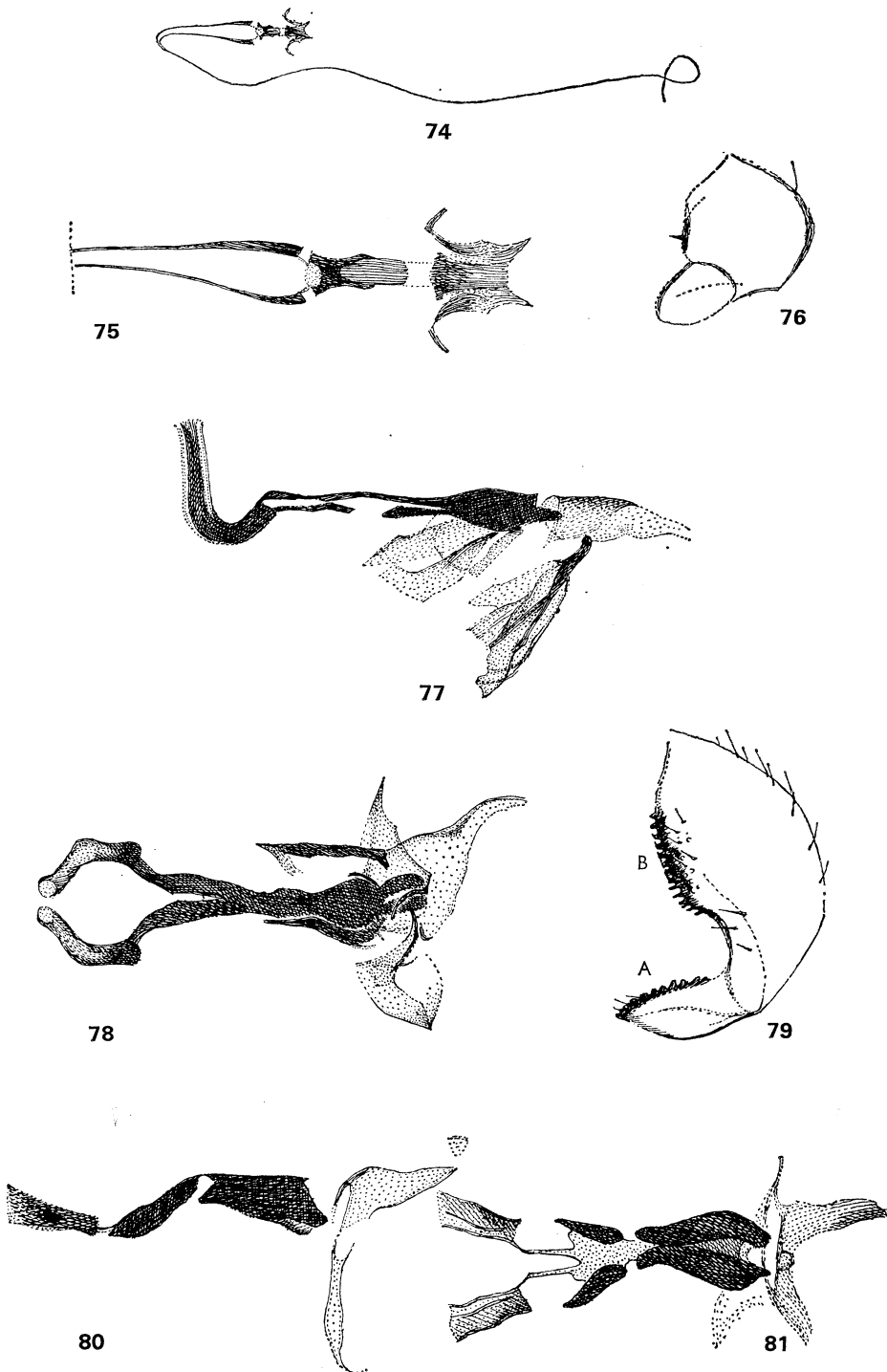
Phytoliriomyza convoluta Spencer sp.n (Figs. 74-76)

Minute species with yellow third antennal segment and dark scutellum.

Head: two reclinate ors, the upper stronger, one incurved ori; orbital setulae proclinate, well-developed; eye conspicuously slanting, with short, scattered pilosity; jowls 2/5 height of eye; third antennal segment small, round, slightly pubescent, arista long, drooping.

Mesonotum: 3 + 1 dc, third and fourth short; acr sparse, in two rows.

Wing: length from 1.5 mm in male to 1.7 mm in female; last section of M 3 + 4 from 1½ to twice length of penultimate.



FIGS. 74-76.—*Phytoliriomyza convoluta*: 74, aedeagus, ventral view; 75, same (enlarged); 76, surstylus and epandrium. FIGS. 77-79.—*Phytoliriomyza bicolorata*: 77, aedeagus, side view; 78, same, ventral view; 79, surstylus (A) and epandrium (B). FIGS. 80, 81.—*Phytoliriomyza* sp. (Auckland Is.): 80, aedeagus, side view; 81, same, ventral view.

Colour: frons yellowish-brown, jowls, face, palps and antennae yellow; mesonotum and scutellum entirely mat, brownish-grey; pleura largely yellow; mesopleura with only small black patch on lower margin; legs: femora yellow with slightly darker striations, tibiae and tarsi more brown; halteres largely yellow but normally with knob pale brown above, in palest specimens entirely yellow.

Male genitalia: aedeagus as in Figures 74, 75, distal tubules fused beyond end of aedeagal apodeme, exceptionally long, at rest coiled beneath ninth sternite, sclerotised throughout; surstyli oval or slightly elongate, virtually bare, separated from epandrium only by a weak suture, lower corner of epandrium with one short, stout spine (Fig. 76).

Type locality: North I., Mt Te Aroha, 460-610 m.

Material: Collected:

HOLOTYPE: ♂, North I., Mt Te Aroha, 460-610 m, on *Senecio* sp., 27.xii.74 (K.A.S.), in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

PARATYPES: Whakamaru, 1 ♂ 6.x.69 (R. Petty, in Canadian National Collection); Little Barrier I. 1 ♀, "Kauri gully and tracks", 24.xi.54 (R. A. Harrison); South I.: Rotorua, near Murchison, 1 ♂, 2.i.75.

REMARKS: On external characters this species is not distinguishable from *australensis* Spencer, 1963. Re-examination of *australensis* shows that the aedeagus is in fact longer than illustrated by Spencer, 1963: fig. 62; it is entirely membranous distally and also lies in a coil but the coiled section is difficult to detect and easily overlooked.

***Phytoliriomyza huttensis* Spencer sp.n.**

Minute species with dark, pubescent third antennal segment and dark scutellum.

Head: frons distinctly projecting above eye in front (measurements not possible owing to deformation); two ors, the upper stronger, one inclined ori, stronger than lower ors; orbital setulae long, proclinate; jowls deep, approximately 1/3 height of eye; eye conspicuously slanting, with distinct pilosity; third antennal segment rounded, broader than long, with conspicuous fringe of upcurved pubescence.

Mesonotum: 3 + 1 dc, acr in 2 rows.

Wing: length in female 1.5 mm, last section of vein M 3 + 4 slightly less than twice penultimate, first cross-vein at midpoint of discal cell.

Colour: frons black, orbits paler, yellowish-grey; lunule, jowls, face and palps yellow; first and second antennal segments yellow, third largely black but yellowish on inside adjoining second; mesonotum entirely mat, brownish-black; rear of humerus yellow, notopleural area grey, mesopleura largely yellow but black on lower third; legs: femora yellow with brownish striations, tibiae and tarsi dark brown; abdomen largely mat black, with tergites very narrowly yellow-bordered except last segment which has broad yellow border; basal cone of ovipositor entirely shining black; squamae including margin and fringe black; halteres brownish-yellow, knob darker above; wing veins conspicuously black.

HOLOTYPE: ♀, South I.: Mt Hutt, 1580 m, 12.xii.73, puparium "in mat plants sample No. 73/143" G. Kuschel, in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

REMARKS: This species is clearly distinct from any others known in New Zealand and Australia. It will not be difficult to associate a male with the female holotype, and it is to be hoped that additional specimens will be obtained with further collecting on Mt Hutt.

***Lemurimyza* Group**

Paired tubules of aedeagus broad, strongly chitinized; both surstyli and inner margin of epandrium frequently with a "comb" of black bristles (reduced to a single strong bristle in sp. (Auckland Is.)); mesonotum frequently with yellow patch before scutellum.

