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*The Australian Agromyzidae*  
(*Diptera, Insecta*)

By  
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Pages 305-354

Figs. 1-78

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# THE AUSTRALIAN AGROMYZIDAE

By KENNETH A. SPENCER

(Figs. 1—78) Manuscript received 7.10.61

## SYNOPSIS

The known Australian Agromyzidae have been revised, 24 new species are described and keys are given to genera and species in the 10 genera now known to be represented in Australia. The origin of the 57 species is discussed. No evidence is so far available of any close relationship with South American species and it is concluded that the Australian Agromyzidae have arrived from the north, in at least three distinct waves, the earliest possibly being in the Cretaceous.

## INTRODUCTION

The Australian Agromyzidae have hitherto been largely unknown, with a total only of 21 species recorded (Malloch, 1923, 1925, 1927; Hering, 1951, 1962; Kleinschmidt, 1960). This excludes *Fergusonina* spp. which Malloch (1924) and Tonnoir (1937) included in this family, although they are aberrant in a number of features from currently accepted concepts of the Agromyzidae. Hennig (1958) has now raised this group to family rank.

During a month's visit to Australia in January-February, 1961, I was able to make brief collecting trips around Darwin, Brisbane, Sydney, Canberra, Melbourne, Adelaide and in Tasmania and have also been able to study unidentified material from the Australian Museum, Sydney, the Institute of Hygiene and Tropical Medicine, Sydney, the C.S.I.R.O., Canberra, and the Commonwealth Institute of Entomology, London. I was able to examine in Sydney the types of 7 of the 8 Australian species described by Malloch.

In the present paper 57 species are discussed, of which 24 are described as new. Seventeen of the species now recorded for Australia are known from the Oriental region. The biology is known in 30 species and of these 22 are leaf-miners, the others being internal stem-borers (5), gall-causers (2) or seed-feeders (1). No new genus has been discovered. A number of *Melanagromyza* spp. were found, feeding as leaf-miners and pupating in the leaf. The mine in these species is not epidermal but deeper, either upper or lower surface. No other species of this genus are known to feed in this way.

Only 10 genera out of the world total of 22 are represented. All Australian genera occur in the Oriental region, which has only a single additional genus, *Phytagromyza* Hendel, not present in Australia. The close similarity of the generic distribution in Australia and the Oriental region is shown in the following table:—

	Australia		Oriental Region	
	Species	Percentage	Species	Percentage
<i>Agromyza</i> Fall .....	1	1.75	13	16
<i>Japanagromyza</i> Sasakawa .....	1	1.75	3	4
<i>Melanagromyza</i> Hend. ....	24	42.1	28	35
<i>Ophiomyia</i> Brasch .....	6	10.5	4	5
<i>Cerodontha</i> Pz. ....	3	5.3	1	1
<i>Phytobia</i> Lioy .....	7	12.3	15	19
<i>Liriomyza</i> Mik .....	9	15.8	6	8
<i>Phytoliriomyza</i> Hend. ....	1	1.75	1	1
<i>Phytagromyza</i> Hend. ....	—	—	1	1
<i>Pseudonapomyza</i> Hend. ....	1	1.75	4	5
<i>Phytomyza</i> Fall.....	4	7	4	5
	—	—	—	—
	57		80	

My own observations made in January-February—admittedly not the best collecting season—suggest that the Agromyzidae are widespread in Australia but not abundant, as, for instance, in Western Europe or parts of South America. It is incorrect, as Paramonov (1959: 175) suggests, that many leaf-mining species of *Agromyza* and *Phytomyza* remain to be discovered. Certainly many new species do still await discovery, but there is no reason to believe they will not be found approximately in the proportions of the species now known, with a continuing dominance of *Melanagromyza*. In two days' collecting in Tasmania, on Mount Wellington and in the Mt. Field National Park, I was only able to discover two species.

The main genera of the Agromyzidae have recently been characterized in detail by Frick (1952), and it is not proposed to recapitulate generic characters here, apart from those given in the key to genera. The scale line of the drawings represents 0.1 mm. for genitalia and pupal spiracles and 0.5 mm. in other cases, except where otherwise indicated. The following abbreviations have been used:—

ors—upper fronto-orbital bristle(s). acr—acrostichals.  
ori—lower fronto-orbital bristle(s). dc—dorso central bristle(s).

The dc are numbered forwards, the strongest being referred to as the first.

The location of types of previously described species is indicated as follows:—

Institute of Hygiene and Tropical Medicine, Sydney—IHTM.  
Deutsches Entomologisches Institut, Berlin—DEI.  
Author's Collection—AC.  
U.S. National Museum, Washington—USNM.  
British Museum (Natural History), London—BM.  
Queensland Museum, Brisbane—QM.  
Hungarian National Museum, Budapest—HNM.  
Zoological Museum, Amsterdam—ZM.

Collectors are abbreviated as follows: D. K. McAlpine—D.K.M.; S. J. Paramonov—S.J.P.; K. A. Spencer—K.A.S.

#### ZOOGEOGRAPHY

The distributional pattern of the Australian Agromyzidae can be summarized as follows:—

Endemic (on basis of existing information),	37
Also in Oriental region,	14
Also in Palaearctic region,	2
Also in New Zealand,	1
Cosmopolitan,	3
	—
	57

The two Palaearctic species, *Phytomyza plantaginis* R.-D. and *P. vitalbae* Kalt., almost certainly represent introductions with European colonization. The aedeagus of *vitalbae* is strikingly different from that of *clematidicolla* Spencer, suggesting that the two species are not closely related, although feeding on the same host plant.

Of the 17 species common to the Oriental region, three are the Cosmopolitans *Calycomyza humeralis*, *Liriomyza brassicae*, *Phytomyza atricornis*; three feed on cultivated leguminous crops—*Melanagromyza centrosematis*, *M. phaseoli* and *M. sojae*—and *Pseudonapomyza spicata* occurs commonly on sugar and maize, and there seems little doubt that the natural distribution of these four species has been enlarged by commerce in recent times. *Ophiomyia lantanae* has been deliberately introduced to many areas as a possible aid in controlling *Lantana camara*. Some of the remaining nine species probably form part of the invasion from the north which occurred following the Pleistocene glaciation, when a land connection last existed across the present Torres Straits. Such species may be *Melanagromyza alternata* and *Liriomyza caulophaga*, whose known distribution is limited to South-east Asia and Australia. It seems certain, however, that others are of earlier origin. Two which definitely appear to fall within this category are *M. albisquama* Malloch (= *leguminum* Bezzi) and *M. alysicarpi* Bezzi, which were hitherto considered to be endemic on Fiji. If it is accepted that these two species reached Fiji by land connection and not by fortuitous subsequent crossing of a wide water gap, they provide interesting confirmation of the so-called "outer Melanesian arc", which, it is postulated, linked New Guinea to Fiji in the Miocene as a series of island stepping stones or even a direct land connection, when many Asiatic species also reached Australia. The wide range of *M. albisquama* across Asia and Africa to the Cape Verde Islands suggests that this is not a species of recent origin.

*M. alysicarpi* has also been recently confirmed in Java and India. Another such species, which occurs right across Africa and Asia from the Cape Verde Islands to Micronesia, New Guinea, the Solomons and as far as East Santo and Vila in New Hebrides (but has not been recorded in Fiji), is *M. metallica* (Thomson).

The diminutive epidermal miner, *Melanagromyza atomella* (Malloch), which has now been found on numerous hosts in Australia as far south as Clyde Mountain, New South Wales, occurs widely throughout the Oriental region, including Micronesia and New Guinea, also in Southern Japan (as *M. styracicola* Sasakawa); the same species or a close relative also occurs in Africa and Madagascar. This also may well have formed part of the Miocene southward expansion, and it will be interesting to know whether, with further collecting, the species will also be found on Fiji.

The only species common to Australia and New Zealand (apart from the cosmopolitan *P. atricornis*) is *Liriomyza chenopodii* (Watt) (= *imitans* Malloch). This species feeds on cultivated plants such as spinach and beet, and, in view of the total distinctness of the New Zealand Agromyzidae, it is plausible to accept this as a relatively recent introduction by man. Of the 16 New Zealand Agromyzidae listed by Harrison (1959), 13 can be immediately accepted as endemic; this includes *Melanagromyza* sp.n. (confirmed from examination of specimens kindly sent me by Dr. Harrison) referred to by Harrison as *aeneiventris* Fall., a species "recorded" in various parts of the world but which is in fact an *Urtica* feeder limited to the Palaearctic region. I have also been able to confirm that specimens referred to as *Cerodontha denticornis* Pz. are not in fact the Palaearctic species but are close to *australis* Malloch; however, a distinctive difference in genitalia suggests that the New Zealand specimens represent an endemic species. The ancestor of this species and of *australis* could have reached New Zealand and Australia simultaneously at the time of the "inner Melanesian arc", which Ross (1956) suggests linked New Guinea to New Zealand at the end of the Cretaceous. Alternatively, if the theory of the Melanesian arcs is not accepted, the New Zealand "*denticornis*" could represent a diverging form of *australis*, which at some time has successfully crossed the water gap from Australia. It should be mentioned here that Darlington (1957) considers that the entire New Zealand fauna, including vertebrates, can be reasonably accounted for without land connections, merely by a slow accumulation of species across the wide water gaps involved.

The origin of the 37 endemic species is less obvious. Some, no doubt, are not in fact endemic and merely await discovery in the Oriental region to the north. A number of the *Melanagromyza* spp. such as *apii* Hering, *placida* sp.n., *seneciophila* sp.n., *specifica* sp.n. and *verdescens* sp.n. closely resemble many typical Oriental species and could belong to this category. Others have presumably evolved from earlier northern immigrants in the Miocene. The non-epidermal, leaf-mining *Melanagromyza* spp., such as *indigoferae* Kl. and *wikstroemiae* Kl., are without parallel elsewhere. *Ophiomyia angustilunula* sp.n. and *O. micra* sp.n., small species with a white squamal fringe, belong to a group well represented in South Africa (Spencer, 1960: 28). *Melanagromyza dianellae* Kl. and *M. paramonovi* sp.n., both with white squamae and fringe, also have a close relative in the southern hemisphere, *M. galactoptera* Bezzi from Mauritius. These two groups have a distinctly Gondwanan distribution. *Cerodontha australis* Malloch appears from the structure of the aedeagus to be more closely related to the northern *C. denticornis* than to *C. flavifrons* (Philippi) (cf. Frick, 1952: 399), from Chile. *Cerodontha robusta* Mall. and *vittigera* Mall. have a peculiarly developed spine on the third antennal segment (fig. 41b) which differentiates them from all other known species in the genus. It is interesting in this connection that both species have been found on Mt. Wilson, N.S.W., where many relict species in other groups occur. *Phytomyza clematidicola* sp.n. has the same host as *clematidi* Watt, 1924, in New Zealand, and both pupate in the mine. The genitalia (figs. 63 and 68) suggest that these two species are more closely related than either to the northern hemisphere species *vitalbae* Kalt. (fig. 69). There is nothing obviously aberrant in the other endemic species, which in all genera are very similar to species known elsewhere throughout the world.

Paramonov (1959: 187) accepts as self-evident that in a number of families, of which 10 are cited, a close relationship exists between Australian and South American species. Hennig (1960), in the most detailed and scientific study of this problem as affecting Diptera which has yet been made, fails to find conclusive evidence for any New Zealand-Australian-South American link which would have provided a closer relationship between species from Australia-New Zealand and South America on the one hand than with species from the northern hemisphere on the other. Unfortunately, no comprehensive study of Neotropical Agromyzidae has yet been made. I have myself collected in Brazil, Venezuela, Colombia and Jamaica and am familiar with a number of Malloch's (1933) species from Patagonia. Information, however, is still very incomplete, but there is no evidence so far to support theories of a partial southern origin of the Australian species. Assuming an exclusive northern origin—and there is nothing in the existing distribution pattern which cannot be explained on the basis of this assumption—it is a matter of pure conjecture as to which species may have reached Australia during the Miocene and which during a possible earlier land connection in the Cretaceous. The extreme paucity of species so far found in Tasmania supports the theory of a northern origin.

## KEY TO GENERA OF THE AUSTRALIAN AGROMYZIDAE

1. Subcosta developed throughout its length, coalescing with r1 before reaching costa ... 2  
Subcosta becoming a fold distally and ending in costa separately and basad of r1 .... 5
2. Prescutellar bristles present ..... 3  
Prescutellar bristles lacking ..... 4
3. Three or more pairs of dc present ..... *Agromyza* Fallén  
Only two pairs of dc present ..... *Japanagromyza* Sasakawa
4. Facial keel between antennae prominent ..... *Ophiomyia* Braschnikov  
Facial keel, if distinguishable, narrow and flattened ..... *Melanagromyza* Hendel
5. Two scutellar bristles, distinct spine or angle at upper corner of third antennal segment .....  
..... *Cerodontha* Rondani  
Four scutellar bristles ..... 6
6. Orbital setulae erect or reclinate, sometimes weak or absent ..... 7  
Orbital setulae proclinate, well developed ..... 9
7. Costa strongly developed to vein m1 + 2 ..... 8  
Costa extending only to vein r4 + 5 ..... *Pseudonapomyza* Hendel
8. Scutellum same colour as mesonotum, black or grey ..... *Phytobia* Lioy  
Scutellum yellow, at least centrally or apically ..... *Liriomyza* Mik
9. Costa extending to vein m1 + 2, vein mm. present ..... *Phytoliriomyza* Hendel  
Costa only reaching vein r4 + 5, vein mm. absent ..... *Phytomyza* Fallén

Genus *Agromyza* Fallén

*Agromyza* Fallén, 1810, Nov. Dipt. Dispon. Method. p. 21, No. 66.

Type species *Agromyza nigripes* Meigen, Europe.

Only a single species of this widespread genus has been recorded in Australia, *A. testacea* sp.n., described below. The leaf-miner on *Oplismenus* referred to on p. 339 almost certainly belongs here. Even accepting two species the genus appears to be significantly less numerous than in the Oriental region.

*Agromyza testacea* sp.n.

Head: very large, frons one and a quarter times width of eye, slightly projecting above eye in profile anteriorly; two strong ors (missing on both sides but detectable from large basal pits), two strong ori, directed inwards and upwards the lower slightly weaker, orbital setulae sparse, reclinate; ocellar triangle not defined beyond foremost ocellus; orbits scarcely differentiated, lunule small and low, at right angles to plane of frons; jowls narrow, one-tenth height of eye; cheeks linear; vibrissa strong, equal to lower ori; eye exceptionally large, almost round, third antennal segment slightly longer than broad, rounded at end, very finely pubescent above, arista conspicuously long, equal to vertical height of eye.

Mesonotum; 3 + 1 strong dc, third and fourth equal, equidistant each side of suture, prsc well-developed; inner post-alar slightly shorter, acr short, irregular, in some eight rows in front, extending to prsc.

Wing: Length in female 2.8 mm., costa extending to m1 + 2, rm at midpoint of discal cell, last and penultimate segments of m4 equal.

Colour: frons sooty black, small shining areas round basal pits of orbital bristles, first and second antennal segments black, third paler, more brownish; mesonotum matt black, with no trace of grey, abdomen more shining black, legs entirely black, wings clear, veins brownish-black, wing base dark brown, squamae grey, fringe black, halteres yellowish.

Holotype: ♀, N. Queensland, Kuranda, 20.xii.1958 (D.K.M.), Australian Museum, Sydney.

*A. testacea* is readily distinguishable from the two species from the Oriental region having a distinct pre-scutellar dc:

*A. flavisquama* Malloch, 1914 (Formosa), has a pale squamal fringe, and a new species shortly to be described from Thailand has a shining black mesonotum and conspicuously yellow wing base.

Genus *Japanagromyza* Sasakawa

*Japanagromyza* Sasakawa, 1958, Sci. Rep. Saikyo Univ. (Agr.) 10: 140.

Type species: *Agromyza duchesneae* Sasakawa, 1954 a, Japan.

This small genus consists of 14 world species, of which one new species is described below; three additional species will be described shortly, from New Guinea, New Hebrides and Thailand. Known distribution is limited to the Ethiopian and Oriental regions (Spencer, 1961 and 1961a), Japan, Micronesia, (Spencer, in press), New Guinea and New Hebrides.

The Australian species is the first true Agromyzid known to feed on Eucalypts. A species widespread in Asia and Japan, *J. variihalterata* (Mall.), 1914, is a blotch-miner on cultivated leguminous crops, such as *Glycine* and *Pueraria*, and might be expected to occur in Queensland.

This genus is readily recognizable by the presence of two strong dc, together with well developed pre-scutellars or a distinct postero-lateral bristle on the fore-tibia.

*Japanagromyza eucalypti* sp.n.

Head: frons narrow, equal to width of eye, not projecting above eye in profile; two strong equal ors directed upwards; two ori, upper weaker than ors, directed upwards, lower smaller, directed inwards; orbital setulae distinct, in single row, reclinate; ocellar triangle small, inconspicuous, scarcely differentiated; lunule small, semicircular; jowls narrow, deepest at rear, cheeks linear, third antennal segment rounded, with slight upturned pubescence; arista long, bare.

Mesonotum: two pairs of dc, second at level of supra-alar, three-quarters length of first, prsc somewhat weaker than second dc and equal to intra-alar; inner post-alar distinct but slight; acr in some eight rows in front, ending at prsc.

Wing: length in male 1.9, in female 1.9 to 2.2 mm.; costa extending strongly to vein m1 + 2; rm at basal third of discal cell, last segment of m4 two thirds length of penultimate.

Legs: mid-tibiae with two strong postero-dorsal bristles, fore-tibiae with one weaker but distinct bristle.

Colour: frons matt, sooty-black, orbits weakly shining; ocellar triangle scarcely so; lunule silvery-grey; remainder of head black; mesonotum shining black, appearing slightly more greyish, matt, when viewed from front; abdomen shining black; legs entirely black; wings clear, veins dark; squamae grey, margins and fringe black; halteres with dark stalk but entirely white knobs.

Male genitalia: aedeagus (fig. 1a) ending in long tubule, distinctive ventral appendage, as figured; spermal sac small (fig. 1b).

Puparium: orange-red, segments well defined, largely smooth; posterior spiracles trifurcated (fig. 2), each arm with some 12 buds, 6 along each side.

Holotype ♂, N.S.W., Lisarow, bred 23.ii.1958, ex leaf-mine in *Eucalyptus camaldulensis* Dehnhardt found 6.ii.1958; 5 paratypes, Lisarow: one ♀ same data as holotype, one ♀ 10.iii.1958 on tips of same host; one ♂, two ♀, bred 26-27.ii.1961 ex leaf-mines on same host found 3.ii.1961 (all K. M. Moore). Holotype in Australian Museum, Sydney; paratypes: two in British Museum (Natural History), two in collection of Forestry Commission, N.S.W., one in author's collection.

This is the first true Agromyzid known to feed on any species of Eucalypt. It closely resembles *insularum* Spencer (in press) from Micronesia, but is readily distinguishable by the more shining black mesonotum; the aedeagi of the two species are entirely different. Other species in which the larva has a similar arrangement of posterior spiracles are *J. variihalterata* (Malloch), 1914 (*Glycine*, *Pueraria*), *J. elaeagni* (Sasakawa), 1954a (*Elaeagnus*) and *J. quercus* (Sasakawa), 1954a (*Quercus*).

Genus *Melanagromyza* Hendel

*Melanagromyza* Hendel, 1920, Arch.f. Natg. for 1918, 7: 14.

Type species *Agromyza aeneiventris* Fallén, Europe.

This is the dominant genus throughout the Ethiopian and Oriental regions, Madagascar and Australia. By contrast it accounts for only 5 per cent. of the species in the Palaearctic region. Eight new species are described below; leaf-mines or empty puparia found in stems of three undescribed species almost certainly referable to this genus are discussed under Unidentified Species, p. 339 and a further apparently undescribed species is discussed on p. 322.