***Phytoliriomyza bicolorata* Spencer sp.n. (Figs. 77-79)**

Species with small yellow mesonotal patch adjoining scutellum.

Head: frons broad, twice width of eye, not projecting above eye in profile; two equal ors, reclinate or inclined slightly outwards, one inclined ori; orbital setulae sparse, reclinate or upright; eye upright, distinctly pilose; jowls 1/3 height of eye; third antennal segment slightly longer than broad, with short but distinct fringe of pubescence.

Mesonotum: 3 + 1 strong dc, acr irregularly in 2 rows.

Wing: length from 2.25 mm in male to 2.5 mm in female; discal cell large, last section of vein M 3 + 4 only 1½ times length of penultimate.

Legs: mid-tibiae without lateral bristles.

Colour: frons, face and jowls bright yellow; upper orbits slightly darkened, both vt on black ground; first antennal segment yellow, second and third black; palps black; mesonotum mat grey, with small yellow patch between first dc and margin of scutellum; rear of humerus, notopleural area and upper margin of mesopleura yellow, mesopleura and sternopleura largely black; scutellum bright yellow; legs black, with only fore-knees narrowly yellowish; abdomen broadly yellow laterally; squamae grey, margin and fringe black; halteres bright yellow.

Male genitalia: aedeagus (Figs. 77, 78) with tubules of distiphallus conspicuously angular and curving dorsally; surstyli with suture and broadly joined to epandrium, with a row of about 10 short stout bristles (Fig. 79A), inner margin of epandrium strongly chitinized, with a row of some 15 bristles (Fig. 79B), ejaculatory apodeme pale, with broad blade and lightly chitinized bowl-shaped base; ninth sternite conspicuously angular, with short, slender hypandrial apodeme.

Type locality: Fox Glacier area, South I., 1220m.

HOLOTYPE: ♂, South I.: "Alpine Garden", above Fox Glacier, 1220 m, 8.i.75 (K.A.S.), in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

PARATYPES: 1 ♀, same data as type; 1 ♀, roadside Cascade-Homer Tunnel near Hollyford track, 22.i.75, on *Hebe salicifolia*.

REMARKS: The yellow patch on the mesonotum adjoining the scutellum makes this a distinctive species. With relatives known both in Australia and New Guinea, it seems certain that the ancestor of *bicolorata* reached New Zealand from Australia.

Phytoliriomyza sp. (Auckland Is.) (Figs. 80, 81)

A single male from Enderby Is., 18.i.63 (K. A. J. Wise) represents a species being described from New South Wales: Brown Mountains and Western Australia: Mt Singleton (Spencer, in press). This specimen unfortunately now lacks its head but an accurate identification can be made from the male genitalia.

Essential characters of this species are as follows: frons broad, twice width of eye; two ors, one ori; third antennal segment round, prominent; 3 + 1 dc, acr sparse, in two rows; wing length 2-2.1 mm, last section of vein M 3 + 4 little more than $1\frac{1}{2}$ times length of penultimate; colour: frons dark behind, more reddish in front; third antennal segment black; pleura largely black, only upper hind corner of mesopleura yellow; legs almost completely black, only knees of fore-femora narrowly and indistinctly yellowish; halteres bright yellow. Male genitalia: aedeagus as in Figures 80, 81; surstyli round, divided from epandrium by a suture, with a single stout bristle; inner margin of epandrium with one or two short bristles.

Although this species may be present in South Island, it may equally well have reached the Auckland Islands by long-distance dispersal direct from Australia.

The Fern-Feeders

Paired tubules of aedeagus expanded at apex; surstyli with a conspicuous comb of black bristles (reduced to two in *tearohensis*); inner margin of epandrium either with a comb of strong black bristles or bristles scattered more irregularly on hind-corner (Figs. 87B, 89B).

Phytoliriomyza cyathae Spencer sp.n. (Figs. 82-84)

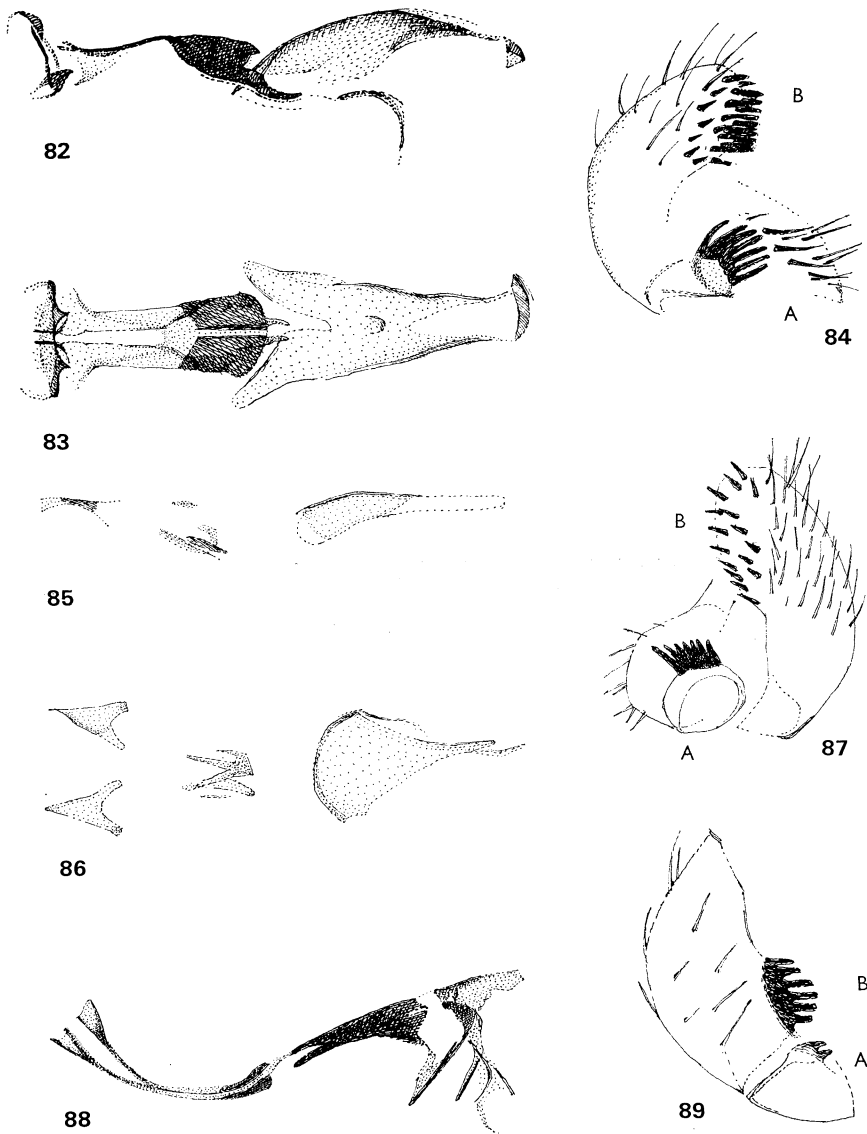
Large species with yellow head and scutellum and mesonotum divided into bands.

Head: frons $1\frac{1}{2}$ times width of eye, distinctly projecting above eye in profile; two reclinate ors, two strong inclined ori, orbital setulae sparse, either almost completely lacking or at most four or five, irregular, predominantly upright or those above, reclinate, and below, proclinate; jowls broad, almost $1/3$ height of eye, eye slanting; third antennal segment small, round.

Mesonotum: 3 + 1 dc, acr sparse, in two rows.

Wing: length from 2.5 mm in male to 2.9 mm in female, discal cell large, last and penultimate sections of vein M 3 + 4 equal.

Colour: head entirely bright yellow, including entire hind-margin of eye; mesonotum in male broadly yellow adjoining scutellum, dark area dark grey, predominantly mat but with some subshine, divided into bands (cf. Fig. 57), in female variable, either with similar bands to male but distinctly black, or with bands merging but still detectable and area adjoining scutellum substantially darker, brownish-yellow, up to the darkest form, in which the banding is scarcely detectable and the yellow adjoining the scutellum is only detectable when viewed from rear; pleura almost entirely bright yellow, with only sternopleura having faint yellowish-



FIGS. 82-84.—*Phytoliriomyza cyatheae*: 82, aedeagus, side view; 83, same, ventral view, 84, surstylus (A) and epandrium (B). FIGS. 85-87.—*Phytoliriomyza flavopileura*: 85, aedeagus, side view; 86, same, ventral view; 87, surstylus (A) and epandrium (B). FIGS. 88, 89.—*Phytoliriomyza tearohensis*: 88, aedeagus; 89, surstylus (A) and epandrium (B).

brown patch in lower half; scutellum varying from entirely yellow in both male and female to faintly yellow centrally in darkest females; legs: in both sexes coxae and femora conspicuously pale yellow, tibiae and tarsi more brownish; abdomen largely yellow in male to predominantly black in female; squamae yellow, margin and fringe black; halteres bright yellow.