Known Australian species are leaf-miners or internal stem-borers; elsewhere the larvae have also been found to feed as seed-eaters and gall-causers. A distinctive group of minute epidermal leaf-miners, causing a conspicuous whitish mine, hitherto known from the Ethiopian and Oriental regions, is well represented in Australia. In my opinion, in this group there is one dominant, highly polyphagous species, *M. atomella* (Malloch) (= *styrivicola* Sasakawa in Japan), and two further species in the group, *M. cassiae* and *M. murrayae*, are described below.

The genitalia drawings below confirm the close phylogenetic relationship of many of the species. On the other hand, there is a striking difference between the aedeagus of *atomella* and *cassiae*, two morphologically similar epidermal leaf-miners which appear not to be very closely related. *M. dianellae* and *M. paramonovi* closely resemble *Ophiomyia angustilunula* and *O. micra*, but in the two former species the aedeagus is strikingly different from the typical *Ophiomyia* pattern of the latter.

#### KEY TO AUSTRALIAN MELANAGROMYZA SPECIES

1. Squamal fringe pale, white or ochreous ..... 2  
Squamal fringe dark, black or brown ..... 13
2. Orbital setulae proclinate ..... *bowralensis* sp.n.  
Orbital setulae reclinate ..... 3
3. Mesonotum entirely shining black ..... 4  
Mesonotum distinctly greenish ..... 7
4. Abdomen black, similar to mesonotum ..... 5  
Abdomen shining green ..... *sofae* (Zehntner)
5. Large species, wing length 2·7 mm. .... *alternata* Spencer  
Small species, wing length at most 1·9 mm. .... 6
6. Jowls narrow, one-tenth height of eye, wing length 1·6 mm. .... *dianellae* Kleinschmidt  
Jowls broader, one-quarter height of eye, wing length 1·9 mm. .... *paramonovi* sp.n.
7. Arista appearing bare ..... 8  
Arista distinctly pubescent ..... 11
8. Large species, wing length at least 2·5 mm. .... 9  
Smaller species, wing length at most 2 mm. .... 10
9. Mesonotum shining green, third antennal segment conspicuously round .... *apii* Hering  
Mesonotum more blackish, only faintly greenish, third antennal segment longer than broad ..... *seneciophila* sp.n.
10. Lunule narrow, higher than semicircle ..... *verdescens* sp.n.  
Lunule in form of semicircle ..... *specifica* sp.n.
11. Eye in male bare ..... *albiquama* (Malloch)  
Eye in male distinctly pilose ..... 12
12. Eye in female distinctly pilose ..... *piliseta* (Malloch)  
Eye in female virtually bare ..... *metallica* (Thomson)
13. Mesonotum with 3 pairs of dc ..... *trispina* (Malloch)  
Mesonotum with 2 pairs of dc ..... 14
14. Ocellar triangle greatly elongated, brilliantly shining ..... *phaseoli* (Tryon)  
Ocellar triangle not so ..... 15
15. Mesonotum conspicuously matt ..... *wikstroemiae* Kleinschmidt  
Mesonotum at least somewhat shining ..... 16
16. Third antennal segment with long whitish pubescence ..... 17  
Antennal pubescence normal ..... 18
17. Minute species, wing length in male 1·3 mm. jowls narrow .... *indigoferae* Kleinschmidt  
Larger species, wing length 2·2-4 mm., jowls broader, one-sixth height of eye  
..... *conspicua* Spencer
18. Last and penultimate segments of vein m4 equal ..... 19  
Last segment of m4 distinctly shorter than penultimate ..... 22
19. Large species, wing length 2·4 mm., jowls broad, one-fifth height of eye ..... *sp.* (N.S.W.)  
Smaller species, wing at most 1·7 mm. .... 20
20. Costa extending at most to midway between veins r4 + 5 and m1 + 2 .. *alysicarpis* Bezzi  
Costa extending strongly to vein m1 + 2 ..... 21
21. Arista bare; jowls broad, one-sixth height of eye ..... *pisi* Kleinschmidt  
Arista distinctly pubescent; jowls narrow, one-tenth height of eye ..... *murrayae* sp.n.



22. Jowls relatively broad, one-sixth height of eye, arista virtually bare .. *centrosematis* de Meij.  
Jowls narrower, one-tenth height of eye ..... 23
23. Arista distinctly pubescent ..... *atomella* (Malloch)  
Arista appearing bare ..... 24
24. 4 ors, 2 ori, distance separating cross-veins equal to length of vein mm. .... *placida* sp.n.  
2 ors, 2 ori, distance separating cross-veins greater than length of mm. .... *cassiae* sp.n.

***Melanagromyza albisquama* (Malloch), comb.nov.**

*Agromyza* (*Melanagromyza*) *albisquama* Malloch, 1927.

*Melanagromyza leguminum* Bezzi, 1928, syn.nov.

*Melanagromyza minora* Spencer, 1959 (synonymized with *leguminum*, Spencer, 1961c).

Location of holotype: IHTM.

Malloch described this species from a single caught male from N.S.W., Eccleston. I have compared this specimen with the type of *leguminum* Bezzi from Fiji, and it is clear that the two are synonymous. I therefore synonymise *leguminum* with *albisquama* herewith. Further specimens have been examined from north Queensland.

Essential characters of the species are as follows: frons not projecting above eye, ocellar triangle broad, not elongated, lunule in form of semi-circle, jowls one-tenth height of eye, third antennal segment distinctly shining, with extremely short pubescence, arista long, distinctly pubescent (fig. 3a), eye in male bare; mesonotum and abdomen shining greenish, squamae and fringe white; wing length 1.6 to 2.2 mm.; *M. leguminum* was bred from "pods of No. 51 C.T.W."; the species has recently been discussed by Spencer, 1961c and in press; the aedeagus of a specimen from Palau was illustrated by Spencer (in press, fig. 5).

Distribution.—N.S.W.: Eccleston; north Queensland: Atherton Tableland, Head of Clohesy River; Fiji, Micronesia, Indonesia, South Africa, Cape Verde Islands.

***Melanagromyza alternata* Spencer, 1961**

Location of holotype: DEI.

One male, Otford, N.S.W., 26.i.1951 (D.K.M.). This specimen has been compared with the hitherto unique female holotype from Formosa.

This is a relatively large species with wing length of 2.6 mm. and has an entirely shining black mesonotum and abdomen without any trace of sheen, combined with white squamae and fringe; the eye in the male is haired; no other species is known with this combination of characters.

The aedeagus is shown in fig. 4.; the ninth sternite has an exceedingly long hypandrial apodeme, similar to that in *seneciophila* (fig. 26).

Distribution.—N.S.W.: Otford; Formosa. New to Australia.

***Melanagromyza alysicarpi* Bezzi, 1928**

Location of holotype: BM.

This is one of the smallest shining black species, with wing length of 1.5 mm. in male and 1.6 mm. in female. It is readily distinguishable by the costa terminating shortly after vein  $r_4 + 5$ ; it is also separable from the *centrosematis* group by the last two segments of vein  $m_3 + 4$  being equal.

The aedeagus is illustrated in fig. 5; the distiphallus consists of a large sac-like structure covered with conspicuous sensory pores, as found in a number of species in the genus.

The puparium is pale white with large, black anterior spiracles, similar to those in *atomella* and with the posterior spiracles in the form of two widely-separated projections, dark at the base and each bearing distally three pale buds.

The larva forms a distinctive, white, leaf-mine (fig. 6) in *Alysicarpus vaginalis* DC, primarily along the midrib with smaller branches along the stronger lateral veins; the puparium remains on the midrib with the anterior spiracles projecting through the leaf epidermis.

I found the mines to be relatively common on the host-plant at Darwin, Northern Territory, on 22.i.1961, and again on 16.ii.1961. The species was described from the same host on Fiji. Prof. Hering has mentioned that he has leaf-mines, which he can now refer to this species, on *A. nummularifolius* (L.) from Java. I have also seen young mines in *A. vaginalis* from Madras, India, in the Herbarium at Kew which almost certainly belong to the same species.

Distribution.—N. T.: Darwin; Fiji, Java, possibly India. New to Australia.

#### *Melanagromyza apii* Hering, 1951

The larva of this species mines in the petiole and midrib of *Apium graveolens* L., and it must be considered a pest on cultivated celery; described from Sydney.

The adult belongs to the large complex of metallic greenish species and can be briefly characterised as follows: frons at most slightly projecting above eye; jowls relatively broad, one-sixth vertical height of eye; third antennal segment distinctly round, arista bare, eye bare in both sexes; mesonotum and abdomen shining green, possibly with bluish tinge; squamae and fringe white; wing length up to 2.7 mm.

The posterior spiracles of the larva are separated by approximately their own diameter and consist of a ring of 9 or 10 buds enclosing a strongly chitinised horn. The pale brown puparium remains in the mine at the base of the leaf. The adult has been recorded in November-December, and in April-May. Hering (1951) illustrates the male genitalia and larval characteristics.

Distribution.—N.S.W.: Mascot and Bronte, near Sydney, Mona Vale, Jenolan; South Australia: Athelstone.

#### *Melanagromyza atomella* (Malloch)

Location of holotype: HNM.

*Agromyza atomella* Malloch, 1914.

*Melanagromyza atomella* (Malloch), Hennig, 1941.

*Melanagromyza styricicola* Sasakawa, 1954a, syn. nov.

*Agromyza euonymi* Kuroda, 1954.

*Melanagromyza polyphyta* Kleinschmidt, 1960, syn. nov.

This species is a highly polyphagous epidermal leaf-miner, occurring widely from India to Micronesia, including Japan, and now found to be common in N.S.W.

Malloch's description is based on caught specimens, and, although he established 20 paratypes, I have found that only one specimen of this series agrees with the holotype. Subsequently silvery, epidermal mines have been found on numerous plants in Java, Japan, India, Ceylon, Guam and Australia, but in view of the limited material available it has hitherto been difficult to decide whether a number of closely related species were involved or whether the virtually identical mines were caused by one widespread, polyphagous species.

I have recently reviewed this problem in the light of the additional material I have collected and received from other sources, and have also re-examined the types from Formosa, kindly lent me by the Zoological Museum, Budapest. The following facts can now be recorded:—

1. Until recently it was thought that *styricicola* was distinct from *atomella*, in view of the generally larger size. Specimens bred from *Passiflora foetida* L. and *P. suberosa* L. in Ceylon have a wing length of up to 1.6 mm. (Spencer, 1961) and the same size is normal in a lengthy series from Guam (Spencer, in press), whereas in Japanese specimens a wing length of 2.3 is not uncommon and the smallest size recorded is 1.75 mm. However, in a series bred from *Hydrangea macrophylla* Ser., N.S.W., the smallest male has a wing length of 1.6 mm. and the largest female 2.3 mm.
2. Sasakawa has found the female terminalia of Japanese specimens to be identical with one of the Guam series.
3. The puparium in all cases is pale yellowish-brown.
4. I have compared the male genitalia of specimens from *Tylophora barbata* R.Br. and *Hydrangea macrophylla*, N.S.W., *Euonymus japonicus* Linn., Japan, *Passiflora foetida* L., Ceylon, and caught specimens from Guam. The general form of ninth sternite and the complex aedeagus (figs. 7a, b) agree closely; in my opinion, the minor differences noted cannot justify the establishment of separate species.

5. I previously thought that in the smallest specimens the bristle on the mid-tibia was lacking and that *atomella* could be differentiated from *styrivicola* by this character. It is now found, however, that a short, slender bristle is always present; this cannot be detected in the holotype owing to slight damage to the legs, but is distinct in the topotypical paratype.

Sasakawa has hitherto treated *styrivicola* as distinct from *atomella*, owing to lack of detailed information on Malloch's type and on the distribution of the species outside Japan. In view of the evidence cited above, it is now considered that *styrivicola* must be synonymized with *atomella* and this synonymy is formally established herewith.

*M. polyphyta* Kleinschmidt, bred from leaf-mines on *Passiflora suberosa*, is clearly identical with *atomella* which has previously been bred from this host and this synonymy is also established herewith.

Food-plants recorded for the species are as follows:—

**AUSTRALIA:**

1. Adults

*Tylophora barbata* (Asclepiadaceae), Otford, South of Sydney, bred 30.i.1961; one ♂, one ♀, mines also found at Waterfall, N.S.W., 30.i.1961 (K.A.S.).

*Hydrangea macrophylla* (Saxifragaceae), Lisarow, N.S.W., Oct., 1958, 2 ♂, 4 ♀ (K. M. Moore), leaf-mines found at Botanical Gardens, Sydney, 23.i.1961 (K.A.S.).

*Passiflora suberosa* L. (Passifloraceae), Queensland, Kenmore, Feb., 1957 (Kleinschmidt, as *polyphyta* sp.n.).

*Angophora intermedia* DC (Myrtaceae), N.S.W., Lisarow, 17.x.1958 (K. M. Moore).

2. Leaf-mines

*Marsdenia rostrata* R.Br. (Asclepiadaceae), N.S.W., Otford, 29.i.1961 (K.A.S.).

*Stephania japonica* (Thunb.) Miers (Menispermaceae) N.S.W., Otford, 29.i.1961 (K.A.S.).

*Celastrus subspicatus* Hook. (Celastraceae), N.S.W., Windsor, 25.i.1961 (K.A.S.).

*Barringtonia gracilis* (Miers) Knuth (Lecythidaceae), N.T., Darwin, Howard Springs, 16.ii.1961 (K.A.S.).

*Passiflora suberosa* (fig. 9) (Passifloraceae), Qld., Brisbane, Botanical Gardens, 22.i.1961 (K.A.S.).

*Doryphora sassafras* Endl. (Monimiaceae), N.S.W., Clyde Mountain, 5.ii.1961 (K.A.S.).

**JAPAN:**

*Actividia arguta* Plaud. (Actinidiaceae.)

*Celastrus orbiculatus* Thunb. (Celastraceae.)

*Euonymus japonica* T. (Celastraceae.)

*Fraxinus verecunda* Koidz. (Oleaceae.)

*Ilex pedunculosa* Miq. (Aquifoliaceae.)

*Marlea plantanifolia macrophylla* Maki. (Alangiaceae.)

*Pittosporum Tobira* Ait. (Pittosporaceae.)

*Styrax japonicum* Sieb. et Zucc. (Styracaceae.)

*Tylophora aristolochioides* Miq. (Asclepiadaceae.)

**MICRONESIA:**

*Morinda* sp. (Rubiaceae.)

**ORIENTAL REGION:**

*Barringtonia acutangula* Gaertn. (Lecythidaceae), Bombay

*B. asiatica* Kunz, Bombay.

*Bougainvillea spectabilis* Willd (Nyctaginaceae), Bombay.

*Eupatorium odoratum* L. (Compositae), Ceylon.

*Flacourtia* sp. (Flacourtiaceae), Bengal.

*Quisqualis indica* Blanco (Combretaceae), Ceylon.

*Passiflora* spp., (Passifloraceae), Ceylon.

*M. polyphaga* Spencer, 1961, from Ceylon is not distinguishable from larger specimens of *atomella*, but the puparium is consistently dark black. This species was widespread in Ceylon and did not overlap there in choice of host-plant with *atomella*.

In leaf-mines found on *Smilax australis* A. Cunn. ex D.C. (Liliaceae) at Clyde Mountain, N.S.W., and also at Careel Bay, near Sydney, the puparium is also entirely black. It is believed that this represents a distinct species. Similar mines were found by the author on *Smilax indica* Burm. near Calcutta in January, 1960. (Spencer, 1961: 76).

Distribution: Qld., N.S.W., N.T., Japan, Guam, Philippines, Java, Flores, India, Ceylon.

#### **Melanagromyza bowralensis sp.n.**

Head (fig. 10): exceptionally broad, frons slightly wider than eye, only slightly projecting above eye in profile; two equal ors, the upper projecting upwards and outwards, the lower upwards and inwards; three (on one side four) strong, equal ori, all directed inwards; orbital setulae numerous, long, all proclinate, apart from one or two hairs, between ors; orbits broad, pronounced; ocellar triangle broad, apex extending to upper ori; lunule high, narrow, sunk below orbits, with central furrow; jowls one-sixth height of eye, cheeks forming only narrow ring below eye, not projecting at base of antennae; eye large, almost round, only slightly higher than broad, in female with sparse hairs at level of ors; antennae separated at base by distinct, narrow keel, third segment rounded, with short pubescence, arista long, appearing virtually bare.

Mesonotum: Two strong dc, second midway between level of supra and intra-alar, acr in eight rows, four rows extending behind first dc.

Wing: length in female 3.1 mm., costa extending strongly to vein  $m1 + 2$ , rm just beyond midpoint of discal cell, last segment of  $m4$  two-thirds length of penultimate.

Colour: head entirely black, ocellar triangle and orbits only faintly shining, mesonotum black with faint coppery reflection, appearing largely matt from front, more shining from behind, abdomen shining coppery-greenish; wings clear, veins black, squamae white with brownish-orange borders, fringe white.

Holotype: ♀, N.S.W., Bowral, caught on waste ground, 30.i.1961 (K.A.S.), in author's collection.

This species is unusual in having entirely proclinate orbital setulae, which differentiates it from all recorded Australian species. In the area where it was caught there is much introduced European vegetation and it has been carefully compared with European species having the orbital setulae at least partially proclinate. In both *cirsii* (Rondani) and *detmeri* Hg., 1933, the setulae are in two distinct rows, the inner row being proclinate, while the outer row near the eye margin is distinctly reclinate; in addition, in *cirsii* there are only two ori. In the true *aneiventris* (Fall.) from *Urtica* the chaetotaxy of the head is similar but the squamae and fringe are black.

*M. tripolii* Spencer, 1957, which feeds exclusively in stems of the maritime *Aster tripolium* L., has entirely proclinate orbital setulae but they are significantly sparser. It thus seems reasonably certain that a new species is involved.

#### **Melanagromyza cassiae sp.n.**

Head: frons almost one-and-a-half times width of eye, not projecting above eye in profile; two ors, the upper distinctly stronger, two ori, the upper equal to lower ors and directed upwards, the lower weaker and directed inwards; orbital setulae reclinate; ocellar triangle with apex extending to lower ors, with trace of furrow continuing to margin of lunule; jowls narrow, eye large, almost round; third antennal segment rounded, with short pubescence, arista relatively long, little shorter than height of eye, appearing bare.

Mesonotum: two strong pairs of dc, acr ending midway between first and second dc.

Legs: mid-tibia with one strong postero-dorsal bristle.

Wing: length in male 1.9 mm; costa extending strongly to vein  $m1 + 2$ , rm slightly beyond midpoint of discal cell, last segment of  $m4$  distinctly shorter than penultimate in ratio 13:18.

Colour: entirely black, frons matt, ocellar triangle weakly shining; mesonotum largely shining but less so from front; wings clear, veins dark brown, squamae dark grey, fringe black.

Male genitalia: aedeagus highly distinctive (fig. 11a, b), black, asymmetric, with an unusual lateral process on the distiphallus.

Holotype ♂, N.S.W., Careel Bay, N. Sydney, caught on *Cassia bicapsularis* L., 3.ii.1961 (K.A.S.), in author's collection, one ♀ paratype, same data, presented to Australian Museum, Sydney.

It is accepted that this species is responsible for the incomplete epidermal leaf-mines found on the plant where the flies were taken. Similar mines were found on *Erythrina* sp. nearby, and it is believed that these are formed by the same species. Two females, caught on *Erythrina* sp., near Brisbane, where epidermal mines of an earlier generation were also present, are referred to the same species. Confirmation is, however, desirable from males bred from *Erythrina*. Séguy (1951) described *M. vigneae* from Madagascar which, apart from its primary host, *Vigna angivensis* Baker, was also recorded as a leaf-miner on *Cassia occidentalis* L. I have not been able to examine these specimens; however, I have recently examined the genitalia of specimens bred from *Vigna unguiculata* (L.) Walp. in Sénégal, West Africa, which have been identified as *vigneae* Séguy (Spencer, 1959), and can confirm that this species is distinct from *cassiae* and also from *atomella*.

This new species closely resembles *atomella* (Malloch). Apart from the very different genitalia the species can be distinguished by the arista, which is bare in *cassiae* and distinctly pubescent in *atomella*. The latter species, as far as I know, has never been recorded on Leguminosae.

#### **Melanagromyza centrosematis** de Meijere, 1940

Location of holotype: ZM.