Male genitalia: aedeagus as in Figures 82, 83; ejaculatory apodeme minute; ninth sternite narrow throughout, narrowing at apex but rounded; surstyli as in Figure 84A, with "comb" of seven stout black bristles and below further inwards 10-12 longer, finer bristles; conspicuous patch of stout bristles at hind-corner of epandrium (Fig. 84B).

Host-plant/Biology: *Cyathea dealbata*, *C. smithii* (now *Alsophila tricolor*, *A. smithii*), larva forming a linear mine, starting at the tip of a frond section, working downwards and completely eating out up to 10 or more sub-sections on each side of the central vein. The mines

are greenish while the larva is feeding but later turn brown. Frass is in conspicuous black lumps in the first and probably also second instar but in the final instar is finer and less conspicuous, presumably as the mature larva is able to digest a greater proportion of the leaf tissue. Mines can be found only a metre or so above ground level but also in high-growing fronds six or more metres high, when they are conspicuous seen against the light from below. As many as seven mines can occur in a frond section some 15 cm long. Pupation takes place externally. The puparium is reddish brown, with the posterior spiracles each having three elongate bulbs. There is a pair of pronounced anal projections and two lines of some 20 strong black spines at the segment boundary in front of and to the side of the posterior spiracles; smaller spines are present at all segment boundaries.

Type locality: Mt Ngongotaha, Rotorua, North I.

HOLOTYPE: ♂, North I.: Rotorua, Mt Ngongotaha, 24.xii.74, swept on *Cyathea smithii* (J. S. Dugdale), in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

PARATYPES: 1 ♂, 5 ♀, same data (all J. S. Dugdale); Titirangi, 1 ♀, 12.xii.52, at light trap (C. R. Thomas); Stewart I.: Oban, 3 ♂, 3 ♀, 7-10.i.60 (M. N. Watt). Watt's paratypes in National Museum, Wellington.

Mine Material Collected:

NORTH ISLAND

Leaf-mines with larvae found on *Cyathea dealbata* (*Alsophila tricolor*) at Mangamuka Gorge, 24.xii.74; Omahuta Reserve, 24.xii; Manginangina Reserve, 20.xii; Mangakahia Valley, S of Kaikohe, 19.xii; Waipoua Forest, 21.xii; Waitakere, 17-18.xii; Coromandel Forest Park, 26.xii; Wellington Botanical Gardens, 30.xii.74.

SOUTH ISLAND

Hollyford, on *A. smithii*, 22.i.75.

REMARKS: The male genitalia, particularly the surstyli, confirm the generic position of this species. The aedeagus itself is substantially different from the form of any known species groups; the grouping of the epandrial bristles at the lower hind-corner is also not typical of *Phytoliriomyza* but an intermediate evolutionary step is found in *flavopleura* (Fig. 87B).

The dimorphic colouration, with the males being markedly paler than the females, is unusual and has not been noted in any other species in the genus.

P. cyatheae appears to be present throughout New Zealand in association with its host. It is apparently univoltine, with the adults having a restricted flight period in December to January, and no flies could be obtained on plants on which larvae were already feeding.

Phytoliriomyza flavopleura (Watt, 1923), comb. nov. (Figs. 85-87)

Agromyza flavopleura Watt, 1923: 481

Phytobia flavopleura, Harrison, 1959: 319

Agromyza flavopleura var. *casta* Watt, 1923: 482

Harrison (1959: 519) transferred this species to *Phytobia*, following Frick, (1952), and this was correct on the basis of the nomenclature accepted at the time. However, the male genitalia clearly indicate that the species belongs in *Phytoliriomyza*.

Important characters are: frons, jowls and antennae bright yellow; hind-margin of eye black to base of vti; orbits normally narrowly black adjoining eye margin, two ors, one ori, with a group of unusually long, reclinate orbital setulae in area of the missing lower ori; mesonotum and scutellum brilliantly shining black, acr in four rows; sides of thorax almost entirely bright yellow but the lower half of the sternopleura varies from completely yellow through brownish to black; legs: coxae and femora bright yellow, tibiae and tarsi slightly darker, brownish-yellow; halteres bright yellow; wing length from 2.5 mm in male to 2.9 mm in female, last and penultimate sections of vein M 3 + 4 equal.

Watt named the palest form with the sternopleura entirely yellow var. *casta* n. var. I have examined the male and female type specimens and the male genitalia are identical with those of a paratype of *flavopleura*. Even in these two paratypes the sternopleura are brownish-black rather than pure black and this also applies to

six further specimens from Wellington and Nelson in the National Arthropod Collection. There is thus no justification for retaining the name *casta*.

The aedeagus of a paratype is shown in Figures 85, 86, and the surstyli and epandrium in Figure 87. The comb of black bristles on the surstylus is typical of many *Phytoliriomyza* species, particularly fern-feeders, and the strong bristles on the inner face of the epandrium are intermediate between a line of strong bristles as in *bicolorata* sp.n (Fig. 79) and the grouping at the lower corner found in *cyatheae* sp.n (Fig. 84).

Food-plants are restricted to ferns and known hosts are *Asplenium falcatum*, *A. flaccidum*, *A. lucidum* (Aspleniaceae); *Grammitis billardieri* (= *Polypodium australe*) (Grammitidaceae); and *Phymatodes scandens* (Polypodiaceae). Watt (1923) also records *Blechnum filiforme* (as *Lomaria filiformis*) (Blechnaceae) but, as John Dugdale pointed out to me *Phymatodes scandens* can be easily confused with *Blechnum filiforme*; both are climbing ferns but the former is normally higher, the latter lower on the trunks of trees; he has never found any mines on *Blechnum*. With a recent undoubted recorded on *Phymatodes*, it is felt that Watt's identification requires confirmation. Harrison (1959: 320) also records *Polypodium billardieri* and *P. diversifolium* (= *Phymatodes diversifolium*) but the source of these records can no longer be traced.

The larva forms a long, narrow linear mine, not infrequently within the midrib; in *Asplenium lucidum* the larva can move from one leaf to another, by mining for a short distance along the stem between two leaves. In smaller leaves, the mine channels coalesce to form a secondary blotch. Watt (1923) gives six illustrations of leaf-mines. The puparium is pale yellowish, somewhat elongate, with the anterior spiracles on two long stalks projecting through the leaf epidermis; the posterior spiracles are each on a small protuberance, each with some eight bulbs; there is a line of scar bands around the segment boundaries. As Watt rightly noted, emergence takes place through a circular flap on the front three segments, with no longitudinal splitting as is normal in related genera.

P. flavopleura is widely divergent from *P. cyatheae*, differing substantially in external morphology, in the form of the aedeagus and in larval characters. The monophyletic origin of the two species is nevertheless indicated by the synapomorphy of the surstyli and epandrium.

With records from the Auckland area, Wanganui, Wellington, Nelson, and Dunedin, *P. flavopleura* is probably widely distributed throughout New Zealand in suitable habitats where its host-plants occur.

Material Collected:

Auckland, Whatipu: leaf-mines on *Asplenium falcatum*, *A. flaccidum*, *A. lucidum*, *Phymatodes scandens*, 18.xii.74; puparia in mines of *A. falcatum* (only Braconid parasites obtained), all coll. J. S. Dugdale.

Leaf-mines were found at the Wellington Botanical Gardens, 30.xii.74, on immature leaves of *Asplenium bulbiferum* but all empty. This is puzzling, as *P. flavopleura* is accepted as always pupating in the mines. It thus seems possible that a further species may be represented.

Phytoliriomyza tearohensis Spencer sp.n (Figs. 88, 89)

Minute species with black third antennal segment and yellowish scutellum.

Head: frons broad, twice width of eye, slightly projecting above eye in area of ori; two reclinate ors, the upper slightly stronger, one incurved ori; orbital setulae minute, sparse, mainly below lower ori; eye bare, conspicuously slanting, jowls extended at rear, $\frac{1}{4}$ height of eye; third antennal segment slightly enlarged, rounded above, flat and distinctly longer below, with short white pubescence.

Mesonotum: 3 + 1 strong dc, pre-sutural only slightly shorter than third; acr sparse, in two rows.

Wing: length in male 1.4 mm, last section of vein M 3 + 4 $1\frac{1}{3}$ as long as penultimate, first cross-vein well before midpoint of discal cell.

Colour: frons brownish-yellow; orbits, lunule, jowls, face and palps bright yellow; hind-margin of eye black to midway between vte and vti; third antennal segment entirely black,

first and second bright yellow; mesonotum mat greyish-black; humerus, notopleural area and upper third of mesopleura yellow, mesopleura dull black below; scutellum bright yellow centrally; legs: femora yellow in basal half, merging into brown distally, tibiae and tarsi brownish-black; abdomen black; squamae, margin and fringe black; halteres entirely bright yellow.

Male genitalia: aedeagus as in Figure 88; ninth sternite with narrow side-arms, approximately triangular but rounded at apex; ejaculatory apodeme of medium size, equal in length to distance between side-arms of ninth sternite at midpoint; surstyli (Fig. 89A) completely separated by a suture, with two short stout spines at end, inner margin of epandrium with a "comb" of six stout spines (Fig. 89B).

Type locality: North I., Mt Te Aroha.

HOLOTYPE: ♂ North Island, Mt Te Aroha, c. 610 m, 27.xii.74, on *Cyathea dealbata* (*Alsophila tricolor*), (K.A.S.), in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

REMARKS: The aedeagus of the unique specimen of this species has clear apomorphic characters in common with *P. pteridii* Spencer, 1973b, a common miner of bracken (*Pteridium aquilinum* L.) in Europe. In particular the dilation of the distal tubules (Spencer 1973b: figs. 3, 4) is a character not as highly developed in any other species in the genus. It therefore seems certain that *tearohensis* is a fern-feeder. It can never be assumed that the presence of a fly on a particular plant indicates that this is its host but in this case there seems a strong possibility that *Alsophila* is the host.

Genus *Phytomyza* Fallén, 1810

Phytomyza Fallén, 1810: 10. Type species: *Musca ranunculi*

Schrank, 1803 (as *flaveola* = *flava* Fallén, 1823b)

Phytomyza is the largest world genus with some 450 described species, of which the great majority occur in temperate areas of the northern hemisphere. In Britain 100 species are known. Distinctive characters are the proclinate orbital setulae, the reduction of the costa to vein R 4 + 5 and in all except a few species the absence of the second cross-vein.

Harrison (1959: 312) discusses three species in New Zealand. One, *P. plantaginis*, which has been known for several years, is now formally recorded and discussed below and two new species are described.

KEY TO NEW ZEALAND *Phytomyza* SPECIES

- | | |
|---|----------------------------|
| 1. At least fore-coxae yellow | 2 |
| Fore-coxae black | 5 |
| 2. Large species, wing from 2.25 mm in male to 2.85 mm in female | 3 |
| Smaller species, wing length less than 2 mm in both sexes | 4 |
| 3. Third antennal segment elongate, black | <i>improvisa</i> sp.n. |
| Third antennal segment round, normally bright orange-yellow (rarely black); femora normally bright orange-yellow (rarely darkened with brownish striations) | <i>clematadi</i> Watt |
| 4. Aedeagus as in Figs. 92, 93; host: <i>Ranunculus</i> spp. | <i>costata</i> Harrison |
| Aedeagus as in Figs. 100, 101 (in New Zealand only females known); host: <i>Plantago</i> spp. | <i>plantaginis</i> R.-D. |
| 5. Third antennal segment small, round; orbits yellow | <i>syngenesiae</i> (Hardy) |
| Third antennal segment large, elongate, orbits grey | <i>lyalli</i> sp.n. |

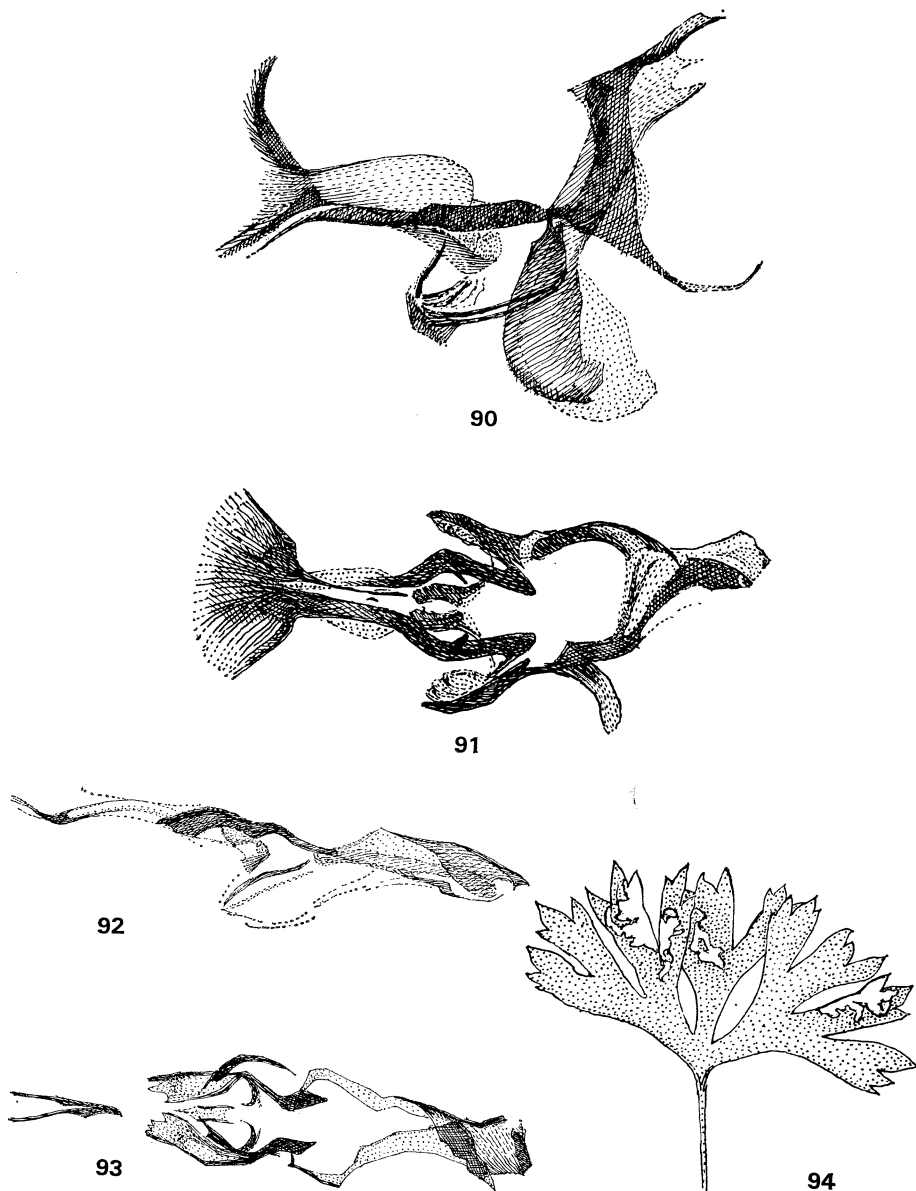
Phytomyza clematadi Watt, 1923 (Figs. 90, 91)

Phytomyza clematadi Watt, 1923: 484; Harrison, 1959: 313

This is the only *Phytomyza* in New Zealand with the femora largely yellow. However, in material I had seen before visiting New Zealand I had noticed a

significant colour variation which suggested that two species might be present. Both forms form typical linear leaf-mines, pupating internally. The complex of populations is further complicated by the larval feeding producing in some cases a type of gall which has been found at Huia, near Auckland and near Eltham (see below).

Watt's description refers to the antennae as having the "first two joints yellow, pedicel obscurely blackish above" and femora as being "yellowish with obscurely brownish darkening towards tibiae" (f_1) and "obscurely brownish yellow" (f_2, f_3).



FIGS. 90, 91.—*Phytomyza clematadi*: 90, aedeagus, side view; 91, same, ventral view (paratype). FIGS. 92-94.—*Phytomyza costata*: 92, aedeagus, side view; 93, same, ventral view; 94, leaf-mines on *Ranunculus verticillatus*, Lake Sylvester. FIGS. 95, 96.—*Phytomyza improvisa*: 95, aedeagus, side view; 96, same, ventral view. FIGS. 97-99.—*Phytomyza lyallii*: 97, aedeagus, side view; 98, same, ventral view; 99, leaf-mines on *Ranunculus lyallii*, Mt. Cook.