This small, shining black species closely resembles *M. atomella* (Mall.), and *M. cassiae* Spencer; it has recently been discussed by Spencer (1961, 1961a). The distinguishing characters are the relatively deep jowls and the fine, virtually bare arista.

The species has a very distinctive aedeagus, which has been illustrated together with the ninth sternite, by Spencer (1961a). In view of its peculiar asymmetry a further drawing is shown in fig. 12a and also the characteristic spermal sac in fig. 12b.

The larva has been recorded feeding in the stem and roots of *Centrosema pubescens* Benth. and *Glycine soja*; it seems likely that it will also feed in other Leguminosae.

The single Australian specimen is from N.S.W., 10 m. west of Wilcannia, 22.xi.1949 (S.J.P.).

Distribution: N.S.W., Malaya, Formosa, Java, Tanganyika. New to Australia.

#### **Melanagromyza conspicua** Spencer, 1961

Location of holotype: AC.

This small black species resembles *atomella* (Mall.) but is readily distinguishable by the deeper jowls, which are one-sixth the vertical height of the eye, and the distinct pubescence on the third antennal segment in both sexes.

The species was described from two males from Singapore and Ceylon; the latter specimen was caught on *Tithonia diversifolia* A. Gray (Compositae). A series of two males and three females were caught on foliage of *Siegesbeckia orientalis* L. at Cabbage Tree Creek, Clyde Mountain, N.S.W., on 5.ii.1961, and a male and female were swept on damp vegetation at the foot of Mt. Coot-tha, Brisbane, on 22.i.1961.

The aedeagus of the species is distinctive, having a large, pale-brown sac-like structure covered with conspicuous sensory pores, similar to that occurring in *O. angustilunula* and *O. micra* described below; it was illustrated in the holotype by Spencer (1961, fig. 42).

The female has not hitherto been known; it agrees exactly with the male, apart from its larger size, having wing-length up to 2.4 mm. In the type specimens the frons does not project above the eye in profile; however, in some of the N.S.W. series the frons is distinctly raised above the eye in the area of the ori and the same applies to five specimens examined from New Guinea. It is unusual to find this degree of variation in the configuration of the frons, which has hitherto been found to be a reasonably constant character.

This species very closely resembles *M. provecta* de Meij, 1922, described from Java and since widely recorded in Africa (as *communis* Spencer). In *provecta* the genitalia are distinctive (Spencer, 1961b, fig. 1) and the arista is longer and more distinctly pubescent.

It now seems certain that the species feeds on a number of genera of the Compositae either as a leaf-miner or possibly in the flower-head.

Distribution.: Queensland: Brisbane; N.S.W.: Clyde Mountain; New Guinea, Formosa, Singapore, Ceylon. New to Australia.

**Melanagromyza dianellae** Kleinschmidt, 1960

Location of holotype: QM, Reg. No. T5808.

This is a small, shining black species, with wing-length up to 1.6 mm. and with white squamae and fringe. It is very similar to *M. paramonovi*, described below, but immediately distinguishable by the narrow jowls (fig. 13), which are one-tenth height of eye and the smaller size. The ninth sternite has the same conspicuously elongated hypandrial apodeme as in *paramonovi*, but is smaller, and the postgonites have a distinct group of minute sensory pores; the aedeagus (fig. 14) is also of similar type but the basal section is more regular, not distinctly asymmetric. The genitalia and also leaf-mines are figured by Kleinschmidt (1960: 12-13).

This species forms a clear group with *M. paramonovi* and a further species shortly to be described from New Guinea; the only other similar species are *M. galactoptera* Bezzi, 1926, from Rodrigues and *M. lustralis* Spencer, 1959, from the Cape Verde Islands.

The larva forms a silvery epidermal mine in the narrow leaves of *Dianella caerulea* Sims. I have also found mines referable to the same species on *Eustephus* at Mt. Coot-tha, Brisbane. The larva pupates in the leaf.

Distribution.: Queensland: Coolangatta, Brisbane; N.S.W.: Cobar, Lawson, Bronte, near Sydney.

**Melanagromyza indigoferae** Kleinschmidt, 1960

Location of holotype: QM, Reg. No. T5806.

Head: two ors, upper slightly stronger, two equal ori, the upper directed upwards, the lower incurved, orbital setulae sparse, but long; jowls narrow, rounded; third antennal segment with conspicuously long, whitish upcurved pubescence, arista bare, distinctly thickened at base.

Mesonotum: 2 dc, acr irregularly in three or four rows in front, not extending behind second dc.

Wing: length in male 1.3 mm., costa extending strongly to vein  $m1 + 2$ ,  $rm$  at anterior third of discal cell, last and penultimate segments of  $m4$  equal, costal segments 2, 3, 4, in ratio 22: 6: 5.

Legs: mid-tibia without differentiated postero-dorsal bristles.

Colour: entirely black, mesonotum only moderately shining, greyish-black, wings clear, veins dark, squamae grey, fringe black.

The genitalia have been figured by Kleinschmidt (1960: 10).

The type series was bred from leaf-mines in *Indigofera suffruticosa* Mill.; the species has also been bred from *Indigofera australis* Willd. (A. Dyce). The leaf-mine (fig. 15) is indiscriminately upper or lower surface (not epidermal), linear, whitish. The puparium is brilliantly shining black and is glued very firmly to the leaf, with the anterior spiracles projecting through the leaf-epidermis.

This is the smallest species of this genus known to me. It is readily distinguishable from *pisi* Kleinschmidt by the more greyish mesonotum, narrow jowls and more pubescent third antennal segment.

Distribution.: Queensland: Eight Mile Plains; N.S.W.: Clyde Mountain, Cabbage Tree Creek and Colo Vale.

**Melanagromyza metallica** (Thomson)

*Agromyza metallica* Thomson, 1869.

*Melanagromyza metallica* (Thomson), Spencer, 1959.

Location of holotype: Naturhistoriska Riksmuseum, Stockholm.

This species appears to be common in Queensland, extending south to the Sydney area in N.S.W.

It is the commonest and most widespread of the shining green species, and although its biology has not yet been clarified, it is virtually certain that the larva feeds either in the stems or flower-heads of Compositae.

The species agrees almost completely with *albisquama* (Malloch), apart from the distinctive patch of hairs on the male eye; wing length is normally from 2.2 to 2.4 mm., but larger specimens have been confirmed in South Africa. The female specimens from Queensland have a wing length of up to 2.6 mm. The arista is always distinctly plumose. The aedeagus is distinctive, with conspicuous sensory pores on one of the distal processes, and has been illustrated by Spencer (in press, fig. 6b). The species has recently been discussed by Spencer (1959, 1961, 1961a, 1961b, 1961c, in press).

Distribution: Queensland, N.S.W., New Guinea, Micronesia, Indonesia, Philippines, Mauritius, Seychelles, South Africa, Congo, Cape Verde Islands. New to Australia.

**Melanagromyza murrayae** sp.n.

A minute black species with the following essential characters: jowls narrow, arista long, distinctly pubescent, mid-tibia without postero-dorsal bristle, wing length 1.5 mm., with costa extending strongly to  $m1 + 2$ ,  $rm$  well beyond centre of discal cell, last and penultimate segments of  $m4$  equal (fig. 16), squamae grey, fringe black. Puparium pale brown, with darker markings dorsally, spiracles as in *atomella* (Mall.).

Holotype ♀, Brisbane, Botanical Gardens, bred from epidermal leaf-mine in *Murraja paniculata* Jack (Rutaceae) 22.i.1961, adult emerged 6.ii.196 (K.A.S.), in author's collection.

This species is immediately distinguishable from *atomella* by the equal last and penultimate segments of vein  $m4$  and from *alysicarpus* by the stronger costa, which continues distinctly to vein  $m1 + 2$ ; it is distinguishable from the even smaller *indigoferae* by its more pubescent arista.

The only other species known to feed on the Rutaceae is *M. citri* Spencer, 1959, bred from *Citrus* sp. in Africa; in this species the costa extends only to vein  $r4 + 5$ .

**Melanagromyza paramonovi** sp.n.

Head (fig. 17): frons one-and-one-third times width of eye, not projecting above eye in profile, two strong, equal ors, two weaker ori, lower ori directed predominantly inwards, upper ori and ors predominantly upwards; orbital setulae reclinate; ocellar triangle with apex at level of lower ors, lunule in form of semicircle; jowls relatively broad, quarter height of eye, cheeks forming narrow ring below eye; third antennal segment small, round, arista fine, bare, as in *M. verdescens* (fig. 3b).

Mesonotum: chaetotaxy normal.

Wing: length in male 1.9 mm., costa extending to vein  $m1 + 2$ ,  $rm$  beyond midpoint of discal cell, last and penultimate segments of  $m4$  equal.

Colour: head black, frons matt, ocellar triangle and orbits weakly shining; mesonotum and abdomen shining black, wing conspicuously pale; veins pale brown; squamae and fringe white.

Male genitalia: aedeagus (fig. 18a) with two long tubules distally, basal section asymmetric, reduced on one side; ninth sternite (fig. 18b) with conspicuously elongated hypandrial apodeme, postgonites with two distinct sensory pores distally; spermal sac as in fig. 18c.

Holotype: ♂, N.S.W., 10 m. W. Wilcannia, 22.xi.1949; six paratypes: one ♂, same data as holotype, one ♂, 50 m. W. Cobar, one ♀, 30 m. W. Cobar, 24.xi.1949, 3 ♀, 40 m. N. Broken Hill, 19.xi.1949 (all S.J.P.). Holotype, four paratypes, C.S.I.R.O., Canberra, two paratypes in author's collection.

This species is closely related to *M. dianellae* Kleinschmidt, but is readily distinguishable by the deeper jowls and differing genitalia. The closest known relative outside Australia is *M. galactoptera* Bezzi, 1926, from Rodrigues; this is somewhat larger, the jowls are narrower and the arista is conspicuously long.

The species is named in honour of S. J. Paramonov; 16 specimens he collected in western N.S.W. in November, 1949, included five species described as new in this paper.

#### **Melanagromyza phaseoli (Tryon)**

*Oscinis phaseoli* Tryon, 1895.

*Agromyza phaseoli* Coquillet, 1899.

*Agromyza destructor* Malloch, 1916.

*Melanagromyza phaseoli* (Tryon), Spencer, 1959: 283-4.

Location of holotype: believed lost.

This species is well known in Australia as the Bean Fly; it was until recently credited to Coquillet, but Tryon's original description must be accepted as valid.

The small black fly is readily distinguishable from all others in the genus by the greatly elongated, brilliantly shining ocellar triangle.

The larva is a serious pest on cultivated leguminous crops and has been recorded on *Phaseolus*, *Vigna*, *Soja*, *Cajanus*, *Dolichos*, *Crotalaria*. I found the species to be common on *Phaseolus lathyroides* L. near Brisbane, at the end of January, 1961.

Oviposition takes place in a young upper leaf and the larva initially forms a narrow linear leaf-mine running towards the petiole and stem. The mine continues down the stem, either beneath the epidermis or deeper inside the stem, where pupation takes place. At the point of pupation the stem turns brown and frequently breaks open. Young plants infested invariably die. The biology of the species has been dealt with in some detail by Otanes y Quesales (1918), van der Goot (1930) and Hassan (1947).

The genitalia have not, as far as I know, previously been examined. The ninth sternite has a short, rounded hypandrial apodeme similar to that in *sojae* (Zehntner); the aedeagus (fig. 19) appears to resemble most closely that of *albisquama* (Malloch).

Distribution: Queensland, N.S.W., Micronesia, Formosa, Indonesia, Philippines, Malaya, India, Africa, Egypt.

#### **Melanagromyza piliseta (Malloch)**

*Agromyza piliseta* Malloch, 1914.

*Melanagromyza piliseta* (Malloch), Hennig, 1941; Spencer, 1961.

Location of holotype: HNM.

One female, Queensland, Townsville (F. H. Taylor), no date. This is a large green species, with wing length of 2.7 mm.; the arista is conspicuously plumose and in both male and female the eye has a distinct patch of white hairs; the ocellar triangle is conspicuously large and shining.

The species is widespread in the Oriental region, and its occurrence in Queensland is not surprising.

Distribution: Queensland, Formosa, Indonesia, Ceylon. New to Australia.

#### **Melanagromyza pisi Kleinschmidt, 1960**

Location of holotype: QM.

Very similar to *indigoferae* Kleinschmidt, so that differences only need be noted:

Jowls conspicuously broad, one-sixth vertical height of eye, third antennal segment with only slight pubescence; acrostichals extending in several rows to level of first dc; wing length 1.6 mm.; mesonotum shining black.



I have been able to examine two specimens, one a paratype, and there appears to be a distinct narrow keel separating the antennae, suggesting that the species might belong to the genus *Ophiomyia*. However, the genitalia confirm that the species is correctly placed in *Melanagromyza*.

The larva forms an upper surface, whitish leaf-mine on *Pisum sativum* L., pupating in the mine. Male genitalia and leaf-mines have been illustrated by Kleinschmidt (1960: 5).

Distribution.: Queensland: Toowong.

#### *Melanagromyza placida* sp.n.

Agreeing closely with *M. cassiae* Spencer, with the following points of difference: four ors directed upwards, the two lower distinctly shorter, two incurved ori, orbital setulae rather long; wing length in male 2.2 mm., venation distinctive (fig. 20), rm three-quarters distance from base of discal cell; aedeagus (fig. 21) distinctive, distiphallus a large elongated, bowl-shaped structure, pale-brown, basiphallus forming complete ring, black, strongly chitinized above, broader, paler below, phallopore elongated, spermal sac large.

Holotype ♂, Queensland, Lake Placid, near Cairns, 24.v.1958 (D.K.M.), Australian Museum, Sydney.

This species agrees with *cassiae* in having narrow jowls, bare arista and a distinct bristle on the mid-tibia, but is slightly larger and immediately distinguishable by the different position of cross-vein rm and the larger number of orbital bristles.

#### *Melanagromyza seneciophila* sp.n.

Head: frons broad, in male one-and-a-half times, in female twice, width of eye, not projecting above eye in profile; two equal ors directed upwards, orbital setulae reclinate apart from single proclinate hair in front; ocellar triangle large but ill-defined at apex, lunule slightly higher than semicircle, almost flat at upper margin; jowls well-developed, one sixth vertical height of eye; cheeks linear; antennae approximate, third segment small, slightly longer than broad, rounded above, arista only minutely pubescent, appearing bare.

Mesonotum: two strong dc, second mid-way between supra- and intra-alar; acr coarse, in eight rows, extending in some four rows to first dc.

Wing (fig. 22): length in male 2.5, in female 3 mm., unusually narrow; costa extending strongly to vein m1 + 2, rm near centre of discal cell, last segment of m4 about half length of penultimate.

Colour: Ocellar triangle weakly shining, head otherwise matt black; mesonotum and abdomen predominantly shining black but with faint greenish or coppery reflections, wing conspicuously clear, veins unusually dark, black, squamae pale, whitish-grey, margins brown, fringe white.

Puparium: dirty greyish-brown with distinctive bands of scars and minute black tubercles around segment boundaries and also additional scars dorsally between these bands (fig. 23). Each posterior spiracular process an ellipse of 10-12 indistinct, heavily chitinized buds surrounding strong black truncate horn, the two processes separated by their own diameter.

Male genitalia (fig. 24): aedeagus as illustrated, ninth sternite with strong, characteristically elongated hypandrial apodeme.

Holotype ♂, N.S.W.: Waterfall, south of Sydney, larva found 29.i.1961, in stem of *Senecio vagus* F. Muell, emerged 20.ii.1961, in author's collection; ♀ paratype, same locality, puparium found 29.i.1961, emerged 9.ii.1961 (both K.A.S.), presented to Australian Museum, Sydney.

The unusually narrow wings, black veins and short last segment of m4 make this a distinctive species; the greenish tinge of mesonotum and abdomen might be overlooked and the species confused with *alternata*, but the species can immediately be distinguished by differences in the wing. The exceptionally long hypandrial apodeme of the ninth sternite is also similar to that in *alternata*. Other species feeding as internal stem-borers in *Senecio* spp.—*seneciocaulis* Spencer (1960) in Africa and *dettmeri* Hering (1933) in Europe have the eye in the male conspicuously haired.

**Melanagromyza sojae** (Zehntner)

*Agromyza sojae* Zehntner, 1900.

*Agromyza prolifica* Malloch, 1914.

*Melanagromyza sojae* (Zehntner), de Meijere, 1922; Spencer 1961, in press.

Location of holotype: ZM.

One male, bred from stem of *Swainsona galegifolia* (And.) R.Br. (Smooth Darling Pea) N.S.W., Groman, 29.xii.1960 (T. V. Bourke).

This small species is immediately recognizable by the shining black mesonotum and green abdomen; the squamal fringe is white.

The larva feeds as an internal stem-borer in Leguminosae, and recorded hosts include *Glycine*, *Cajanus* and *Phaseolus*. The species is frequently found on cultivated crops, but damage caused is invariably slight. The biology has been discussed in some detail by van der Goot (1930: 54-68).

Distribution: N.S.W., Formosa, Java, Flores, Sumbawa, India, Egypt. New to Australia.

**Melanagromyza specifica** sp.n.

This species closely resembles *metallica* (Thomson), and it is only necessary to give here the points of difference: ocellar triangle and orbits more distinctly shining; arista long but virtually bare; jowls somewhat deeper; mesonotum dull blackish-green, not predominantly shining green; squamae and fringe entirely white, borders of squamae not contrasting orange-brown, wing length in male 1.9-2 mm., aedeagus distinctive, as illustrated (fig. 25a), without sensory pores on lower distal process, ninth sternite with conspicuously elongated pre-gonites (fig. 25b).

Holotype ♂, Queensland: near Brisbane, swept on damp vegetation by gravel pit below Mt. Coot-tha, 22.i.1961 (K.A.S.), in author's collection; one ♂ paratype, N.S.W., 40 m. north of Broken Hill, 19.xi.1949 (S.J.P.), C.S.I.R.O., Canberra. One ♀, same data as paratype, is substantially larger, with wing length 2.6 mm.; it agrees otherwise closely with this species, but, in view of the larger size, it is not placed as a paratype.

This species has the pilose eyes in common with *metallica*, but is immediately distinguishable by the virtually bare arista, which appears intermediate between the long, pubescent arista of *metallica* and the short bare arista of *verdescens*. The generally darker colouration is also distinctive.

The aedeagus is somewhat similar to that of *M. inulivora* Spencer (1961c, fig. 8) from South Africa, but it seems preferable at this stage to treat the species as distinct.

**Melanagromyza trispina** (Malloch), comb. nov.

*Agromyza* (*Melanagromyza*) *trispina* Malloch, 1927.

Location of holotype : IHTM.

This species is represented only by the unique, male holotype from Merredin, Western Australia.

I have examined the holotype, which is in perfect condition. The species is immediately recognizable from all others so far known in Australia by the presence of three pairs of dc. Other essential characters of the species are: mesonotum and abdomen entirely black, squamae and fringe white, orbits well-defined, ocellar triangle large but ill-defined at apex, body robust, wing length approximately 2.7 mm.

**Melanagromyza verdescens** sp.n.

Head: frons just wider than eye, not projecting above eye in profile, two ors, upper slightly stronger, two ori, upper equal to lower ors, lower distinctly weaker, orbital setulae upright in front, reclinate behind, extending to upper ors; ocellar triangle conspicuous, narrow but elongated, apex beyond lower ors; lunule narrow, higher than semicircle, upper margin midway between ori, jowls deepest in centre below eye, vibrissa equal to lower ori, eye circular below, more oval above, bare in male; third antennal segment small, rounded, arista short, fine, bare, thickened at base (fig. 3b).

Mesonotum: two pairs of dc, second at level of supra-alar, acr in six rows in front, scattered hairs extending behind first dc.

Wing: length in male 1.9 mm., costa extending to  $m1 + 2$ , rm at mid-point of discal cell, last segment of  $m4$  in ratio 14:19 with penultimate.

Colour: ocellar triangle and orbits distinctly shining, head otherwise matt black, mesonotum shining blackish with distinct greenish tinge, abdomen more greenish; wings clear, veins dark-brown, squamae and fringe white, halteres black.