The male holotype was obtained on 6.xii.21. This now lacks its head but the femora are somewhat darkened. There are six identical specimens in the Watt collection. In a male paratype I have examined, 25.xi.21 (in Hering collection), the third antennal segment is essentially orange but could agree with Watt's description; in both this male and a female paratype, 1.xi.21 (with the head now missing) the femora are entirely orange-yellow with no trace of dark markings. The male I obtained at Wellington, and five specimens bred from "galls" are also of this completely pale form. By contrast three males and a female also bred by Watt at Dunedin, 1.xii, 6.xii, 8.xii and 10.xii.21, have the third antennal segment and palps completely black and the femora are conspicuously darkened by brownish-black striations.

I have carefully examined the extremes of both the pale and dark forms bred from leaf-mines and also the pale form from "galls", and I can find nothing to separate them, apart from the colour differences. Watt obtained both forms at Dunedin, and it is surprising that he did not comment on this striking colour difference. Harrison (1959: 313) suggested that "North Island specimens are lighter in colour than South Island specimens. This is particularly so in the case of the antennae, palps and legs." This is only partially true. Certainly no examples of the dark form have been seen from North Island but both are present at Dunedin and the two specimens recorded below from Stewart Island are entirely pale. The colour difference cannot therefore be explained as a geographical variation.

Galls have been found on both seed-heads and leaves. It seems that the host does not consistently react to larval feeding by the production of gall-like swellings. Possibly this reaction is limited to cases where oviposition has taken place in very young leaves. The one leaf of this type I have seen shows evidence of production of abnormal cells which may correctly represent a gall but this is very different from the typical galls caused by some Agromyzids (cf. Fig. 8) where there is a small oval swelling on the twig. The only reported case of leaf-galls is of *Phytobia* (*Praspedomyza*) *pittosporophylli* Hering, 1962, on *Pittosporum undulatum* Andr. in Australia. Here the larva feeds within well-defined circular swellings in the leaves (Hering 1962: fig. 3). Further detailed study of the galls on *Clematis* will be necessary before their exact significance can be determined, but the resulting adults cannot be separated in any way from typical *clematadi*.

Clematis vitalba, introduced from Britain, was examined for mines at a number of localities, including Mona Vale, Christchurch, 1.xii.74, Oaro, south of Kaikoura, 3.xii.74, and on the roadside Blenheim-Nelson, 31.xii.74. No mines could be found. However, a few mines were found on this host in the "Clematis garden" at the Botanical Gardens, Christchurch, and also on an adjacent plant, *C. dioscoreifolia*, which had been introduced from Japan many years ago. These mines are shorter and narrower than those of *clematadi* on *C. paniculata* but the puparia, although smaller, are otherwise similar to those of *clematadi*. They definitely do not represent the European species, *P. vitalbae* Kaltenbach, whose normal host is *C. vitalba* and which is present in Australia on local *Clematis* species.

The aedeagus of a paratype is shown in Figures 90, 91. The genitalia of species feeding on Ranunculaceae, including many on *Clematis*, have been examined from many parts of the world, and none have the aedeagus in any way comparable to that of *clematadi*. The highly differentiated genitalia and also the distinctive colouration suggest a long period of isolation (or unusually rapid evolutionary change) in New Zealand. It should nevertheless be emphasized that larval characters and biology, with pupation in the leaf and the anterior spiracles projecting through the epidermis, is characteristic of many feeders on Ranunculaceae, and this must be given due weight in assessing the monophyly of *clematadi* with species such as *vitalbae* Kalt. in Europe and *clematidicola* Spencer 1963, in Australia.

P. clematadi is widespread throughout much of New Zealand. Harrison (1959) gives records for Three Kings Island and Little Barrier Island and new records for Stewart Island are given below.

Material Collected and Seen:

NORTH ISLAND

Waitakere Range, near Auckland, mines on *Clematis paniculata*, 17.xii.74 (K.A.S. and J.S.D.); Wellington Botanical Gardens, 1 ♂, 30.xii.74 on *C. hookeriana* (mines also present); Whatipu, near Auckland, 1 ♂, 1 ♀, emerged 3.x.74 ex galls on *C. paniculata* coll. 13.xi.74 (B. M. May); Lake Rotokere, 17 km east of Eltham, Taranaki, emerged 4.iv.75 from galls coll. 30.iii.74 (J.S.D.).

STEWART ISLAND

Oban, "Garden Mound", 1 ♀, 13.i.61; Glory Bay, 1 ♀, emerged 11.ii.61 ex *C. paniculata* (both M. N. Watt).

***Phytomyza costata* Harrison (Figs. 92-94)**

Phytomyza costata Harrison, 1959: 315

The significant characters of this species are the brownish-yellow frons, black third antennal segment, ash-grey mesonotum and scutellum, virtual lack of acrostichals and the bright yellow knees on all legs. As Harrison in his description pointed out, *costata* somewhat resembles *syngenesiae*, but it resembles even more closely *plantaginis*, these two species both having a large, slightly elongate third antennal segment and yellow fore-coxae. The wing length is 1.5-1.9 mm in the male, 1.75 mm in one female seen. The aedeagus of a paratype is shown in Figures 92, 93.

Although it is impossible to separate *costata* and *plantaginis* on external characters, the two are in no way related. The male genitalia clearly indicate the close relationship between *costata* and *improvisa* sp.n.

The larva forms an irregular whitish linear-blotch mine (Fig. 94). The dark brown puparium remains in the mine, with the widely diverging anterior spiracles just protruding through the epidermis of the leaf. The posterior spiracles are each on a large protuberance with a total of some 15 bulbs arranged in two semi-circular groups.

This species has previously only been known from the type locality, Beeby's Knob, Nelson Prov. I have also seen a leaf-mine on *R. lyallii* from Mt Borland, Hunter Mtns, east of Fiordland, 1050 m, 14.i.70 (J. G. R. MacBurney); two additional localities are recorded below. The exact hosts have not previously been known but the mines I found were on *Ranunculus verticillatus* and it is possible that other endemic *Ranunculus* spp. serve as hosts.

NORTH ISLAND

Mt Egmont, roadside below Park HQ, 1 ♂, 10.xii.74.

SOUTH ISLAND

Nelson Prov., Lake Sylvester, 1310 m, 2 ♂, emerged 13.i.75 from mines on *Ranunculus verticillatus* coll. 1.i.75.

***Phytomyza improvisa* Spencer sp.n. (Figs. 95, 96)**

Head: frons broad, twice width of eye, distinctly projecting above eye in profile; two equal, reclinate ors, one similar incurved ori, occasionally a weak additional bristle below; orbital setulae sparse, normally 3-5; jowls deep, 1/3 height of eye, cheeks almost 1/2 depth of jowl; third antennal segment conspicuously enlarged, sometimes almost round, normally longer than broad.

Mesonotum: 3 + 1 strong dc, acr entirely lacking.

Wing: length from 2.25-2.5 mm in male and from 2.5-2.85 mm in female, normally about 2.3 in male, 2.8 in female; vein R 2 + 3 sinuous, second costal section in male slightly over twice length of fourth, in female 2 1/2 times (average in six males, five females).

Colour: frons orange-yellow, orbits, jowls and cheeks slightly paler; hind-margin of eye black, both vt on black ground; palps black; second and third antennal segments black, first yellowish; mesonotum and scutellum entirely mat, brownish-grey; pleura black, apart from narrow yellow upper margin of mesopleura; legs: fore-coxae bright yellow, femora black with all knees yellow, tibiae and tarsi black; abdomen black, with all tergites narrowly yellow-bordered; in female, ovipositor sheath entirely shining black.

Male genitalia: aedeagus as in Figures 95, 96.

Type locality: Paradise Springs, Rotorua, North I.

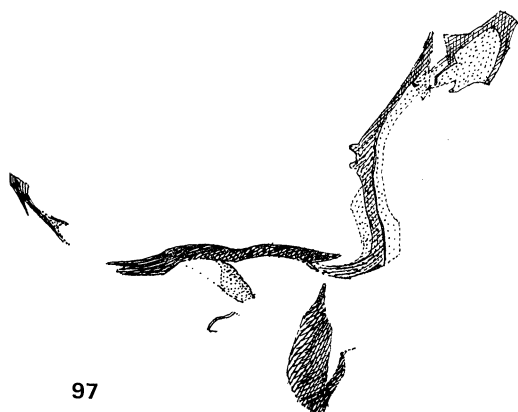
HOLOTYPE: ♂ North I., Rotorua, Paradise Springs, 13.xii.74 (K.A.S.), in N.Z. National Arthropod Collection, D.S.I.R., Auckland.