Male genitalia: aedeagus as illustrated (fig. 26a), basal section with strongly chitinized ring distally, largely membranous adjoining aedeagal apodeme, spermal sac (fig. 26b) conspicuously large.

Holotype: ♂, N.S.W., 10 m. west of Wilcannia, 22.xi.1949; two ♂ paratypes, one, same data, one, 12 m. south of Mt Pack Saddle, 18.xi.1949 (all S.J.P.); holotype and one paratype C.S.I.R.O., Canberra, one paratype in author's collection.

This species is readily distinguishable from *albisquama* (Mall.) and *metallica* (Th.) by the high narrow lunule, deeper jowls and the fine, bare arista. The form of arista is that found in the majority of *Ophiomyia* spp., but in other characters, including the aedeagus, this species is a typical *Melanagromyza*. The third antennal segment and distinctly more pubescent arista of *M. albisquama* is shown in fig. 3a.

#### *Melanagromyza wikstroemiae* Kleinschmidt, 1960

Location of holotype: QM, Reg. No. T 5800.

Head: frons broad, almost twice width of eye, not projecting above eye in profile; two strong, equal ors directed upwards, two equal, weaker ori, the upper directed upwards, the lower inwards; orbital setulae reclinate, from lower ori to upper ors; ocellar triangle not greatly differentiated, lunule low, normal; jowls well-developed, one-seventh vertical height of eye, rounded, cheeks linear, eye oval, upright, not pilose; antennae with bases slightly separated, third segment small, rounded, arista fine, bare, thickened at base.

Mesonotum: two pairs of strong dc, second at level of supra-alar, acr relatively long, in six to eight rows, not extending to level of first dc.

Legs: Mid-tibiae without differentiated postero-dorsal bristle.

Wing: Length in male and female 2.1 mm., costa extending strongly to vein  $m1 + 2$ , rm just beyond mid-point of discal cell, last segment of  $m4$  three quarters length of penultimate.

Colour: frons matt black, ocellar triangle and orbits scarcely shining, jowls more brownish; mesonotum matt black, scarcely shining even from behind, abdomen largely matt black, though slightly more shining than mesonotum; wings clear, veins black, squamae grey, fringe deep black.

Male genitalia: (fig. 27) ninth sternite with exceptionally broad and elongated hypandrial apodeme, aedeagus ending in characteristic distal tubule. The genitalia are also illustrated by Kleinschmidt (1960: 2).

Puparium: entirely matt black, segmentation indistinct, anterior spiracles on two long arms, posterior spiracles minute, each with three buds on common, low spherical protuberance.

Leaf-mine (fig. 28): irregular, considerably widening, upper surface linear mine, frons widely spaced in distinct lumps, puparium remains in mine, with anterior spiracles projecting through leaf epidermis.

The species is readily distinguishable by the matt mesonotum and absence of a bristle on the mid-tibia. The leaf-mines are abundant locally but the species is heavily parasitized by a Chalcid and also by a Braconid.

The type series was bred from leaf-mines on *Wikstroemia indica* Endl. I have also found the species to be abundant on *Pimelea ligustrina* Labill.

Distribution: Queensland: Kenmore; N.S.W.: Otford, Kangaroo Valley.

I have examined a female from Otford, 26.i.1959 (D.K.M.), in the Australian Museum Sydney, which is close to *M. wikstroemiae* but appears to represent a distinct species; there is one strong bristle on the mid-tibia and the wing length is greater, 2.4 mm; more material, however, is necessary before this can be satisfactorily described as a new species.

**Melanagromyza** sp. (N.S.W.)

A single female from N.S.W., Upper Hunter, Tubrabucca to Moonan, c. 2,000 ft., 19.x.1961 (D.K.M.), in Australian Museum, Sydney, appears to represent a new species.

The specimen is in somewhat imperfect condition, and it seems preferable not to describe a further species until additional material is available. The essential characteristics of the species are as follows:—

Frons one-and-a-half times width of eye, slightly projecting above eye in profile, two ors, two ori, ocellar triangle conspicuous, rather strongly shining, jowls deep, one-fifth vertical height of eye, mid-tibia possibly with single postero-dorsal bristle, wing length 2.4 mm., venation distinctive, with last and penultimate segments of vein m4 equal, first cross-vein at distal third of discal cell, slanting slightly forwards so that, if extended, it would meet lower end of second cross-vein, an entirely black species, mesonotum and abdomen largely shining, squamae grey, fringe black.

Genus **Ophiomyia** Braschnikov

*Ophiomyia* Braschnikov, 1897, Ann. Inst. Agron. Moscow 3: 40.

Type species *Agromyza maura* Meigen, Europe.

This relatively small genus is distributed fairly equally throughout the world. The males of most, but not all, species have a distinctive vibrissal fascicule (fig. 37); again in most, but not all, species there is a conspicuously bulbous carina dividing the base of the antennae. In South Africa there is a well-developed group of diminutive species with white squamae and fringe (Spencer, 1960), which is represented in Australia by *O. angustilunula* and *micra*, described below.

The feeding habit of the larva is greatly varied. Many are external stem-miners (*O. atralis*), others leaf-miners (*O. goodeniae*) or seed-eaters (*O. lantanae*).

*O. cornuta* (de Meijere) 1910, a leaf-miner on *Scaevola* spp., is widely distributed in the western Pacific and can be expected to occur in coastal areas of Queensland; it is included in the key to Australian species given below.

- |  |                             |
|--|-----------------------------|
| 1. Squamal fringe black .....  | 2                           |
| Squamal fringe pale, whitish .....   | 3                           |
| 2. Facial keel broad and bulbous .....   | <i>lantanae</i> (Froggatt)  |
| Facial keel narrow, scarcely projecting .....  | <i>solanicola</i> sp.n.     |
| 3. Vibrissal angle acute, at most 45 degrees .....   | <i>goodeniae</i> sp.n.      |
| Vibrissal angle 60 degrees to 90 degrees .....   | 4                           |
| 4. Mesonotum distinctly grey, male without vibrissal horn .....  | <i>atralis</i> (Spencer)    |
| Mesonotum shining black; male with vibrissal horn .....  | 5                           |
| 5. Lunule conspicuously high and narrow, orbital setulae numerous, directed upwards and outwards ..... | <i>angustilunula</i> sp.n.  |
| Lunule in form of semicircle; orbital setulae sparse, reclinate .....                                  | 6                           |
| 6. Last segment of m4 slightly longer than penultimate; wing length 1.6 mm. ....                       | <i>micra</i> sp.n.          |
| Last segment of m4 shorter than penultimate ratio: 12:17, larger species, wing length 1.9 mm. ....     | <i>cornuta</i> (de Meijere) |

**Ophiomyia angustilunula** sp.n.

Head (fig. 29): frons narrow, scarcely equal to width of eye, not projecting above eye in profile, two ors and two ori (broken, detectable only from basal pits); orbital setulae conspicuously long and numerous, directed upwards and outwards; jowls one-eighth height of eye, deepest in front, cheeks forming broad ring below eye; male with long curving vibrissal horn, characteristically broadening at end, ocellar triangle broad but relatively short; lunule high and narrow, as found in *Poëmyza* spp.; antennae separated by very fine keel which only slightly widens below, third segment small, round, arista short, fine.

Mesonotum: two dc, second at level of supra-alar; acr coarse, in 6 to 8 rows ending mid-way between second and first dc.

Wing (fig. 30): length in male 1.75 mm.; costa extending to vein m1 + 2, rm conspicuously oblique, only own length removed from mm., last and penultimate segments of m4 equal.

Colour: ocellar triangle and orbits distinctly shining, remainder of head matt black, apart from pale brownish vibrissal horn; mesonotum and abdomen shining black; legs entirely black; wing conspicuously whitish, veins pale brown; squamae and fringe white, halteres black.

Male genitalia: aedeagus (fig. 31a) terminating in distinct dark brown sac covered with minute sensory pores, median section long with distinctly chitinized side arms; spermal sac very large (fig. 31b).

Holotype: ♂, N.S.W., 40 m. east of Wilcannia, 23.xi.1949 (S.J.P.), C.S.I.R.O., Canberra.

#### *Ophiomyia atralis* (Spencer)

*Melanagromyza atralis* Spencer, 1961.

*Ophiomyia atralis* (Spencer), in press.

Location of holotype: DEI.

This species was described as a *Melanagromyza* from caught specimens from Flores (Spencer, 1961: 69), but examination of a longer series from Micronesia showed the species to belong to the genus *Ophiomyia*.

Stem-mines found on *Vernonia cinerea* L. near Calcutta airport on 20.i.1961, produced flies 10 days later clearly referable to this species. Identical mines had been found at Bangkok on 16.i.1960, and were illustrated (Spencer, 1961: fig. 40), but no adults were obtained.

Further fresh mines containing puparia were found at the Botanical Gardens, Darwin, on 16.ii.1961, but again, unfortunately, no adults were obtained.

However, these mines and puparia are identical with those from Calcutta and Bangkok, and the identity of the species is not in doubt.

I had previously suggested (Spencer, 1961c) that specimens bred from stems and roots of *Striga hermonthica* Benth. in Kenya were referable to this species; I am now satisfied that these represent a distinct species, which will be described shortly.

The following are the essential characters of *atralis*: frons narrow, not wider than the eye in profile viewed from above; jowls narrow, but distinctly projecting in front, male without vibrissal horn; facial keel narrow and scarcely widening between antennae; mesonotum somewhat shining but distinctly grey; squamae and fringe white; first cross-vein at or slightly beyond midpoint of discal cell, last and penultimate segments of vein m4 approximately equal; wing length in male and female 1.9 mm.

Distribution: Darwin, N.T.; Calcutta, Bangkok, Flores, Micronesia. New to Australia.

#### *Ophiomyia goodeniae* sp.n.

Head (fig. 32): largely collapsed in only available specimen and detailed description not possible; two ors, the upper distinctly stronger; orbital setulae slight, sparse, reclinate, jowls narrow, greatly projecting in front, forming angle of 30 degrees; vibrissa in female strong, equal to upper ors; antennae divided by broad facial keel, bulbous below base of antennae but without centre furrow, arista relatively long.

Mesonotum: very similar to *O. solanicola* described below but second dc distinctly behind level of supra-alar.

Wing: length in female 1.4 mm.; costa extending strongly to vein m1 + 2; rm three-quarters distance from base of discal cell, conspicuously slanting; last segment of m4 in ratio 15:19, with penultimate, virtually identical to *solanicola* (fig. 38).

Legs: mid-tibiae apparently without differentiated postero-dorsal bristle.

Colour: head entirely black, ocellar triangle brilliantly shining, orbits less so, mesonotum and abdomen shining black; squamae and fringe white.

Leaf-mine (fig. 33): a long, winding, white, upper surface channel, initially conspicuously narrow, frass deposited irregularly in black grains and strips, pupation in leaf.

Puparium: 2.2 x .85 mm.; colour pale greyish-yellow, with distinct darker bands of tubercles at borders of segments, posterior spiracles two minute horizontal projections bearing apparently 3 buds, above a conspicuous darker brown anal projection.

Holotype: ♀, N.S.W., Waterfall, National Park, south of Sydney, emerged 1.ii.1961, from leaf-mine in *Goodenia ovata* Sm. found 29.i.1961 (K.A.S.), in author's collection.

The species is readily distinguishable from others with pale squamae by the acute angle formed by the conspicuously projecting jowls.

#### ***Ophiomyia lantanae* (Froggatt)**

*Agromyza lantanae* Froggatt, 1919.

*Ophiomyia lantanae* (Froggatt), de Meijere, 1925: 253.

Location of holotype: believed lost.

This species occurs widely with its food-plant, *Lantana camara* L., and is known in Australia from Queensland and northern N.S.W. The distribution in Africa and Asia has been discussed by Spencer (1959: 298 and 1961: 80).

It is a species typical of the genus, with a broad bulbous keel separating the antennae, a long vibrissal horn in the male and black squamae and fringe.

The aedeagus of a male from Brisbane is shown in fig. 34a; the basiphallus has the long side-arms characteristic of many species in the genus; the spermal sac is shown in fig. 34b.

The larva feeds in the receptacle of the flower-head and also in the fleshy part of the fruit surrounding individual seeds, but my own observations suggest that the hard seed itself is not normally damaged. This was also the view of Subramiam (1934), who has studied this species in India. The species has been widely introduced to assist in the control of lantana, but, in view of the actual feeding habit of the larva, it seems to me doubtful whether such measures are of much practical value.

Distribution: Queensland, N.S.W., India, Singapore, Ceylon, Kenya, Central America, Venezuela, Mexico.

#### ***Ophiomyia micra* sp.n.**

Closely resembling *angustilunula*, so that only points of difference need be noted.

Head: ocellar triangle slightly narrower and more elongated; orbital setulae short, sparse, lunule broader, lower, in form of semicircle; jowls extending more conspicuously in front, vibrissal horn longer, more distinctly bending.

Wing (fig. 35): length in male 1.6 mm., rm at mid-point of discal cell, last segment of m4 longer than penultimate in ratio 16:13.

Colour: wing less conspicuously white, vibrissal horn black but becoming paler distally, otherwise identical to *angustilunula*.

Male genitalia: distiphallus (fig. 36a) paler, sensory pores larger, less numerous, median section short, at most half length of *angustilunula*, spermal sac (fig. 36b).

Holotype ♀, N.S.W., 40 m. east of Wilcannia, 23.xi.1949 (S.J.P.), C.S.I.R.O., Canberra.

#### ***Ophiomyia solanicola* sp.n.**

Head (fig. 37): frons relatively narrow, equal to width of eye, not projecting above eye in profile; two equal ors, two equal ori, only slightly weaker; ors directed upwards, ori more inwards; orbital setulae reclinate, short, sparse; ocellar triangle not greatly elongated, apex slightly below upper ors; orbits narrow but well-defined; jowls narrow, one-tenth vertical height of eye, distinctly projecting in front, forming angle of 80 degrees; male with vibrissal horn, characteristically curving at end; eye large, oval, upright; antennae separated at base by narrow facial keel, which slightly widens below and is distinctly indented, third antennal segment small, round, with distinct pubescence, arista relatively long, equal to width of eye viewed in profile.

Mesonotum: two strong dc, second at level of supra-alar, two-thirds length of first, acr thick in 8-10 rows in front, a few hairs only extending to level of first dc.

Wing (fig. 38): length in male 1.9, in female 2.2 mm.; costa extending strongly to vein m1 + 2, rm conspicuously near mm., four-fifths distance from base of discal cell, last and penultimate segments of m4 about equal.

Legs: mid-tibia with one small differentiated postero-dorsal bristle.

Colour: an all-black species; frons matt, sooty, ocellar triangle and orbits weakly shining; mesonotum largely shining, slightly matt viewed from front, abdomen shining; squamae and fringe black.

Male genitalia: aedeagus typical of the genus (fig. 39a), spermal sac large but conspicuously narrow (fig. 39b).

Puparium: 2.5 x 1.2 mm.; colour mainly brownish yellow but black along centre dorsally, anterior spiracles two long vertical projections slightly knob-like distally; posterior spiracles two short black, horizontal projections arising from corners of a common protuberance, each bearing three buds.

Leaf-mine (fig. 40): a long, winding, whitish, upper surface linear mine, sometimes following leaf-margin but also in centre of leaf, frass in an irregular line along centre of channel; puparium remains in mine with anterior spiracles projecting through epidermis of leaf.

Holotype: ♂, N.S.W., Clyde Mountain, emerged 13.ii.1961 from leaf-mines found Feb. 5, on *Solanum prinophyllum* Dunal (K.A.S.), two ♀ paratypes, one, same data, in author's collection, one presented to Australian Museum, Sydney.

This species is readily distinguishable from *lantanae* (Froggatt) by the narrower facial keel and from *goodeniae* Spencer by the black squamal fringe; it resembles a leaf-miner on *Solanum* from Madagascar being described by the author shortly, but the latter has whitish squamae with a pale, ochrous fringe and in the male the vibrissal horn is longer.

#### Genus *Cerodontha* Rondani

*Cerodontha* Rondani, 1861, Dipt. Hal. Prod: 4-10.

Type species: *Chlorops denticornis* Panzer, Europe.

This small genus of 20 described species is represented in Australia by three species.

The genus is represented throughout the world and, as far as is known, the larvae are exclusively leaf-miners on Gramineae.

The biology of the Australian species has not yet been established.

#### Key to Australian *Cerodontha* species

- |   |                          |
|---|--------------------------|
| 1. Mesonotum uniformly matt blackish-grey .....       | <i>australis</i> Malloch |
| Mesonotum at least partially shining black .....      | 2                        |
| 2. Mesonotum uniformly shining black .....            | <i>robusta</i> Malloch   |
| Mesonotum yellow with three shining black bands ..... | <i>vittigera</i> Malloch |

#### *Cerodontha australis* Malloch, 1925

Location of holotype: IHTM.

The distinctive features of this species are as follows:—

Head: one ors, near centre of head between verticals and lower ori; two ori; orbital setulae short, sparse, not above upper ori; frons greatly projecting above eye in profile, jowls deep; third antennal segment elongated, with short spine on upper corner (fig. 41a).

Mesonotum: 3 + 1 dc; normally one or two pairs of acr present between third and fourth dc.

Wing: length in male 2.2-2.6 mm., in female 2.4-2.7 mm.

Colour: head predominantly yellow, orbits paler than frons which is frequently more brownish; first and second antennal segments yellow, third normally black but often paler, yellowish, particularly on inside; mesonotum greyish-black, scutellum similar, without any trace of yellow, mesopleura normally blackish-grey with very narrow yellowish area in upper margin but in some species more extensively yellow, abdomen blackish but tergites sometimes with yellow borders.

Legs: coxae and femora bright yellow but in hind and mid-legs sometimes distinctively darker, more brownish; tibiae and tarsi brown.

Male genitalia: distal section of aedeagus (fig. 42a) curved, long, rather pale, spermal sac as in fig. 42b.

This species closely resembles the Palaearctic species, *C. denticornis* (Pz.) but is distinguishable from it by the presence of at least sparse acrostichals, the uniformly dark scutellum even in the palest specimens and the paler third antennal segment. In *denticornis* the aedeagus is more strongly chitinized, the mesophallus is stouter, while the distal tubules are more conspicuously curved and longer (Spencer, 1961b: fig. 13).

Distribution: New South Wales: Blue Mountains, National Park, Bowral.

I have also examined six specimens of the species occurring widely in New Zealand and identified as *denticornis* (Harrison 1959: 309). I am satisfied that the species is not *denticornis* and it appears indistinguishable from *australis*. However, the male genitalia clearly suggest that it is a distinct species; the mesophallus is substantially broader and shorter even than in *denticornis*, and the distal tubules are very much shorter and almost straight.

#### *Cerodontha robusta* Malloch, 1925

Location of holotype: IHTM.

Head: frons broad, projecting above eye in profile, two ors, three ori, orbital setulae relatively long, cheeks forming broad ring below; jowls deep; third antennal segment with distinctive, short, upcurved spike at upper corner (fig. 41b); frons conspicuously high and narrow.

Mesonotum: 3 + 1 dc, acr in four irregular rows extending with scattered hairs to first dc.

Wing: length in male 2.4 mm., in female 2.7-3.2 mm.

Colour: frons basically yellow but darkened by microscopic hairs and appearing brownish; orbits, jowls, face yellow; antennae yellow but third segment variably darker on upper corner, spine black; mesonotum shining black, yellow patches at hind corners, scutellum black with trace of yellow in centre; pleurae variably yellowish; legs: coxae and femora yellow, tibiae and tarsi brown, abdomen black, tergites with yellow borders.

The distinctive antennae and general coloration make this species readily distinguishable from all others known in the genus.

Distribution.—New South Wales: Sydney, Katoomba, Glen Davis, Mount Wilson.

#### *Cerodontha vittigera* Malloch, 1927

Location of holotype: IHTM.

Head: frons distinctly projecting above eye in profile; two ors, five ori, orbital setulae numerous, incurved, third antennal segment rounded below, curving up to prominent angle at upper corner, concave above.

Mesonotum: 3 + 1 dc, acr irregularly in four rows, a few hairs extending to midway between first and second dc.

Wing: length in male 3.2 mm.

Colour: head entirely yellow, frons slightly darkened in centre by microscopic hairs; third antennal segment darker at upper angle; mesonotum yellow in centre but with three brilliantly shining black bands; the two outer bands extend from shortly before the front of the mesonotum to the scutellum, filling the area between the line of the dorso-centrals on one side and a line joining the pre-sutural and post-alar on the other; the centre band runs along the entire length of the mesonotum in the holotype, but only to the level of the second dc in a second specimen examined; scutellum yellow in centre with a shining black area each side in the holotype, entirely black in the second specimen. Mesopleura largely black, yellow on upper margin, humerus and notopleural area yellow; sterno-pleura black below, yellow in upper quarter; abdomen black, tergites yellow laterally.

This is a distinctive species with conspicuously contrasting coloration. The variation in the colour of the scutellum of the two specimens noted above may possibly be of specific significance, but additional material is required before this can be confirmed.

Distribution: Western Australia, New South Wales, Mount Wilson.



Genus *Phytobia* Lioy

*Phytobia* Lioy, 1864, Atti Ist. Veneto (3), 9: 1313.

Type species *Agromyza errans* Meigen, Europe.

Frick (1952: 387) revived Lioy's name, which Hendel had ignored. Hendel (1936) divided the genus into eight well-defined sub-genera, five of which are represented in Australia. Nowakowski (1962) is again revising the genus and is proposing to split it into a number of distinct genera. In this paper I am following Frick.

The genus is represented throughout the world, being most strongly developed in the Holarctic region and the largest single genus in North America with 52 described species. In South America there is a striking proliferation of the sub-genus *Calycomyza*.

Key to Australian *Phytobia* species

- |   |  |
|---|--|
| 1. Halteres black .....                           | ( <i>Amauromyza</i> ) <i>caliginosa</i> sp.n.        |
| Halteres pale, white or yellow .....              | 2  |
| 2. Lunule distinctly higher than semicircle ..... | 3  |
| Lunule approximately in form of semicircle .....  | 4  |
| 3. Frons black .....                              | ( <i>Dizygomyza</i> ) <i>poemyzina</i> sp.n.         |
| Frons yellow .....                                | ( <i>Icteromyza</i> ) <i>triplicata</i> sp.n.        |
| 4. 3 + 0 dorso-central bristles .....             | ( <i>Calycomyza</i> ) <i>humeralis</i> (P. C. Roser) |
| 3 + 1 dorso-centrals .....                        | ( <i>Praspedomyza</i> ) 5                            |
| 5. Frons black .....                              | <i>incerta</i> sp.n.                                 |
| Frons pale, yellowish .....                       | 6  |
| 6. Third antennal segment entirely black .....    | <i>pittosporophylli</i> Hering                       |
| Third antennal segment largely yellow .....       | <i>pittosporocaulis</i> Hering                       |

*Phytobia* (*Amauromyza*) *caliginosa* sp.n.

Head: orbits pronounced, distinctly projecting above eye anteriorly (eye sunk, proportions with frons not detectable), two ors, the upper somewhat stronger; two ori, the upper equal to lower ors, the lower substantially weaker, orbital setulae in single row, long; jowls angular, deeply extended at rear; third antennal segment small, rounded, arista relatively short, distinctly thickened in lower third, without distinct pubescence.

Mesonotum: 3 + 1 dc, first and second strong, third and fourth equal, slight, half length of second, equidistant each side of suture; acr in four rows in front, a few scattered hairs extending to midway between first and second dc, inner post-alar slightly longer than third dc.

Wing (fig. 43): length in female 1.9 mm., costa extending strongly to vein m1 + 2, rm at midpoint of small discal cell, last segment of m4 twice length of penultimate, costal segments 2, 3, 4 in ratio 32:12:8.

Colour: frons dark brown, orbits slightly paler, antennae black, mesonotum matt black, with tendency to grey, abdomen slightly more shining, legs entirely black, wings clear, veins black, squamae grey, fringe black, halteres blackish-brown.

Holotype ♀, N.S.W., Blue Mountains, Springwood, Sassafras Gully, 17.xi.1956 (D.K.M.), Australian Museum, Sydney.

Only a single species of this sub-genus is known from the Oriental region (Formosa); this is, however, readily distinguishable from the Australian species by having only three dorso-centrals, by its more shining black coloration and differing venation.

*Phytobia* (*Calycomyza*) *humeralis* (v.Ros.)

*Agromyza humeralis* v.Roser, 1840.

*Calycomyza humeralis* (v.Ros.), Hendel, 1936.

Location of holotype: Museum für Naturkunde, Stuttgart, Germany.

The distinctive features of this species are: frons bright yellow, orbits largely black, antennae black, notopleural area yellow, legs entirely black, squamae and fringe yellow, wing length about 2 mm., discal cell small, last segment of vein m4 three times length of penultimate.

I have examined the specimen recorded by Malloch (1923: 622) as *Agromyza artemisiae* Kalt. and it is clear that the species is in fact *humeralis*.

The larva forms a yellowish blotch-mine pupating in the leaf, and the main hosts are *Aster* spp. and *Erigeron* spp. I found the species to be abundant around Brisbane and Sydney at the end of January, 1961, and noted mines on *Aster subulatus* Michx. and *Erigeron bonariensis* L. I have also seen specimens bred from *Aster* sp., Cairns, Qld., in January, 1960.

Distribution.—Queensland: Brisbane, Cairns; N.S.W.: Sydney; India; West Africa; Europe; North and South America. New to Australia.

#### **Phytobia (Dizygomyza) poemyzina sp.n.**

Head: frons little wider than eye viewed from above, not projecting above eye in profile, orbits distinctly differentiated, slightly widening anteriorly; two ors, the upper stronger than lower, two ori, similar to upper ors, lunule (fig. 45a) relatively broad and high, upper margin semi-circular; jowls narrow but extended at rear, cheeks linear; third antennal segment small in both sexes, rounded, without conspicuous pubescence, arista long, largely bare.

Mesonotum: 3 + 1 strong dc, third and fourth equal, acr regularly in four rows, coarse, extending almost to first dc, prescutellars well-developed, similar to ori.

Wing (fig. 46): length in male 2.4, in female 2.7 mm., discal cell small, penultimate segment of vein m4 thus short, two-thirds length of last segment, first cross-vein at or just before centre of discal cell.

Colour: frons, jowls, antennae matt black, orbits becoming paler in front, almost yellowish, lunule paler grey; mesonotum black, largely matt but with slight subshine, mesopleura with narrow, bright-yellow upper margin, pleura otherwise black, legs black, fore-femora narrowly yellow, abdomen shining black; wing base conspicuously yellow, squamae yellow, fringe basically pale, yellowish brown but at certain angles appearing darker, more contrasting.

Male genitalia: aedeagus (fig. 47) with characteristically curving tubules distally, mesophallus with large ventral appendage on left-side, which is only rudimentary on other side.

Holotype: ♂, N.S.W. Otford, 12.x.1957 (D.K.M.); 5 paratypes, 1 ♀ same data, on same mount as holotype, 1 ♂, 1 ♀, Blue Mountains, Mount Wilson, 30.x.1955 (D.K.M.), 1 ♀, Katoomba, 30.v.1958 (G. H. Hardy), 1 ♂, Mt. Kosciusko, no date (F. H. Taylor). Holotype and 3 paratypes in Australian Museum, Sydney, 1 paratype IHTM, 1 paratype in author's collection.

The form of lunule immediately places this species in the small group hitherto included in the sub-genus *Poëmyza* Hendel, consisting of *angulata* (Loew) (= *semiposticata* Hd.) (cf. Frick, 1959: 380), *scutellaris* (v.Ros.), *caricivora* Groschke, 1954, and also a new species from Africa (confirmed recently from examination of genitalia) previously (Spencer, 1959: 303-4) identified as *caricivora*. The lunule of this group is intermediate between the broad, low lunule (fig. 45b) of *Dizygomyza* Hendel s.s. and the narrow, high lunule of *Poëmyza* Hendel (fig. 45c). Recent studies of genitalia by Nowakowski (1962), which I have been able to confirm, show that *Dizygomyza* and *Poëmyza* cannot justifiably be treated as separate sub-genera and the exact status of what may conveniently be called the *angulata* group thus no longer arises. For the time being I maintain *Dizygomyza* as an enlarged sub-genus of *Phytobia* Lioy, now including *Poëmyza*.

The new species is immediately distinguishable from other members of the group by the longer last segment of vein m4 and also by the shorter lower ors; the yellow marking on the fore-femora is also less distinct.

The larvae of the other species are all leaf-miners on Cyperaceae, and there seems little doubt that *poemyzina* feeds on a similar host-plant.

#### **Phytobia (Icteromyza) triplicata sp.n.**

Head: frons relatively broad, in ratio 11:7 with eye viewed from above, orbits distinctly projecting above eye in profile; two equal ors directed upwards, normally three ori directed inwards, the upper similar to ors, the second only slightly weaker, the front one short, slight; orbital setulae short, sparse, reclinate; lunule broad and high, distance from upper margin to base of antennae similar to that to foremost ocellus; jowls broad, extended at rear, in centre one-fifth vertical height of eye; eye oval, slanting; third antennal segment relatively large, slightly longer than broad, rounded at end, arista slightly shorter than vertical height of eye, moderately pubescent.

Mesonotum: 3 + 1 dc, decreasing uniformly in size, acr coarse, irregularly in four rows.

Wing: length in male 2.2 mm., in female up to 2.7 mm., costa extending strongly to vein m1 + 2, which ends at apex of wing, costal segments 2, 3, 4 in ratio 40: 12: 10, rm at midpoint of discal cell, segments of m4 variable but last and penultimate normally equal.

Colour: frons, lunule, lower orbits, jowls, palps dirty yellow, upper orbits darkened, blackish-brown, hind margin of eye black, first antennal segment yellow, second black at base, yellow apically, third predominantly dark but distinctly yellowish on inside, mesonotum greyish-black, matt from front, more shining from behind. Pleura more distinctly black, brownish at margins, abdomen shining black; legs: coxae mainly black but on fore and mid legs yellow at apex, femora black, bright yellow on all legs on anterior quarter, tibiae brownish-black, yellowish at base adjoining femora, tarsi uniformly dark; wing base conspicuously yellowish, squamae yellow, fringe yellowish-ochrous, halteres yellow.

Male genitalia: aedeagus distinctive, as illustrated (fig. 48).

Holotype ♀, N.S.W., Pacific Highway, south side of Hawkesbury River, 13.x.1956 (lowest specimen of 4 on same mount); 18 paratypes: 3 ♂, same data as holotype; National Park near Sydney, 1 ♂, 1 ♀, 14.x.1956, 1 ♂, 13.xii.1956, 1 ♂, 4.xi.1956; 1 ♂, Burragorang, 12.i.1957; 1 ♂, Blue Mountains, Wentworth Falls, 29.xi.1958, 1 ♂, 3 ♀, Bargo, 22.ix.1956, 1 ♀, Baerani Creek, near Denman, 29.viii.1956, 1 ♀, Paddy's River, near Marolan, 22.ix.1956, 2 ♂, Hartley, 20.ix.1956 (all D.K.M.); 1 ♂, A.C.T., Black Mountain, 8.x.1930 (A. L. Tonnoir). Holotype and 12 paratypes in Australian Museum, Sydney, 1 ♂, C.S.I.R.O., Canberra, 3 ♂, 2 ♀ in author's collection.

A number of species in this sub-genus are extremely close morphologically, but there are consistent differences in the genitalia of the six species I have been able to examine. It has been found in the closely related sub-genera *Poëmyza* Hendel and *Dizygomyza* Hendel and also in *Cerodontha* Rondani that in very similar species slight but constant differences in the genitalia are invariably associated with distinctive differences in larvae and biology.

The biology is known of only two of this group of *Icteromyza* spp. Frick (1959: 38) reports rearing *I. longipennis* (Loew), 1869 from leaf and stem-mines on *Juncus xiphoides* Meyer. It is believed that *I. capitata* (Zett.) also feeds on *Juncus* sp. and it seems probable that *triplicata* and the other species in the group have a similar host plant.

I have recently been able to examine the genitalia of a specimen of *longipennis* kindly sent me by Dr. Frick (fig. 49). It will be seen that the aedeagus is significantly different from that of *triplicata*, although the only difference in the adults is in the degree of yellow on the femora.

The following partial key of *Icteromyza* spp. permits identification of eight species of the subgenus with which I am familiar.

1. Palps black ..... *capitata* (Zett.)  
Palps yellow ..... 2
2. Frons entirely brown; small species, wing length 1.7-1.9 mm. .... *floresensis* Spencer  
Frons largely yellow; larger species, wing length 2.2-2.7 mm. .... 3
3. Orbits yellow; last segment of vein m4 shorter than penultimate .... *nigricoxa* (Malloch)  
Upper orbits dark, black or brown; last segment of m4 longer than penultimate .. 4
4. Femora entirely yellow ..... *piliseta* (Becker)  
Femora only partially yellow ..... 5
5. Femora yellow on anterior third ..... *longipennis* (Loew)  
Yellow at apex of femora equal to width of femora ..... 6
6. Third antennal segment entirely black; median section of aedeagus without curvature,  
forming straight line with distiphallus which only curves up at end, both pale,  
scarcely chitinized ..... *geniculata* (Fallén)  
Third antennal segment partially yellow; median section of aedeagus with conspicuous  
curvature ..... 7
7. Tubules of distiphallus conspicuously swollen at end (Spencer, 1961: fig. 44)  
..... *duplicata* Spencer  
Tubules of distiphallus uniformly tapering, not swollen at end (fig. 48).. *triplicata* Spencer

**Phytobia (Praspedomyza) incerta** sp.n.

Head: frons scarcely wider than eye, not projecting above eye in profile; two strong, equal ors, two ori, the upper somewhat weaker than ors, the lower still weaker; orbits well defined but not significantly raised above frons, ocellar triangle only weakly defined beyond foremost ocellus, apex at level of upper ors, lunule narrow, upper margin forming semicircle; eye large, upright, oval, jowls extremely narrow, forming only narrow line below eye, vibrissa strong, equal to ors; third antennal segment small, rounded, arista long, equal to vertical height of eye, appearing bare.

Mesonotum: 3 + 1 dc, first and second strong, third and fourth equal, weak, half length of first, equidistant each side of suture, acr irregularly in six rows in front, a few scattered hairs extending to first dc, inner post-alar strong, equal to second dc, prsc lacking.

Wing: length in male 2 mm., costa extending to vein  $m1 + 2$ , discal cell large, rm just before midpoint, last and penultimate segments of  $m4$  equal.

Legs: mid-tibiae with two well-defined postero-dorsal bristles.

Colour: frons matt black, orbits distinctly shining, lunule more grey, antennae black; mesonotum black, largely matt, slightly shining from behind, legs entirely black, abdomen moderately shining black; wing clear, veins black, squamae grey, fringe black.

Male genitalia: aedeagus as illustrated (fig. 50), postgonites long, club-shaped dorsally, surstyli bearing one strong spine.

Holotype: ♂, North Queensland, Mulgrove River, 4 miles west of Gordonvale, 4.i.1959 (D.K.M.), Australian Museum, Sydney.

The exact position of this species within the genus is not clear. There are a number of characters associating it with *Praspedomyza* and it can most conveniently be provisionally placed in this sub-genus. The aedeagus is strikingly similar to that of many *Liriomyza* spp.; Nowakowski (in litt.) has mentioned the affinity he has found between the genitalia of *Praspedomyza* and *Liriomyza*.

**Phytobia (Praspedomyza) pittosporocaulis** Hering, 1962

Location of holotype: Department of Agriculture, Entomological Branch, Sydney.

On morphological characters this species seems correctly placed in the sub-genus *Praspedomyza*, generally resembling a number of Palaearctic species.

I have recently examined the genitalia of a male paratype, kindly presented to me by Professor Hering, and the aedeagus is illustrated in fig. 51. The distiphallus consists of long, tapering, paired tubules; the mesophallus is represented by two small black sclerites, with the basiphallus largely membranous and indistinct; there are four distinct spines on the surstyli. The aedeagus of the closely related species, *pittosporophylli* Hering, is generally similar but with slight distinctive differences (fig. 52).

This species is readily distinguishable from *pittosporophylli* by its largely yellow third antennal segment.

The larva forms twig galls on *Pittosporum undulatum* Andr. Both larva and gall have been discussed in detail by Hering (1962).

Distribution: N.S.W.: Normanhurst, Sydney, Seaforth.

**Phytobia (Praspedomyza) pittosporophylli** Hering, 1962

Location of holotype: Department of Agriculture, Entomological Branch, Sydney.

This species closely resembles *pittosporocaulis* Hering but is immediately distinguishable by its entirely black third antennal segment.

The aedeagus of a paratype, kindly presented to me by Professor Hering, is illustrated in fig. 52. The paired tubules of the distiphallus are considerably shorter than in *pittosporocaulis* but they are broader basally, the two sclerites of the mesophallus are larger and less strongly chitinized. On the surstyli there is a row of about 20 short, stout spines.

The larva forms leaf-galls, normally near the mid-rib but also elsewhere in the leaf, on *Pittosporum undulatum* Andr. Larva and gall have been described in detail by Hering (1962).

Distribution: N.S.W.: Normanhurst, Roseville, Sydney.

Genus *Liriomyza* Mik

*Liriomyza* Mik, 1894, Wien.ent. Zeitung, 13: 284.

Type species: *Liriomyza urophorina* Mik, Europe.

This is one of the larger genera in the Palaearctic, Nearctic and Neotropical regions but is reduced to a few species only in the Ethiopian and Oriental regions. In Australia, with 16 per cent. of the described species, it has double the percentage of the Oriental region.

The majority of the species are leaf-miners. The biology is known for only three of the nine Australian species, six of which are endemic. At least two of the undescribed species discussed on pp. 338-9 appear to belong to this genus.

Key to Australian *Liriomyza* species

- |   |                               |
|---|-------------------------------|
| 1. Second cross-vein lacking .....  | 2                             |
| Second cross-vein present .....   | 3                             |
| 2. Mesonotum pale ash-grey, hind-margin of head entirely yellow, four orbital bristles .....                        |                               |
| ..... <i>caulophaga</i> (Kleinschmidt)  |                               |
| Mesonotum black, slightly shining, hind margin of head black beyond vertical bristles, three orbital bristles ..... |                               |
| ..... <i>chenopodii</i> (Watt)  |                               |
| 3. Scutellum distinctly bright yellow, at least in centre .....   | 4                             |
| Scutellum largely black, only faintly yellow distally .....   | <i>helichrysi</i> sp.n.       |
| 4. Third antennal segment partially darkened, black or brown .....  | 5                             |
| Third antennal segment entirely yellow .....  | 8                             |
| 5. Mesonotum yellow centrally adjoining scutellum .....   | <i>australina</i> sp.n.       |
| Mesonotum dark to margin of scutellum .....   | 6                             |
| 6. Orbital setulae and acrostichals lacking .....   | <i>singularis</i> sp.n.       |
| Orbital setulae and acrostichals present .....  | 7                             |
| 7. Mesonotum uniformly matt grey, acr in 2 rows .....   | <i>pallidicentralis</i> Mall. |
| Mesonotum brown-dusted between dc, with grey-dusted bands laterally, acr in 4 rows .....                            | <i>tricolor</i> Mall.         |
| 8. Mesonotum shining black, frons bright yellow, at most orbits darkened, mesopleura largely yellow .....           | <i>brassicae</i> (Riley)      |
| Mesonotum matt black, frons brownish, mesopleura largely black .....  | <i>obscurata</i> sp.n.        |

*Liriomyza australina* sp.n.

Head: frons twice width of eye, not significantly projecting above eye in profile; two equal ors directed upwards, one weaker ori directed inwards; orbital setulae lacking; jowls rounded, deepest in centre, one-third vertical height of eye; eye upright, oval, with distinct, short pilosity; third antennal segment small, round, with conspicuous pubescence, arista short, bare.

Mesonotum: 3 + 1 dc, third and fourth equal, two-thirds length of second, second only slightly shorter than first; acr sparse, only one or two individual hairs between third and fourth dc.