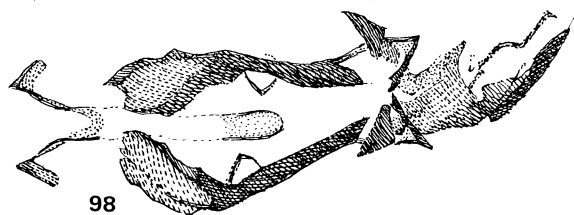
95



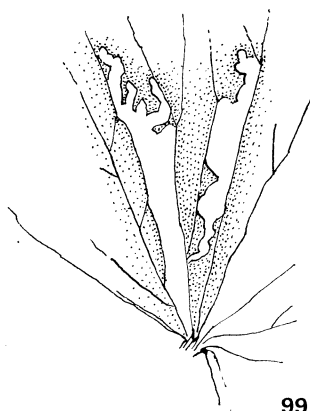
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97



98



99

PARATYPES: 3♂, same data; Mount Te Aroha, roadside at summit immediately below Repeater Station, 945 m, 2♂, 5♀, 27.xii.74; all caught on *Ranunculus* sp.; South I., Murchison, 1♂, 2.i.75.

REMARKS: With 11 of the 12 specimens in the type series caught individually on the leaves of *Ranunculus repens*, it is certain that this is one host, the larvae feeding internally in the stems or possibly in the receptacle. *P. costata*, a smaller species feeding as a leaf-miner but which has retained the habit of pupating internally, has clearly evolved from *improvisa* (cf. Figs. 92, 93).

***Phytomyza lyalli* Spencer sp.n. (Figs. 97-99)**

Head: frons broad, twice width of eye, distinctly projecting above eye in profile; two equal, reclinate ors, one incurved ori; orbital setulae sparse; orbits broad, pronounced; jowls deeply extended at rear, up to $\frac{1}{2}$ height of eye, cheeks at least $\frac{1}{2}$ depth of jowls; third antennal segment large, elongate.

Mesonotum: 3 + 1 strong dc, acr lacking.

Wing: length up to 2.6 mm in female; second costal section short, about twice length of fourth.

Colour: frons orange-brown, paler towards lunule; hind-margin of eye and entire orbits grey; jowls and face greyish-yellow; first antennal segment pale, second and third black; palps black; mesonotum and scutellum ash-grey; sides of thorax entirely grey; legs: coxae grey, femora black, with knees indistinctly yellowish, tibiae and tarsi black; squamae grey, margin and fringe dark.

Male genitalia: aedeagus as in Figures 97, 98.

Host-plant/Biology: *Ranunculus lyallii*, larvae feeding mainly in the flower stem, puparium remaining loose inside the stem, as many as 50 occurring together in a single plant; larvae rarely feed also in petioles, even forming irregular mines (Fig. 99) in the fleshy leaves mainly radiating from end of petiole, sometimes isolated in leaf-blade; the puparium is brownish, elongate, with the posterior spiracles each on a short, stout protuberance, with an irregular ellipse of c.20 minute bulbs; anterior spiracles on diverging black stalks with up to 20 bulbs.

Type locality: South I., Arthur's Pass.

HOLOTYPE: ♀, South I.: Arthur's Pass, emerged July 1975 (forced) from puparia coll. 4.i.75; (K.A.S.), in N.Z. National Arthropod Collection, D.S.I.R., Auckland.

PARATYPE: ♂, extracted dead from pupal case, otherwise same data as type.

REMARKS: The close relationship of this species to *improvisa* is apparent from the very similar male genitalia, but it seems probable that *lyalli* is the more primitive of the two. It will be interesting to establish whether the host is restricted to *Ranunculus lyallii*. There is at least some possible overlapping in distribution with *improvisa* which is known in South Island from Murchison.

J. S. Dugdale found puparia in old flower stalks and petioles of *R. nivicolus* on Mt Egmont, 30.iii.75; it is probable that these will prove to be *lyalli*.

Although numerous puparia were collected at Arthur's Pass, only imperfect adults were obtained. The female holotype is somewhat damaged and the male genitalia were extracted from a puparium with a fully developed specimen which had died before emergence. It is therefore to be hoped that better specimens will be collected in due course.

Phytomyza plantaginis Robineau-Desvoidy, 1851 (Figs. 100, 101) New to New Zealand

Phytomyza plantaginis Robineau-Desvoidy, 1851: 404; Hendel, 1935: 455

Frons narrowly projecting above eye, particularly towards base of antennae; two equal ors, one ori; jowls broad, 1/3 height of eye, cheeks forming broad ring below eye; third antennal segment large, longer than broad; 3 + 1 strong dc, acr normally lacking, at most isolated hairs present; wing length up to 2 mm, second costal section short, 1½-2 times length of fourth; colour: frons, jowls and face bright yellow, orbits normally paler; hind-margin of eye black, with both vt on dark ground; third antennal segment black, second varying from greyish to somewhat yellowish; mesonotum mat, ash-grey, sides of thorax dark but upper margin of mesopleura narrowly yellow; legs: fore-coxae yellow, femora black, with bright yellow knees; abdomen black; squamae yellow, margin and fringe dark, brownish. Male genitalia: aedeagus as in Figures 100, 101.

This species cannot be distinguished on external characters from *costata*, and in cases where the two may occur together positive identification of caught females is impossible.

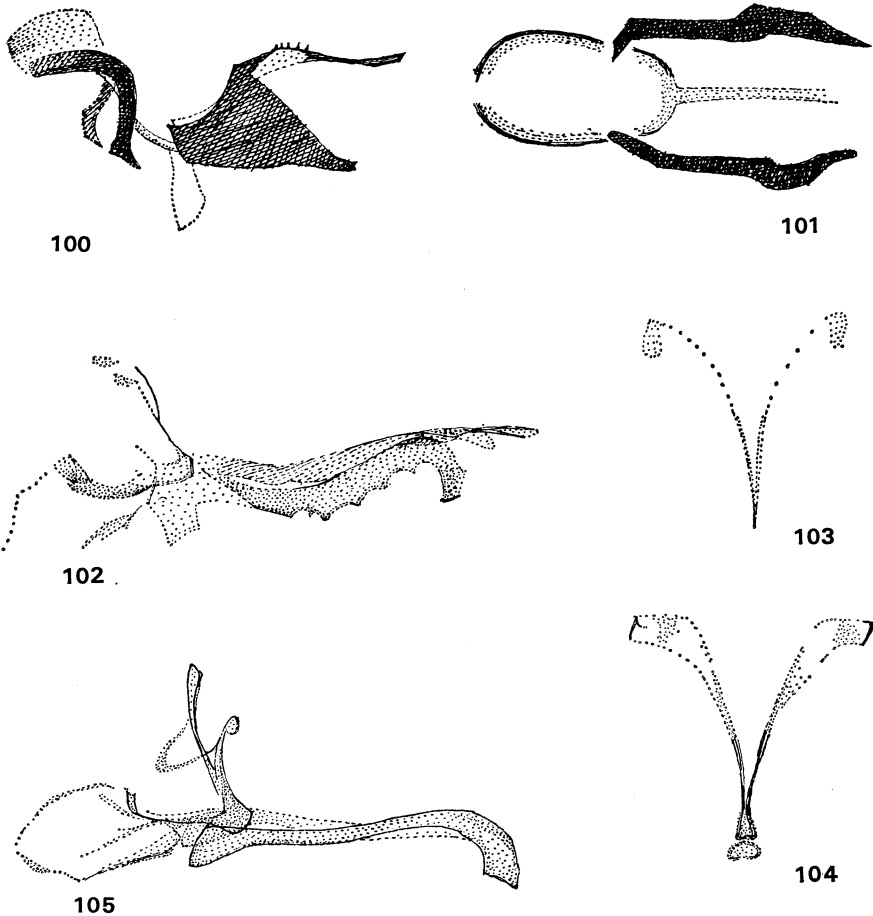
P. plantaginis is unusual in being at least partially parthenogenetic. No males have been found in New Zealand, although in Europe they are not uncommon despite the preponderance of females.

In New Zealand the only known hosts are *Plantago lanceolata* and *P. major*. The larva forms a narrow white linear margin, pupating in the leaf. The puparium is white, with the anterior spiracles projecting through the epidermis.

After *Cerodontha australis*, *plantaginis* is the most frequent Agromyzid to be obtained by sweeping, particularly in meadows and at roadsides. Adults were obtained at 11 localities (mainly on North Island but this is possibly due to the lateness of the season when collecting on South Island), and also on Stewart Island.

Large populations were present in the Tongariro National Park above the Chateau and at Lake Sylvester, and no *Plantago* could be found at either locality. Only females were obtained and it seems certain that the species is *plantaginis*, not *costata*. I am reasonably certain that the main hosts, *P. lanceolata* and *P. major*, were not present but I can only assume that the larvae were feeding on one or other of the endemic *Plantago* species which could have been overlooked. I do not believe the species would accept an alternative host.

It seems certain that *plantaginis* represents an introduction from Europe. Its occurrence virtually throughout the country at the present time suggests that it was either introduced with early settlers or has been introduced on more than one occasion.



FIGS. 100, 101.—*Phytomyza plantaginis*: 100, aedeagus, side view; 101, same ventral view (Europe). FIGS. 102-105.—*Phytomyza syngenesiae*: 102, aedeagus, side view, Oban, ex *Sonchus asper*; 103, same, dorsal processes; 104, dorsal processes, Antipodes Is.; 105, *P. horticola*, aedeagus, side view.

Material Collected:

NORTH ISLAND

East of Waimamaku, north of Waipoua, 2 ♀, 21.xii.74; Coromandel, 4 ♀, 26.xii; Mt Te Aroha, c. 460 m, 2 ♀, 27.xii; Cambridge, 2 ♀, 15.xii; 8 km north of Arapuni, 7 ♀, 15.xii; Rotorua, Lake Tikitere, 8 ♀, 14.xii; Paradise Springs, 9 ♀, emerged 16-20.xii from leaf-mines on *P. lanceolata* coll. 13.xii.74; Tongariro National Park, 1400 m, opposite Car Park No. 2, 11 ♀, 29.xii.

SOUTH ISLAND

Lake Sylvester, Nelson Prov., near hut, 1280 m, 9♀, 1.i.75; Bluff, 1♀, emerged 1.ii.75 from *P. major* coll. 24.i.75 (leaf-mines also present on *P. lanceolata*).

STEWART ISLAND

Oban, 25.i.75, leaf-mines common on *P. lanceolata*.

Phytomyza syngenesiae (Hardy, 1849) (Figs. 102-105)

Chromatomyia syngenesiae Hardy, 1849: 391 (cf. Griffiths, 1967: 7, as *Phytomyza*; 1974: 37, as *Chromatomyia*)

This species is well known in New Zealand and has been discussed in detail by Watt (1923: 485, as *P. albiceps*) and by Harrison (1959: 314, as *P. atricornis*). Griffiths (1967) revised this group and rejected the name *atricornis*, splitting *atricornis* auctt. into two species, *horticola* Goureau, 1851, and *syngenesiae* Hardy. *P. horticola* is a highly polyphagous species occurring on numerous unrelated families. Its range extends naturally from Europe throughout much of Asia to Japan and it is present in many parts of Africa. It is absent from North America, Australia and New Zealand. In Europe, *syngenesiae* occurs primarily on Compositae. Its occurrence on other families is rare. Griffiths (1967: 9) records it on *Daucus carota* in Denmark, and I have recently confirmed it on *Cannabis sativa* (grown for experimental purposes) in England. More non-Composite hosts are known in North America, including *Melilotus indica* and *Pisum* (Leguminosae), *Mentha* sp. and *Stachys bullata* (Labiatae) and *Malva borealis* (Malvaceae).

In New Zealand the favourite hosts are as to be expected in the Compositae. Watt (1923) gives *Chrysanthemum*, *Cineraria*, *Cryptostemma calendulacea*, *Dahlia*, *Erechtites*, *Senecio*, *Sonchus* and *Taraxacum*. Harrison (1959: 315) adds *Bellis*, *Cirsium*, and *Xanthium* sp. Surprisingly, more non-Composite hosts are found in New Zealand than in Europe. Watt (1923) records "nettle" (this is presumably the origin of Hendel's (1934: 356) record of *Urtica ferox*), but I feel this requires confirmation, as it might well represent a misidentification of a young mine of *Liriomyza urticae*. Harrison gives also *Plantago* sp. (probably a misidentification of *P. plantaginis*) and *Melilotus* sp. I bred adults from *Trifolium repens* and *Lamium purpureum* and have also seen a male from *Nepeta cataria* (see details below). There is an interesting parallel in the colonization of non-Composite hosts between New Zealand and North America where the two most favoured families are Labiatae and Leguminosae.

The resemblance between *syngenesiae* and *plantaginis* is superficial (both have the frons yellow, the third antennal segment black and the femora black with yellow knees). In *syngenesiae* the third antennal segment is small and round (elongate in *plantaginis*) and the fore-coxae are black (bright yellow in *plantaginis*). The aedeagus of *syngenesiae* is shown in Figure 102. Although it is improbable that *horticola* is present in New Zealand for comparison its aedeagus is shown in Figure 105. The general form is similar but the dorsal supporting sclerites are substantially stronger in *horticola* (contrast Figure 103). The single specimen seen from Antipodes Islands has unusually large, lightly chitinized processes at the apex of the supporting sclerites (Fig. 104). Some degree of evolutionary change appears to be taking place in this isolated population, which is possibly restricted to the endemic host, *Senecio antipodius*. However, it is unlikely to be reproductively isolated but may be considered as an interesting example of incipient speciation.

Griffiths (1974) has recently revived the genus *Chromatomyia*. However, *Chromatomyia* species can only be placed generically on the basis of the male genitalia. On external characters the adults are entirely typical of the more than 400 species retained in *Phytomyza*. Such splitting, if continued, will lead to a multiplicity of new genera only identifiable by genitalia; treatment as species groups, without erecting new taxa, seems far preferable.

P. syngenesiae is only known in Europe, Western Asia, North America, Australia and New Zealand. Its distribution in North America is largely limited to restricted

areas on the east and west coasts where it has almost certainly been introduced. It is equally certain that it has been introduced from Britain into both Australia and New Zealand. Kelsey (1937) discusses the parasite-host relationship of *syngenesiae* (as *atricornis*) in New Zealand and its possible application for biological control, and the economic importance of *syngenesiae* is discussed by Spencer (1973a: 233-5).

Material Collected or Seen:

NORTH ISLAND

Rotorua, Bay of Plenty, 1 ♂, emerged 10.i.75 from mine on *Nepeta cataria* coll. 24.xii.74 (J.S.D.); Te Rena near Taumarunui, mines on *Arctium minus*, 8.i.75 (H. S. Oliver); east of Waimamaku, north of Waipoua, 1 ♀, 21.xii.74. Leaf-mines also seen: Te Pahi, near North Cape, *Senecio* sp., 31.i.75 (R. A. Harrison); Waipoua Forest, *Chrysanthemum leucanthemum*, 21.xii.74; Mt Te Aroha, c. 610 m, *Senecio* sp., 27.xii.74; Rotorua, Lake Tikitere, *Senecio jacobaea* and *Sonchus oleraceus*, 14.xii.74; Wellington Botanical Gardens, various Composites, 30.xii.74.

SOUTH ISLAND

Christchurch, Riccarton Bush, 1 ♀, on *Lamium purpurem*, 3.xii.74 (mines with larvae also present); Botanical Gardens, emerged 3 ♀, 11-14.xii.74, ex. mines on *Trifolium repens* coll. 1.xii.74. Leaf-mines also seen: Murchison, *Senecio jacobaea*, 3.i.75; roadside Picton-Havelock, *Erechtites minima*, 6.xii.74; Christchurch, *Sonchus oleraceus*, *Taraxacum* sp., 1.xii.74; The Bluff, *Senecio* sp., 24.i.75.

STEWART ISLAND

Oban, 3 ♂, 1 ♀, emerged 2-4.ii.75 ex mines on *Sonchus asper*, coll. 25.i.75.

ANTIPODES ISLAND

Stella Bay, 1 ♂, 16.ii.69, on *Senecio antipodius* (G. Kuschel).

KNOWN HOSTS OF NEW ZEALAND AGROMYZIDAE

The larval feeding habit is indicated as follows: G, gall-causer; L, leaf-miner; S, stem-borer.

The terminology and authorities follow Allan (1961). Families are arranged alphabetically within their separate classes.