Wing: length in female 1.6 mm., in male 1.1-1.25 mm.; first cross vein at mid-point of discal cell, last segment of m4 one-and-a-half times length of penultimate.

Colour: frons, jowls, face bright yellow; third antennal segment black, first and second yellow; palps yellow at base, brown distally; mesonotum (fig.53) with three matt, greyish-black bands, the central one between the dc extending from front of dorsum to midway between first and second dc; two narrower lateral bands from just before level of fourth dc to level of first; laterad of these outer bands, mesonotum bright yellow extending down to pleura; broad central yellow area at rear of mesonotum adjoining scutellum which is entirely yellow in holotype but laterally grey in both paratypes; pleura predominantly yellow but sterno-pleura with central black triangle, hypopleura with smaller, circular black area and narrow black strip at upper margin of notopleural area; abdomen entirely yellow, apart from shining black ovipositor in female and matt black epandrium in male; legs: yellow, tibiae and tarsi slightly darker, yellowish-brown; halteres yellow.

Holotype ♀, N.S.W., Blue Mountains, Springwood, Sassafras Gully, 17.xi.1956, in Australian Museum, Sydney, paratypes 2 ♂, one N.S.W., Otford, 12.x.1957; one, same data as holotype (all D.K.M.); one paratype in author's collection, other in Australian Museum.

This species is immediately distinguishable from all others in Australia by three dark bands and the yellow central area on the mesonotum adjoining the scutellum; it is the smallest species known in the world with this conspicuous colour pattern.

**Liriomyza brassicae** (Riley)

*Agromyza brassicae* Riley, 1844.

*Liriomyza brassicae* (Riley), Hendel, 1936.

Location of holotype: USNM.

This is the species identified by Malloch (1925: 90; 1927: 426) as *pusilla* (Mg.). There are no confirmed records of *L. pusilla* in Australia.

*L. brassicae* is a leaf-miner on Cruciferae and Capparidaceae and also occurs commonly on *Tropaeolum* (fig. 54). It can be a serious pest on cruciferous crops.

I have recently discussed this species in some detail (1961, 1961b, in press) and have shown the colour variation which can occur. The head, including antennae, is bright yellow but there is normally some degree of darkening of the orbits which can range from black to almost entirely yellow; a similar variation can occur in the mesopleura and also in the abdomen, where the tergites may be entirely black or conspicuously yellow laterally; the mesonotum is always shining black and the scutellum yellow.

I have noted the species on the following hosts:—

*Tropaeolum major* L., Sydney, Brisbane, Hobart.

*Gynandropsis speciosa* L., Sydney.

*Raphanus raphanistrum* L., Sydney.

*Diplotaxis muralis* (L.) DC, Hobart.

Distribution: Queensland, New South Wales, Tasmania; Hawaii; Micronesia; India; Africa; Europe; North America; British Guiana. New to Australia.

**Liriomyza caulophaga** (Kleinschmidt), comb.nov.

*Haplomyza caulophaga* Kleinschmidt, 1960.

*Liriomyza haplomyzina* Spencer, 1961, syn.nov.

Location of holotype: QM, Reg. No. T5810.

This is a distinctive species, with bright yellow head, including antennae and entire hind-margin of eye, matt ash-grey mesonotum, bright yellow legs and the second cross-vein lacking; there are two ors and two ori but orbital setulae are normally entirely lacking. The species has three of the four characters accepted by Frick (1959: 412) as defining species of the genus *Haplomyza*, the fourth being the presence of only a single upper orbital bristle. On this definition the species must be transferred to *Liriomyza*, since two upper orbitals are clearly present.

*L. haplomyzina* was described from a single specimen from Lombok, Indonesia, and the description was already in press when Kleinschmidt's (1960) paper describing *caulophaga* was published. I am satisfied that the two species are identical and therefore synonymize *haplomyzina* with *caulophaga* herewith.

The distinctive aedeagus and spermal sac of the species are illustrated in figs. 55a, b; the genitalia were also illustrated by Kleinschmidt (1960: 15).

The bright yellow head, projecting frons, ash-grey mesonotum, sparse or absent orbital setulae make this species readily distinguishable from *L. chenopodii* (Watt), in which the second cross-vein is also lacking.

The two type specimens were bred from the stalk of silver-beet, *Beta vulgaris* L. var. *cicla* L.

Distribution.—Queensland: Nudgee and near Nocundra; N.S.W.: Leeton, Wilcannia, Cobar; Indonesia: Lombok.

**Liriomyza chenopodii** (Watt), comb. nov.*Haplomyza chenopodii* Watt, 1924.*Haplomyza imitans* Malloch, 1934, syn. nov.

Location of holotype: Dominion Museum, Wellington.

Malloch's description of this species, which is reasonably complete, agrees closely with that of Watt, which appears to have been overlooked. The species has further been redescribed by Harrison (1959: 327). I have compared Australian specimens with paratypes of *chenopodii* kindly lent me by Professor Hering, Berlin, and, as they are identical both in external morphology and in the male genitalia, I synonymize *imitans* with *chenopodii* herewith.

This is a typical *Liriomyza* but has been placed in *Haplomyza* on the basis of the absence of the second cross-vein. Frick (1952) has recently redefined *Haplomyza*, including in it only species with the following combination of characters: one ors, matt-grey mesonotum, acr in two rows, second cross-vein lacking. The species under discussion has only the last of these characters and should thus be transferred to *Liriomyza*.

The essential characters of the species are: two reclinate ors, one incurved ori, head including antennae bright yellow but small area on hind margin of eye beyond vte black; mesonotum black, only moderately shining; pleura predominantly yellow, mesopleura with small black patch on lower margin; femora bright yellow; second cross-vein lacking; abdomen shining black, tergites with narrow yellow borders. Male genitalia as in fig. 55a, b.

Watt (1924) also describes the biology. The larva forms a linear leaf-mine and hosts recorded in Australia include *Beta vulgaris* L., *Spinacia oleracea* L., *Stellaris media* (L.) Vill. and wallflower.

Distribution.—New South Wales: Hornsby, Bronte, National Park, near Sydney, Granville; New Zealand.

**Liriomyza helichrysi** sp.n.

Head: frons one-and-a-half times width of eye, not projecting above eye in profile; two ors, the upper longer and directed upwards, the lower directed partially inwards; two equal ori directed largely inwards; orbital setulae sparse, minute; jowls deep, four-tenths length of eye; eye distinctly slanting; third antennal segment small, rounded, with long, upward pubescence.

Mesonotum: 3 + 1 dc, first and second long, third and fourth substantially smaller; third immediately behind suture, fourth somewhat in front; acr sparse, in two rows, from before fourth dc to level of second.

Wing (fig. 57): length in male 1.35 mm., in female 1.75 mm.; first cross-vein beyond centre of discal cell, second conspicuously oblique.

Colour: frons, jowls, antennae yellow; upper orbits slightly darkened, blackish, both vte and vtI on black ground; mesonotum black but largely matt, only slightly shining; scutellum appearing entirely black but with faint trace of yellow between hind scutellar bristles, when viewed from behind; pleura largely blackish; upper margin of sternopleura and mesopleura dirty-yellowish, humerus and notopleural area also yellowish; legs: coxae black but in fore-legs slightly yellowish; femora basically yellow but distinctly blackish above, tibiae and tarsi dark brown; abdomen black.

Male genitalia: aedeagus as figured (fig. 58a); basal half of median section only visible as a narrow, strongly chitinized line; spermal sac conspicuously small (fig. 58b).

Puparium: 1.5 mm. long, brownish-yellow, posterior spiracles each with three buds.

Leaf-mine: an irregular, upper surface channel which finally runs for a short distance on the lower surface, where pupation takes place; frass deposited in only a few large, widely separated lumps.

Holotype: ♂, emerged 7.ii.1961 from leaf-mines on *Helichrysum bracteatum* (Vent). Andr., Mount Gibraltar, near Bowral, New South Wales; two male, one female paratypes, same data (all K.A.S.); holotype and two paratypes in author's collection, one paratype presented to Australian Museum, Sydney.

This species is a typical *Liriomyza* but is unusual in having an almost entirely black scutellum. Empty leaf-mines were also found at Clyde Mountain, N.S.W., and the species is probably widespread with its host-plant.

Distribution.—New South Wales: Bowral, Clyde Mountain.

*Liriomyza obscurata* sp.n.

Head: frons one-and-a-half times width of eye, not significantly projecting above eye in profile; two equal ors directed upwards, two ori directed inwards and slightly upwards, the lower distinctly weaker; orbital setulae sparse, minute; orbits well-defined; jowls angular, deepest at rear, cheeks forming linear ring below eye; third antennal segment conspicuously round, almost bare, arista long, equal to vertical height of eye.

Mesonotum: 3 + 1 dc, first, second and third well-developed, fourth small, half length of third; acr sparse, in two rows only between first and second dc.

Wing: length in male 1.75 mm., in female up to 2.3 mm.; first cross-vein opposite termination of vein r<sub>1</sub>, beyond centre of discal cell; last segment of m<sub>4</sub> in ratio 24:9 with penultimate.

Colour: frons distinctly darkened, brownish; orbits paler, more yellowish in front but black above; both v<sub>ti</sub> and v<sub>te</sub> on black ground, hind-margin of head entirely black; jowls, face, palps orange-yellow, antennae brighter, more lemon-yellow; mesonotum black, without any yellow at hind corners, largely matt but slightly shining, notopleural area yellow, pleura otherwise almost entirely black, mesopleura narrowly yellow on upper margin; scutellum yellow in centre, black on lateral corners; legs: coxae largely black, though front pair paler, more yellowish; femora yellow, tibiae and tarsi brownish-black; abdomen black, only weakly shining; wing normal, squamae and fringe dark, blackish.

Male genitalia: aedeagus and spermal sac as illustrated (figs. 59a, b).

Holotype: ♂, New South Wales, Tubrabucca to Moonan, c. 2,000 ft., Upper Hunter, 19.x.1956 (D.K.M.), Australian Museum, Sydney; paratypes: Blue Mountains: 1 ♂ Springwood, Sassafras Gully, 17.xi.1956, 1 ♂, Mount Wilson, 30.x.1958; 1 ♀, Mount Tomah, 5.x.1957; 1 ♀, Lawson, 3.xii.1956; 1 ♂, 1 ♀, Belltrees, near Scone, N.S.W., 20.x.1956; 3 ♀, Bronte, near Sydney, 5.x.1958; 1 ♂, National Park, 3.xi.1956 (all D.K.M.); 1 ♂, 1 ♀ in author's collection, remainder in Australian Museum, Sydney.

This is a conspicuously dark species, readily distinguishable from all others known from Australia.

*Liriomyza pallidicentralis* Malloch, 1927

Location of holotype: IHTM.

The species has a largely brown third antennal segment, matt grey mesonotum, acr in two rows and a narrow yellow strip down the centre of the scutellum; the eye is small, slanting wing length 2 mm., with the first cross-vein at the centre of the discal cell and the last segment of m<sub>4</sub> slightly larger than the penultimate.

Distribution.—N.S.W.: Sydney.

*Liriomyza singularis* sp.n.

Head (fig. 60): frons unusually broad, over twice width of eye viewed from above, orbits raised, conspicuously projecting above eye in profile; two ors directed upwards and slightly outwards, the lower slightly weaker, two equal ori directed inwards, similar to lower ors, orbital setulae lacking, lunule small and low, below raised frons; jowls very broad, extended at rear, one half vertical height of eye, cheeks forming conspicuously broad band below eye, eye oval, slightly slanting; third antennal segment large, broadening distally, rounded at end, arista appearing bare.

Mesonotum: 3 + 2 dc, second, third and fourth equal, only slightly smaller than first, fifth distinctly weaker, little more than half length of fourth (on one side even smaller), acr virtually lacking, only a single isolated hair present, no hairs in inter-alar area, inner post-alar strong, similar to fifth dc.

Wing: length in female 2.7 mm., rm at centre of discal cell, this large, penultimate segment of vein m<sub>4</sub> thus only slightly shorter than ultimate, in ratio: 23:27.

Legs: mid-tibiae without differentiated postero-dorsal bristles.



Colour: frons brownish, more yellow anteriorly, jowls, cheeks and orbits yellowish-brown, *vti* on brown area, *vte* on black but hind-margin of head beyond again becoming paler, yellowish; first and second antennal segments yellow, third black above, brownish-yellow below; mesonotum matt grey, diffused with yellow, appearing yellowish-brown from front, dark-grey from behind, scutellum matt-grey, with pale yellowish band along centre; pleura entirely dark-grey; legs basically yellowish but variably marked with grey, darker above, more distinctly yellow below, abdomen entirely matt black; wing dull, greyish, veins dark, squamae and fringe pale, yellowish.

Holotype: ♀, A.C.T., Blundell's, 26.xi.1930 (L. F. Graham), School of Hygiene and Tropical Medicine, Sydney.

This is a unique, distinctive species, immediately recognizable by the head shape, absence of orbital setulae and acrostichals and unusual coloration, particularly of the mesonotum.

#### ***Liriomyza tricolor* Malloch, 1927**

Location of holotype: USNM.

The essential features appear to be: head yellow, third antennal segment brownish above, "mesonotum fuscous except between the lateral margins, the dark part densely grey dusted except between the dorso centrals from near anterior margin, the central part brown dusted" (Malloch), abdomen yellow, last section of vein *m4* twice length of penultimate, size 1.5 mm.

Malloch states that the species is distinguished from any species in Australia by the tricoloured thoracic dorsum.

Distribution.—N.S.W.: Como.

#### **Genus *Phytoliriomyza* Hendel**

*Phytoliriomyza* Hendel, 1931, in Lindner: Flieg.Palaeart. Reg. 59: 203.

Type species: *Agromyza perpusilla* Meigen, Europe.

This genus was erected by Hendel for the single Palaearctic species *perpusilla* Mg. Three additional species have subsequently been described or transferred to the genus from Hawaii, Greenland and Chile and a fourth species is shortly being described by the author from Scotland.

A distinctive new species from Australia is described below.

#### ***Phytoliriomyza australensis* sp.n.**

Head (fig. 61): frons broad, twice width of eye, not projecting above eye in profile; two ors directed upwards, the upper substantially stronger, one ori directed inwards, equal to lower ors; orbital setulae sparse, proclinate; jowls relatively deep behind, cheeks forming only narrow ring below eye; eye conspicuously slanting, variably covered with short hairs in both sexes; third antennal segment rounded, with distinct upcurved pubescence, arista conspicuously long, longer than maximum vertical height of eye.

Mesonotum: 3 + 1 dc, third at suture, fourth slightly in front of pre-suturals; *acr* entirely absent or present in two short rows.

Wing: length in male 1.4-1.5 mm., in female 1.5 mm.; costa extending strongly to vein *m1* + 2, vein *rm* slightly basad of centre of discal cell, last segment of *m4* relatively short, less than one-and-a-half times length of penultimate.

Colour: highly variable; frons yellowish brown, first and second antennal segments bright yellow, third basically yellow with varying degree of darkening above; mesonotum matt grey, pleura predominantly yellow, mesopleura with small slightly darker patch along lower margin, pteropleura with darker triangle varying from pale brown to black; abdomen varying from greyish-black to entirely yellow including epandrium; legs usually entirely yellow, tibiae and tarsi sometimes more distinctly brown; halteres yellow but knob sometimes darkened, brownish.

Male genitalia (fig. 62): aedeagus as illustrated, apex not reaching end of ninth sternite.

Holotype: ♂, National Park, N.S.W., 14.x.1956. 10 paratypes, 3 ♂, Blue Mountains, Jenolan, Camping Ground, c. 4,000 ft., 10.xii.1956; 3 ♂, Blue Mountains, Lawson 3.xii.1956, 1 ♂, Bronte near Sydney, 28 xi. 1955, 1 ♂, Qld., Atherton Tableland, head of Clohesy River, 20.v.1956, 2 ♀, Blue Mountains, Springwood, Sassafras Gully, 17.xi.1956, 1 ♀, N.S.W., Pacific Highway, 1 mile south of Hawkesbury River, 29.ix.1956 (all D.K.M.). Holotype and 7 paratypes in Australian Museum, Sydney, 2 ♂, 1 ♀ paratypes in author's collection.

This small species resembles in size *P. montana* Frick, 1953, from Hawaii, in which wing length varies from 1.25-1.6 mm. *P. montana* is a conspicuously dark species, in which the third antennal segment and the greater part of the mesopleura are constantly black; in this species the distal tubules of the aedeagus extend far beyond the end of the ninth sternite, immediately distinguishing the species from *australensis*.

The new species has been compared with a number of specimens of *P. perpusilla* (Mg.) and apart from the smaller size can be distinguished by the consistently dark scutellum, the longer arista and the larger discal cell; in *australensis* the ratio of the last to the penultimate segment of vein m4 is 1-1.3: 1, whereas in *perpusilla* the last segment is at least twice as long as the penultimate. In the three paratypes of *montana* I have examined, this ratio is 1.5-2: 1 and the three species can be virtually separated on this character alone.

The following key permits identification of the three confirmed species considered above:—

1. Wing length 1.4-1.6 mm.; last segment of vein m4 normally less than twice length of penultimate ..... 2
- Wing length 1.75-2.3 mm.; last segment of vein m4 at least twice as long as penultimate; aedeagus long, twice length of ninth sternite ..... *perpusilla* (Mg.).
2. Third antennal segment and mesopleura largely yellow; last segment of m4 at most one-and-one-third times length of penultimate; aedeagus short, apex not reaching end of ninth sternite (fig. 62) ..... *australensis* Spencer
- Third antennal segment and mesopleura largely black; last segment of m4 one-and-a-half to twice length of penultimate; aedeagus long, twice length of ninth sternite ..... *montana* Frick

The exact position of *imperfecta* (Malloch), 1934 from Chile and *arctica* (Lundbeck) (cf. Frick, 1952) from Greenland and North America remains to be clarified.

#### Genus *Pseudonapomyza* Hendel

*Pseudonapomyza* Hendel, 1920, Arch. Naturgesch. Abt.A., 84: 15.

Type species: *Phytomyza atra* Meigen, Europe.

This small genus of 10 species was erected for the single Palaearctic species, *atra* Mg. having a conspicuous angle to the third antennal segment and characteristic wing venation, with a short costal segment between veins r1 and r2. *P. spicata* (Malloch) which is widespread throughout the Pacific area agrees exactly with Hendel's original concept and the larva also has distinctive papilli as in *atra*. Additional species without the characteristic angle to the third antennal segment and also without the distinctive venation of *atra-spicata* have since been placed in this genus on the basis of genitalial and larval affinities (Spencer, 1961, and 1961b). The genitalia of these species were illustrated by Spencer (1961: figs. 46-48).

#### *Pseudonapomyza spicata* (Malloch)

*Phytomyza spicata* Malloch, 1914.

*Pseudonapomyza spicata* (Malloch), Hennig, 1941.

Location of neotype: HNM.

This is a very small black species, with wing length of 1.65 mm. It can be recognized by the sharp angle at the upper corner of the third antennal segment, shining black mesonotum and white squamae and fringe. The species has recently been discussed in detail by Spencer (1961: 93 and in press).

The larvae form leaf-mines on numerous Gramineae, including sugar and corn (*Zea*), where severe damage can be caused to the growth of young plants; the larva pupates on the ground. I have found mines and larvae on *Eleusine indica* (L.) Gaertn., on 4.ii.61 at Sydney and on *Brachiaria miliformis* (Presl.) Chase on 22.i.1961, at Darwin.

Distribution.—New South Wales: Sydney; N.T.: Darwin; Fiji, Samoa, Hawaii, Micronesia, Formosa. New to Australia.

Genus *Phytomyza* Fallén

*Phytomyza* Fallén, 1810, Nov. Dipt. Dispon. Method., p. 21, No. 67.

Type species: *Phytomyza flaveola*, Fallén, Europe.

Only four species of this large genus have so far been recorded in Australia, and two are common European species which have almost certainly been introduced in recent times.