FILICOPSIDA

Aspleniaceae

<i>Asplenium falcatum</i> Lam.	<i>Phytoliriomyza flavoppleura</i>	L
<i>A. flaccidum</i> Forst. f.	<i>Phytoliriomyza flavoppleura</i>	L
<i>A. lucidum</i> Forst. f.	<i>Phytoliriomyza flavoppleura</i>	L

Cyatheaceae

<i>Alsophila tricolor</i> (Colenso) (Forst. f.) (= <i>Cyathea dealbata</i> auct.)	<i>Phytoliriomyza cyatheae</i>	L
<i>A. smithii</i> Hook. f.	<i>Phytoliriomyza cyatheae</i>	L

Grammatidaceae

<i>Grammitis billardieri</i> Willd. (= <i>Polypodium australe</i> (R. Br.) Mett.)	<i>Phytoliriomyza flavoppleura</i>	L
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Polypodiaceae

<i>Phymatodes diversifolium</i> (Willd.) Pic. Ser. (= <i>Polypodium diversifolium</i> Willd.) (= <i>Polypodium billardieri</i> R. Br.)	<i>Phytoliriomyza flavoppleura</i>	L
<i>P. scandens</i> (Forst. f.) Presl	<i>Phytoliriomyza flavoppleura</i>	L

SPERMATOPSIDA

DICOTYLEDONES

Campanulaceae

<i>Wahlenbergia albomarginata</i> Hook.	<i>Liriomyza wahlenbergiae</i>	L
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Caryophyllaceae			
<i>Cerastium holosteoides</i> Fries	<i>Liriomyza chenopodii</i>		L
Chenopodiaceae			
<i>Beta vulgaris</i> L.	<i>Liriomyza chenopodii</i>		L
<i>Spinacia vulgaris</i> L.	<i>Liriomyza chenopodii</i>		L
Compositae			
<i>Arctium minus</i> Bernh.	<i>Phytomyza syngenesiae</i>		L
<i>Bellis</i> sp.	<i>Phytomyza syngenesiae</i>		L
<i>Chrysanthemum leucanthemum</i> L.	<i>Phytomyza syngenesiae</i>		L
<i>Cineraria</i> sp.	<i>Phytomyza syngenesiae</i>		L
<i>Cirsium</i> sp.	<i>Phytomyza syngenesiae</i>		L
<i>Craspedia uniflora</i> Forst. f.	<i>Liriomyza craspediae</i>		L
<i>Cryptostemma calendulacea</i> R. Br.	<i>Phytomyza syngenesiae</i>		L
<i>Dahlia</i> sp.	<i>Phytomyza syngenesiae</i>		L
<i>Erechtites minima</i> (Poir.) DC.	<i>Phytomyza syngenesiae</i>		L
<i>Olearia hectori</i> Hook. f.	<i>Liriomyza oleariae</i>		L
<i>O. virgata</i> Hook. f. var. <i>lineata</i> Kirk	<i>Liriomyza oleariae</i>		L
<i>Senecio jacobaea</i> L.	<i>Melanagromyza senecionella</i>		S
	<i>Phytomyza syngenesiae</i>		L
<i>Senecio lyallii</i> Hook. f.	sp. indet.		L
<i>Sonchus asper</i> L.	<i>Phytomyza syngenesiae</i>		L
<i>S. oleraceus</i> L.	<i>Phytomyza syngenesiae</i>		L
<i>Taraxacum</i> sp.	<i>Phytomyza syngenesiae</i>		L
Cruciferae			
<i>Lepidium oleraceum</i> Forst. f.	<i>Liriomyza lepidii</i>		L
Gentianaceae			
<i>Gentiana corymbifera</i> Kirk	sp. indet.		L
Labiales			
<i>Lamium purpureum</i> L.	<i>Phytomyza syngenesiae</i>		L
<i>Nepeta cataria</i> L.	<i>Phytomyza syngenesiae</i>		L
Leguminosae			
<i>Carmichaelia grandiflora</i> Hook. f.	<i>Liriomyza cianthi</i>		L
<i>C. williamsii</i> Kirk	<i>Liriomyza cianthi</i>		L
<i>Clianthus puniceus</i> (G. Don) Sol. ex Lindl.	<i>Liriomyza cianthi</i>		L
<i>Melilotus</i> sp.	<i>Phytomyza syngenesiae</i>		L
<i>Trifolium repens</i> L.	<i>Phytomyza syngenesiae</i>		L
Myoporaceae			
<i>Myoporum laetum</i> Forst. f.	<i>Liriomyza citreifemorata</i>		L
Plantaginaceae			
<i>Plantago lanceolata</i> L.	<i>Phytomyza plantaginis</i>		L
<i>P. major</i> L.	<i>Phytomyza plantaginis</i>		L
<i>P. raoulii</i> Decne	<i>Liriomyza plantaginella</i>		L
Ranunculaceae			
<i>Clematis dioscoreifolia</i> (Lev. and Vaniot) Rehd. var. <i>robusta</i> (Carr.) Rehd. (= <i>maximowicziana</i> Fr. and Sav., sensu Ohwi, 1965).	<i>Phytomyza ?clematadi</i>		L
<i>C. hookeriana</i> Allan	<i>Phytomyza clematadi</i>		L
<i>C. paniculata</i> Gmel.	<i>Phytomyza clematadi</i>	L, G	
<i>C. vitalba</i> L.	<i>Phytomyza ?clematadi</i>		L
<i>Ranunculus lyallii</i> Hook. f.	<i>Phytomyza costata</i>		L
	<i>Phytomyza lyalli</i>	S, L	
<i>R. nivicolus</i> Hook.	? <i>Phytomyza lyalli</i>		S
<i>R. verticillatus</i> Kirk.	<i>Phytomyza costata</i>		L
Rubiaceae			
<i>Coprosma acerosa</i> A. Cunn.	<i>Hexomyxa coprosmae</i>		G
<i>C. propinqua</i> A. Cunn.	<i>Hexomyxa coprosmae</i>		G

Scrophulariaceae

<i>Hebe</i> aff. <i>albicans</i> (Petrie) Ckn.	<i>Liriomyza hebae</i>	L
<i>H. colensoi</i> (Hook. f.) Ckn.	<i>Liriomyza umbrinella</i>	L
<i>H. elliptica</i> (Forst. f.) Pennell	<i>Liriomyza flavocentralis</i>	L
<i>H. macrocarpa</i> (Vahl) Ckn. et Allan	<i>Liriomyza flavocentralis</i>	L
	<i>Liriomyza hebae</i>	L
	<i>Liriomyza umbrina</i>	L
<i>H. odora</i> (Hook. f.) Ckn.	<i>Liriomyza umbrinella</i>	L
<i>H. salicifolia</i> (Forst. f.) Pennell	<i>Liriomyza flavocentralis</i>	L
	<i>Liriomyza umbrina</i>	L
<i>H. speciosa</i> (A. Cunn.) Ckn. et Allan	<i>Liriomyza umbrina</i>	L
<i>H. strictissima</i> (Kirk) L. B. Moore	<i>Liriomyza umbrinella</i>	L
<i>H. subalpina</i> (Ckn.) Ckn. et Allan	<i>Liriomyza umbrosa</i>	L

Tropaeolaceae

<i>Tropaeolum majus</i> L.	<i>Liriomyza brassicae</i>	L
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Umbelliferae

<i>Hydrocotyle novaezealandiae</i> DC.		
<i>Schizeilema</i> sp.	sp. indet.	L

Urticaceae

<i>Urtica ferox</i> Forst. f.	<i>Liriomyza urticae</i>	L
<i>U. incisa</i> Poir.	<i>Liriomyza urticae</i>	L

Violaceae

<i>Melicytus ramiflorus</i> J. R. et G. Forst.	<i>Liriomyza flavolateralis</i>	L
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MONOCOTYLEDONES

Gramineae

<i>Dactylis glomerata</i> L.	<i>Cerodontha</i> (Cer.) <i>australis</i>	L
<i>Holcus lanatus</i> L.	<i>Cerodontha</i> (Cer.) <i>angustipennis</i>	L
<i>Hordeum vulgare</i> L.	<i>Cerodontha</i> (Cer.) <i>australis</i>	L
<i>Lolium perenne</i> L.	<i>Cerodontha</i> (Cer.) <i>australis</i>	L
<i>Poa anceps</i> Forst.	<i>Cerodontha</i> (Cer.) <i>australis</i>	L
<i>Triticum aestivum</i> L.	<i>Cerodontha</i> (Cer.) <i>australis</i>	L

Juncaceae

? <i>Juncus</i> sp.	<i>Cerodontha</i> (<i>Icteromyza</i>) <i>triplicata</i>	L
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