Key to Australian *Phytomyza* species

1. Scutellum at least partially yellow ..... *vitalbae* Kalt.  
Scutellum uniformly black or grey ..... 2
2. Femora entirely bright yellow ..... *clematidicolla* sp.n.  
Femora at most yellow at knees ..... 3
3. Third antennal segment small, round; acrostichals normally lacking .... *atricornis* Mg.  
Third antennal segment larger, elongated; some acrostichals normally present  
..... *plantaginis* R.-D.

*Phytomyza atricornis* Meigen

Location of holotype: believed lost.

This is the most widespread and polyphagous species of the Agromyzidae. It is readily recognizable by the yellow frons, round, black, third antennal segment and matt ash-grey mesonotum, normally entirely without acrostichals.

The larva forms an upper or lower surface, narrow, linear mine, pupating in the mine. Host plants on which I have noted the species in Australia are:—

*Bidens pilosa* L.

*Senecio dryadeus* Sieb. ex Spreng.

*Chrysanthemum maximum* Ramond

*S. lautus* Forst.f. ex. Willd.

*Cirsium vulgare* (Savi) Ten.

*S. linearifolius* A. Rich.

*Coreopsis* sp.

*S. minimus* Poir.

*Helichrysum rutidolepis* DC

*S. pterophorus* DC.

*Sonchus oleraceus* L.

Distribution: New South Wales; Canberra; Victoria; Tasmania; South Australia; Queensland.

*Phytomyza clematidicolla* sp.n.

Head (fig. 63): frons almost twice width of eye viewed from above, slightly projecting above eye in profile at base of antennae; two equal ors directed upwards, one similar ori directed inwards; orbital setulae short, sparse, none above lower ors; jowls deeply extended at rear, little less than half vertical height of eye, cheeks forming broad ring below eye; third antennal segment large, conspicuously longer than broad; arista long, somewhat longer than maximum height of eye.

Mesonotum: 3 + 1 dc, second, third and fourth equal, acr in two rows, present only between third and fourth dc.

Wing: length in male 2.2-2.3 mm., ratio between second, third and fourth costal segments 33: 7: 15 in holotype, 38: 9: 18 in paratype.

Colour: frons, jowls, face and palps bright orange-yellow, third antennal segment black, first and second yellow, mesonotum and scutellum uniformly dark matt-grey; pleura predominantly blackish-grey, mesopleura narrowly yellow on upper and hind margin; legs: coxae and femora bright yellow, tibiae and tarsi dark-brownish; abdomen black, fore-segments slightly yellow laterally and all segments may have narrow yellow hind margins, wing normal, veins dark, squamae grey, fringe black.

Male genitalia (fig. 64): aedeagus as illustrated.

Puparium (fig. 65): orange-brown, segment boundaries indistinct, anterior spiracular processes relatively long, black, projecting through leaf epidermis, hind spiracles shorter, strongly chitinized at apex, each bearing nine buds.

Leaf-mine (fig. 66): a narrow, winding, upper-surface channel with frass deposited in conspicuous strips at alternate sides of the mine (fig. 67a); pupation takes place in the mine.

Holotype: ♂, A.C.T., Bull's Head, emerged 22.ii.1961, from leaf-mines found, 5.ii.1959, on *Clematis aristata* R. Br. ex DC (A. L. Dyce); one ♂ paratype N.S.W., Blue Mountains, Springwood, Sassafras Gully, 17.xi.1956 (D.K.M.). Holotype in author's collection, paratype in Australian Museum, Sydney.

Leaf-mines of this species were also found by the author on the same host at Mount Gibraltar, Bowral, N.S.W., on 30.i.61 and at Ferntree Gully, Victoria, on 9.ii.1961, but no adults were reared.

Leaf-mines of this species occur commonly, often on the same leaf, together with those of *P. vitalbae* Kalt. In the latter species, however, the larva pupates on the ground and the frass arrangement is quite different (fig. 67b).

The adult of *clematidicolla* is readily distinguishable from *vitalbae* by the entirely yellow femora, uniformly dark scutellum and presence of two ors; it can be distinguished from *clematidi* Watt, 1924, from New Zealand, which also pupates in the mine by the difference in the third antennal segment which is yellow and rounded in the latter species. The aedeagus is shown in fig. 68.

This brings to 16 the species of this genus known to feed on *Clematis* spp.

#### *Phytomyza plantaginis* R.-D.

Location of holotype: Musée d'Histoire Naturelle, Paris.

This species somewhat resembles *atricornis* Mg., but can be distinguished by the more prominent orbits, larger, somewhat elongated third antennal segment and presence of a few scattered acrostichais.

The larva forms a whitish linear mine on *Plantago* spp., pupating in the mine.

In a short, bred series from Tasmania (C.S.I.R.O., Canberra) the orbits and jowls are distinctly grey and the frons brownish; this appears to represent a dark, local Tasmanian form.

Distribution.—New South Wales: Broadwater, Bargo, Bowral; Canberra; Tasmania: Launceston. New to Australia.

#### *Phytomyza vitalbae* Kaltenbach

Location of holotype: auctioned in London in 1880, now believed lost.

This species has been described in detail by Hendel (1936). It is one of the small group with a partially yellowish scutellum and has a yellow frons and rounded black third antennal segment. It is immediately recognizable among Australian species by having only a single ors and a single ori. The distinctive aedeagus is illustrated in fig. 69, and suggests that the species is not closely related to the other Australian *Clematis* feeder, *P. clematidicolla* Spencer.

The larva forms an upper-surface, irregularly winding, linear leaf-mine on *Clematis* spp., and known Australian hosts are *C. aristata* R. Br. ex DC and *montana* Buch.-Ham. ex D.C.

The leaf-mines may occur together with those of *P. clematidicolla*, but can be immediately recognized by the characteristic arrangement of frass which is deposited for long stretches at alternate sides of the channel (fig. 67b); pupation takes place on the ground.

Distribution.—N.S.W.: Clyde Mountain, Bowral; A.C.T., Canberra; Europe. New to Australia.

#### Additional Unidentified Species

##### 1. Leaf-mines on *Billardiera scandens* Sm.

Mines with young larvae were found at National Park, near Sydney, on 29.i.1961, and empty mines on 3.ii.1961, at Careel Bay, near Sydney. Mines with larvae have recently been reported at Hornsby, near Sydney (A. Dyce).

The mine (fig. 70) is irregularly linear, entirely upper-surface, with the black frass scattered along the centre of the channel. The larva leaves the mine to pupate and forms a brownish puparium.

The species concerned is almost certainly a *Liriomyza* sp.

2. Leaf miner on *Cassinia aculeata* R.Br.

Empty mines found at Otford, N.S.W., on 29.i.1961. The mine fills the upper half of the narrow leaves and normally measures  $\frac{1}{2}$  in. x  $\frac{1}{8}$  in.

3. Leaf mine on *Cassinia aureonitens* N.A. Wakefield and *Helichrysum dendroideum* N.A. Wakefield. Empty mines found on *Cassinia* on 29.i.1961, at National Park, near Sydney (K.A.S.).

The mine (fig. 71) starts as a narrow, linear, upper-surface channel with frass in distinct strips at alternate sides of the mine; in the second instar the mine greatly widens and the frass is deposited in larger black lumps.

Similar mines were found on *Helichrysum* on 9.ii.1961, at Ferntree Gully, near Melbourne.

4. Stem borer on *Cassinia aureonitens*.

An empty puparium found in the stem, data as 3 above, belongs to an undescribed *Melanagromyza* sp. The puparium is pale whitish, with indistinct segmentation but distinctive posterior spiracular processes (fig. 72); each process has 4 or 5 rather large buds with a small black horn above and the two processes are separated by their own diameter.

5. Leaf-miner on *Desmodium polycarpum* DC.

Mines found on Mt. Coot-tha, Brisbane, 22.i.1961. Oviposition takes place beside the mid-rib, where a narrow linear channel is formed; the mine subsequently greatly widens, becoming a conspicuous linear-blotch, centrally filled with diffused blue frass (fig. 73). The black puparium remains at the end of the mine with the anterior spiracles projecting through the epidermis. This is the only mine known to me in which the frass is so distinctively blue. The species is almost certainly a *Melanagromyza* sp.

6. Leaf-miner on *Goodenia ovata* L.

A single blotch-mine (fig. 74) found on 9.ii.1961, at Ferntree Gully, near Melbourne, together with a number of the characteristic linear mines of *Ophiomyia goodeniae* Spencer, represents a distinct species.

The yellowish blotch is on the lower surface, with frass in fine, black, scattered grains. The puparium is brown with the posterior spiracles in the form of two short projections surmounted by numerous minute buds.

7. Leaf-miner on *Oplismenus compositus* (L.) Beauv.

Mines with larvae feeding were found on 5.ii.1959, at Cabbage Tree Creek, Clyde Mountain, N.S.W.

The mine (fig. 75) is upper-surface, initially linear, but gradually filling the entire leaf, and is filled with diffused, greenish frass. Two or more larvae may feed together. The reddish-brown puparium is illustrated in fig. 76. The species is probably an *Agromyza* sp.

8. Stem borer in *Senecio pterophorus* DC.

Empty puparia found in stems, Mt. Lofty, Adelaide, 13.ii.1961. The puparium is pale whitish, with distinctive posterior spiracular processes. The two processes are separated by their own diameter and each bears a long, tapering horn ringed by 10 well-defined buds (fig. 77). The buds are far paler and less strongly chitinized than in the closely related species *M. seneciophila* Spencer (p. 319).

This appears to represent a further undescribed *Melanagromyza* sp.

9. Leaf-miner in *Senecio* sp.

Leaf-mines found at East Slope, Clyde Mountain, N.S.W., 5.ii.1961 (fig. 78).

One puparium was found in the mine but other mines were empty. It is relatively short and broad with distinct segmentation, shining reddish-brown.

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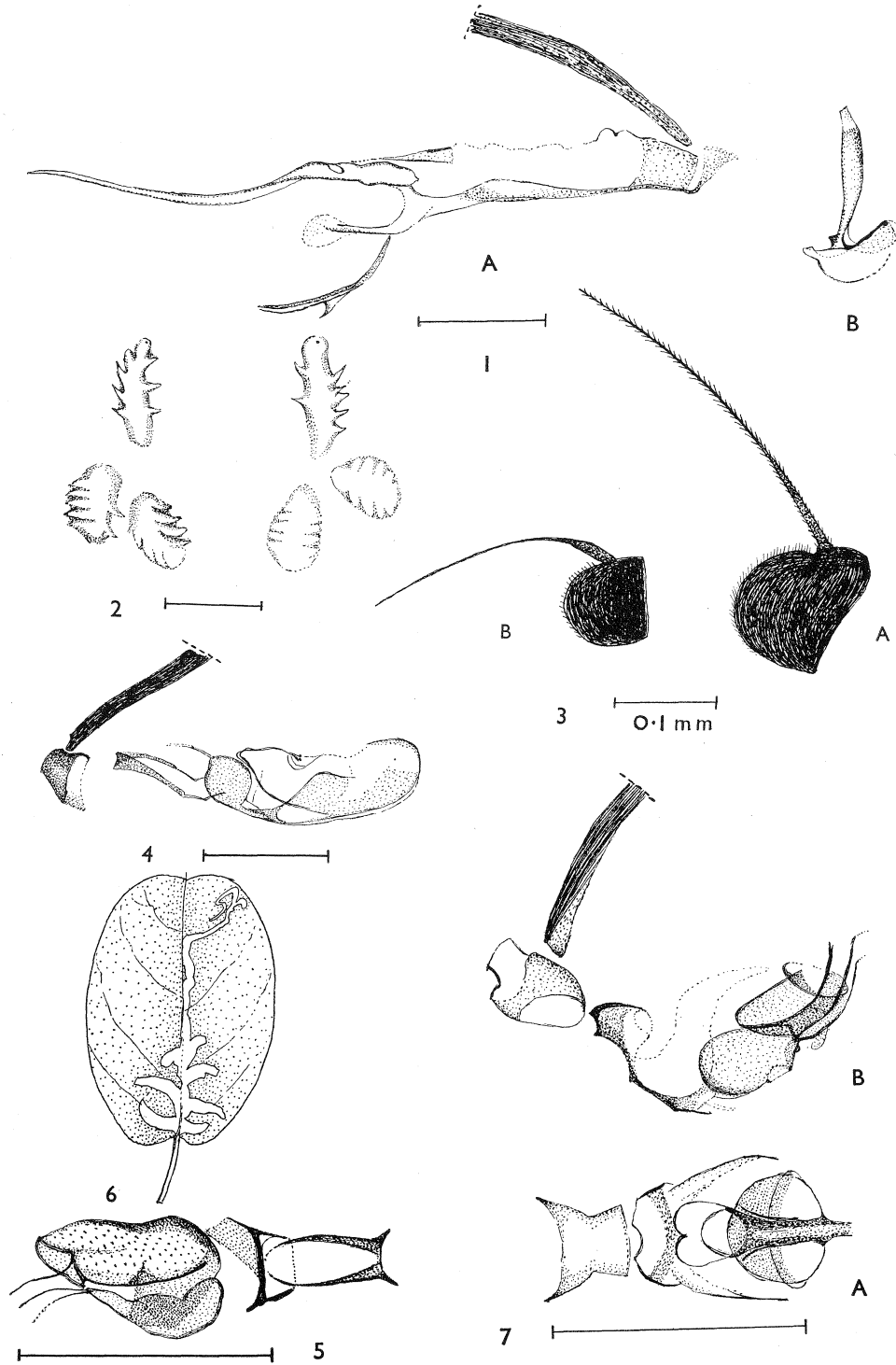
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## EXPLANATION OF FIGURES

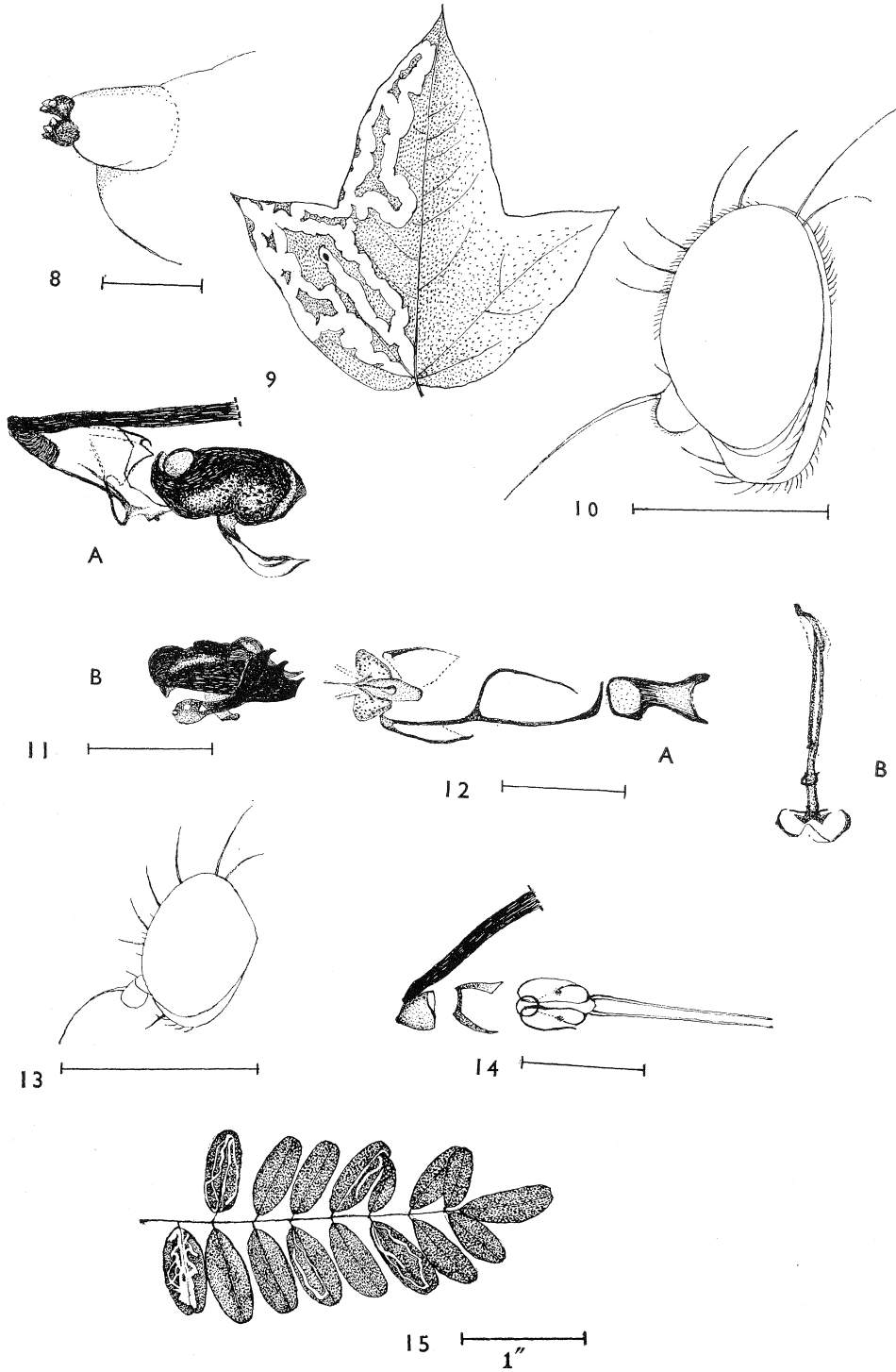
1. *Japanagromyza eucalypti* sp.n. a, aedeagus, side view; b, spermal sac.
2. *J. eucalypti*. Posterior spiracles of puparium.
- 3A. *Melanagromyza albisquama* (Mall.). Third antennal segment.
- 3B. *M. verdescens* sp.n. Third antennal segment.
4. *M. alternata* Spencer. Aedeagus, side view.
5. *M. alysicarpi* Bezzi. Aedeagus, side view.
6. *M. alysicarpi*. Leaf-mine on *Alysicarpus vaginalis*.
7. *M. atomella* (Mall.), bred from *Hydrangea*, N.S.W. Aedeagus: a, from below; b, side view.
8. *M. atomella*. Posterior spiracles of puparium.
9. *M. atomella*. Leaf-mine on *Passiflora suberosa*, Brisbane.
10. *M. bowralensis* sp.n. Head, side view.
11. *M. cassiae* sp.n. Aedeagus: a, side view; b, from below.
12. *M. centrosematis* de Meij. a, Aedeagus from below; b, spermal sac.
13. *M. dianellae* Kleinschmidt. Head, side view.
14. *M. dianellae*. Aedeagus.
15. *M. indigoferae* Kleinschmidt. Leaf-mine on *Indigofera* sp., Clyde Mt., N.S.W.
16. *M. murrayae* sp.n. Wing.
17. *M. paramonovi* sp.n. Wing.
18. *M. paramonovi*. a, Aedeagus, side view; b, spermal sac; c, ninth sternite.
19. *M. phaseoli* (Tryon). Aedeagus of specimen bred from *Phaseolus lathyroides*, Brisbane.
20. *M. placida* sp.n. Wing.
21. *M. placida*. Aedeagus, from below.
22. *M. seneciophila* sp.n. Wing.
23. *M. seneciophila*. Scar bands on puparium.
24. *M. seneciophila*. Aedeagus and ninth sternite.
25. *M. specifica* sp.n. a, Aedeagus, side view; b, ninth sternite.
26. *M. verdescens* sp.n. a, Aedeagus, side view; b, spermal sac.
27. *M. wikstroemiae* Kleinschmidt. Aedeagus and ninth sternite.
28. *M. wikstroemiae*. Leaf-mine on *Pimelea ligustrina*, Otford, N.S.W.
29. *Ophiomyia angustilunula* sp.n. Head of male, side view.
30. *O. angustilunula*. Wing.
31. *O. angustilunula*. a, Aedeagus, side view; b, spermal sac.
32. *O. goodeniae* sp.n. Head of female, side view.
33. *O. goodeniae*. Leaf-mine on *Goodenia ovata*, Waterfall, N.S.W.
34. *O. lantanae* (Froggatt). a, Aedeagus, side view; b, spermal sac.
35. *O. micra* sp.n. Wing.
36. *O. micra*. a, Aedeagus, side view; b, spermal sac.
37. *O. solanicola* sp.n. Head of male, side view.



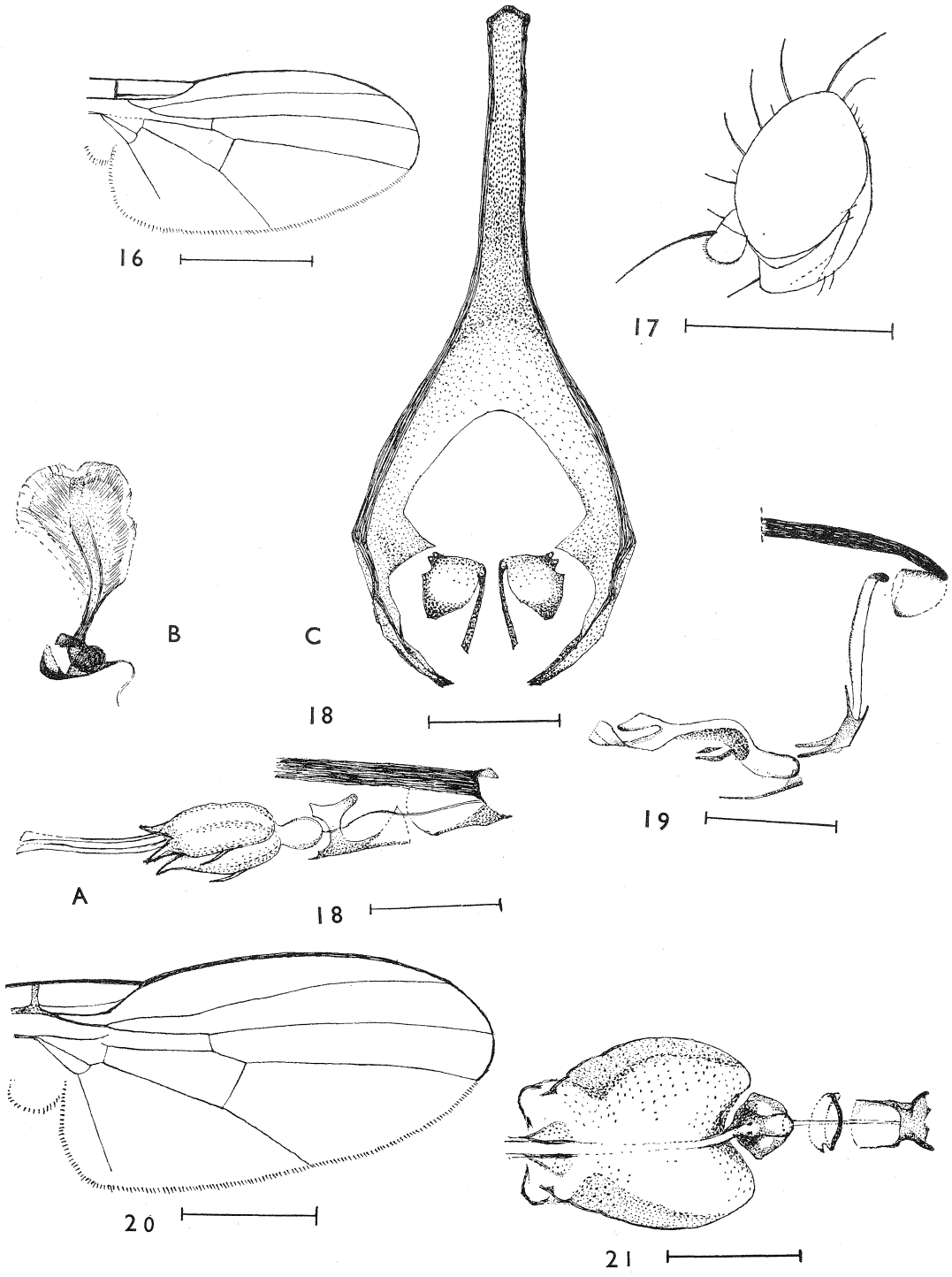
38. *O. solanicola*. Wing.
39. *O. solanicola*. a, Aedeagus, side view; b, spermal sac.
40. *O. solanicola*. Leaf-mine on *Solanum prinophyllum*, Clyde Mt., N.S.W.
- 41A. *Cerodontha australis* Mall. Third antennal segment.
- 41B. *C. robusta* Mall. Third antennal segment.
42. *C. australis*. a, Aedeagus, side view; b, spermal sac.
43. *Phytobia (Amauromyza) caliginosa* sp.n. Wing.
44. *P. (Calycomyxa) humeralis* (v.Ros.). Aedeagus, side view.
45. *P. (Dizygomyza) poemyzina* sp.n. a, Lunule; b, lunule, *Dizygomyza* sp.; c, lunule, *Poemyza* sp.
46. *P. (Diz.) poemyzina*. Wing.
47. *P. (Diz.) poemyzina*. Aedeagus, side view.
48. *P. (Icteromyza) triplicata* sp.n. Aedeagus, side view.
49. *P. (Ict.) longipennis* (Loew). Aedeagus, side view.
50. *P. (Praspedomyza) incerta* sp.n. Aedeagus, side view.
51. *P. (Prasp.) pittosporocaulis* Hering. Aedeagus.
52. *P. (Prasp.) pittosporophylli* Hering. Aedeagus.
53. *Liriomyza australina* sp.n. Mesonotum.
54. *L. brassicae* (Riley). Leaf-mine on *Tropaeolum*, Brisbane.
55. *L. caulophaga* (Kleinschmidt). Aedeagus, side view; b, spermal sac.
56. *L. chenopodii* (Watt). a, Aedeagus, side view; b, spermal sac.
57. *L. helichrysi* sp.n. Wing.
58. *L. helichrysi*. a, Aedeagus, side view; b, spermal sac.
59. *L. obscurata* sp.n. a, Aedeagus, side view; b, spermal sac.
60. *L. singularis* sp.n. Head, side view.
61. *Phytoliriomyza australensis* sp.n. Head.
62. *P. australensis*. Aedeagus.
63. *Phytomyza clematidicolla* sp.n. Head.
64. *P. clematidicolla*. Aedeagus.
65. *P. clematidicolla*. Puparium.
66. *P. clematidicolla*. Leaf-mine on *Clematis aristata*, Clyde Mt., N.S.W.
- 67A. *P. clematidicolla*. Frass line in leaf-mine.
- 67B. *P. vitalbae* Kalt. Frass line in leaf-mine.
68. *P. clematadi* Watt. Aedeagus, side view.
69. *P. vitalbae*. Aedeagus, side view.
70. ? *Liriomyza* sp. Leaf-mine on *Billardiera scandens*, Waterfall, N.S.W.
71. Agromyzid sp. Leaf-mine on *Cassinia aureonitens*, National Park, N.S.W.
72. *Melanagromyza* sp. Posterior spiracles of puparium ex stem of *Cassinia aureonitens*, National Park, N.S.W.
73. ? *Melanagromyza* sp. Leaf-mine on *Desmodium polycarpum*, Mt. Coot-tha, Brisbane.
74. Agromyzid sp. Leaf-mine on *Goodenia ovata*, Ferntree Gully, Vic.
75. ? *Agromyza* sp. Leaf-mine on *Oplismenus compositus*, Clyde Mt., N.S.W.
76. ? *Agromyza* sp. Puparium ex leaf-mine as above.
77. *Melanagromyza* sp. Posterior spiracles of puparium ex stem of *Senecio pterophorus*, Mt. Lofty, Adelaide.
78. Agromyzid sp. Leaf-mine on *Senecio* sp., Clyde Mt., N.S.W.



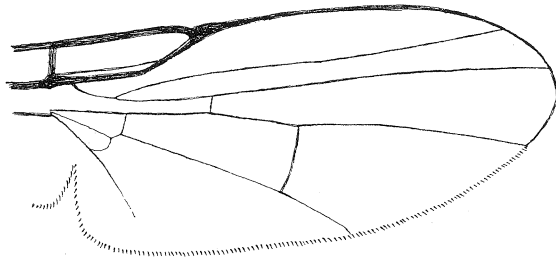
Figs. 1-7.



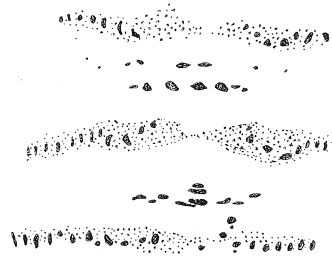
Figs. 8-15



Figs. 16-21

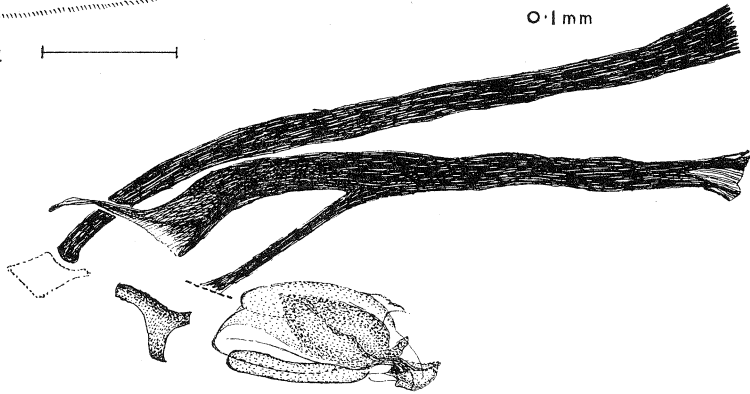


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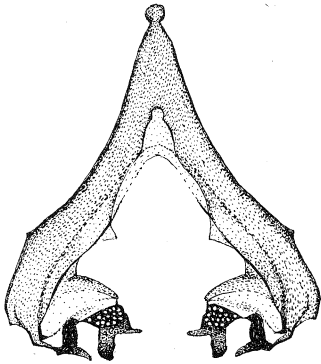


23

0.1 mm

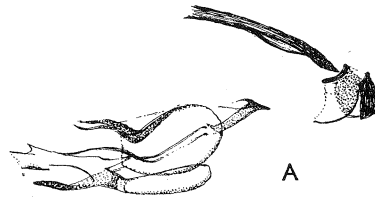


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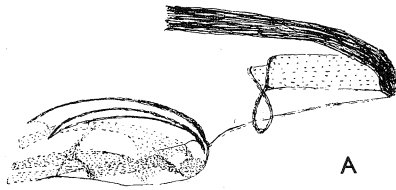


B

25

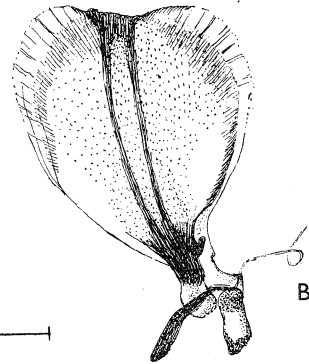


A



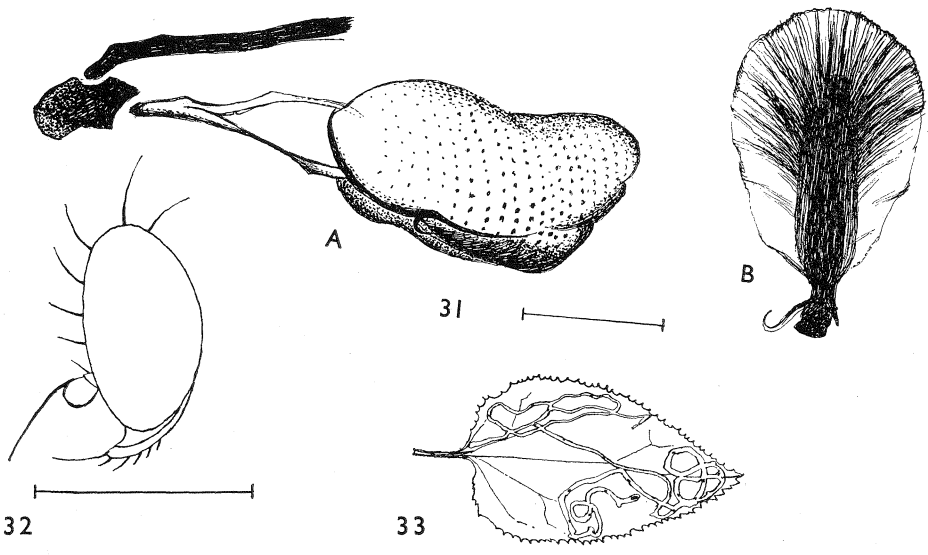
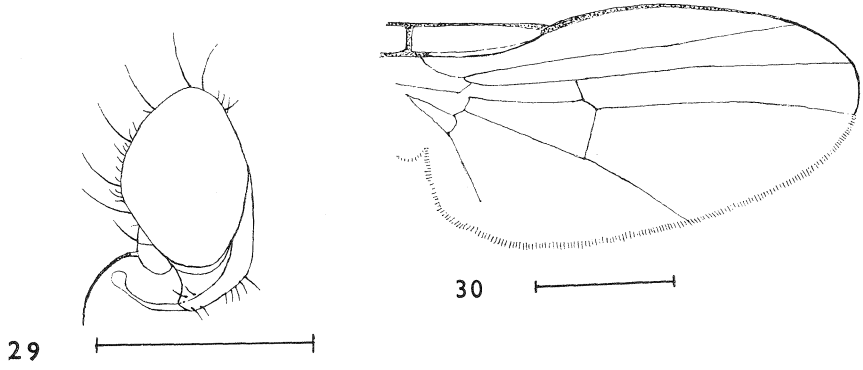
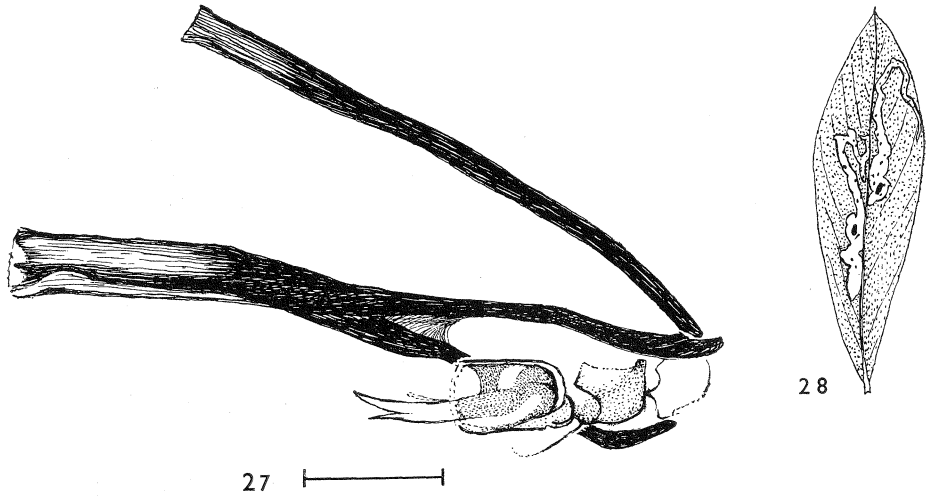
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26

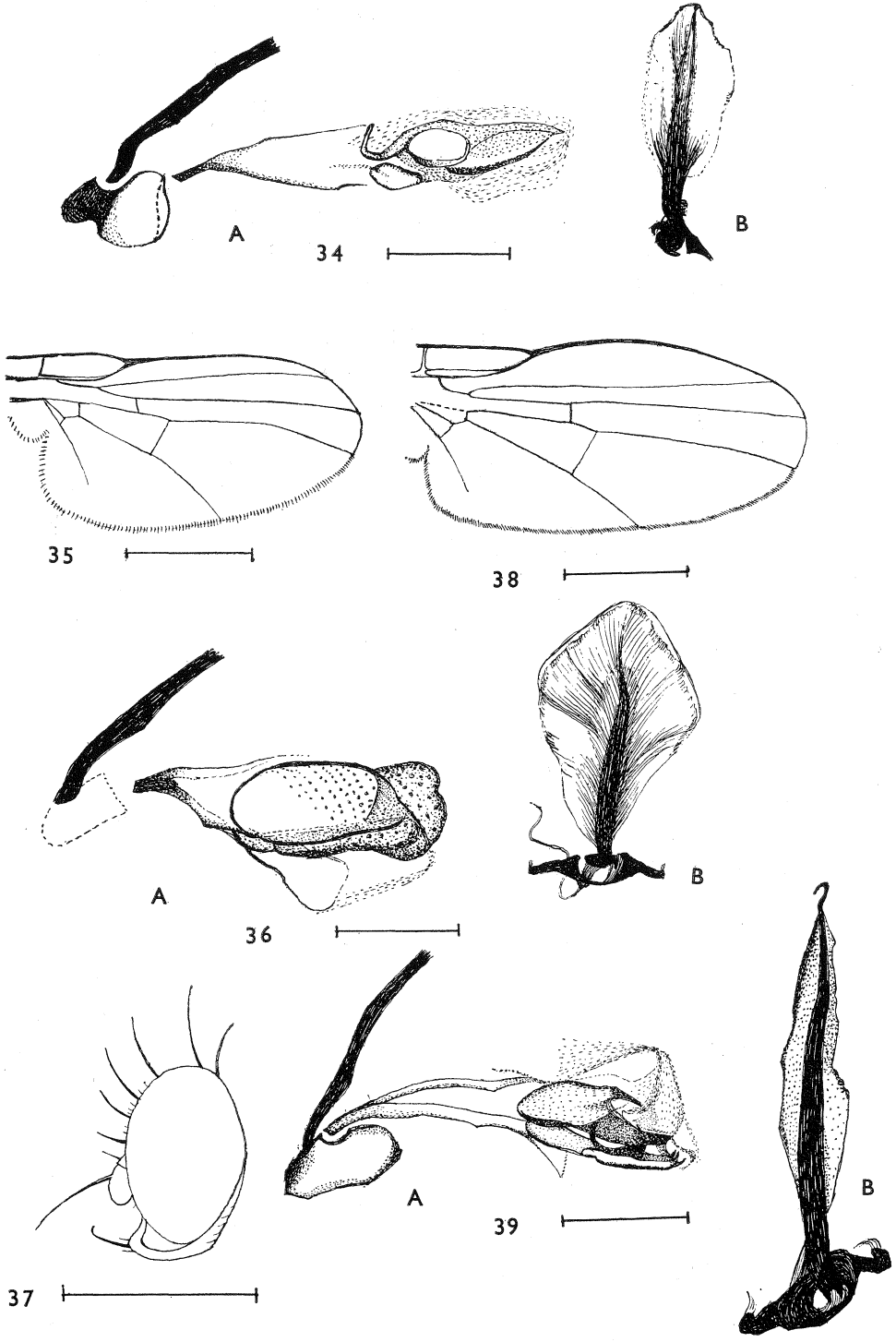


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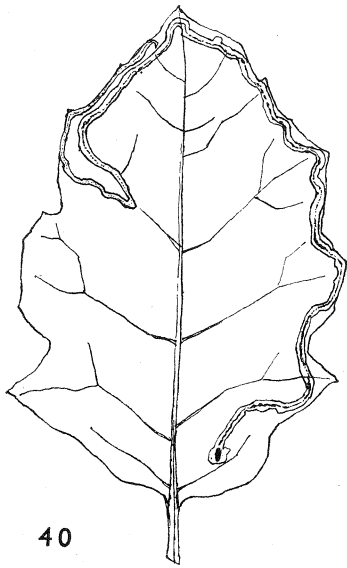
Figs. 22-26



Figs. 27-33



Figs. 34-39



40



A

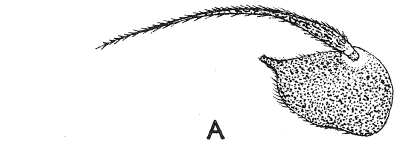


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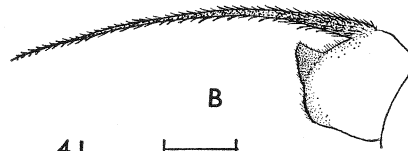


C

45



A

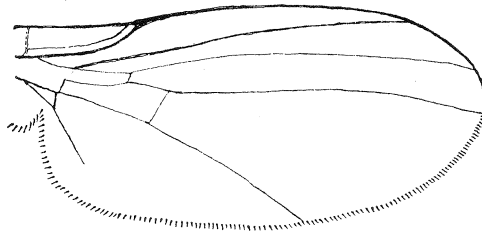


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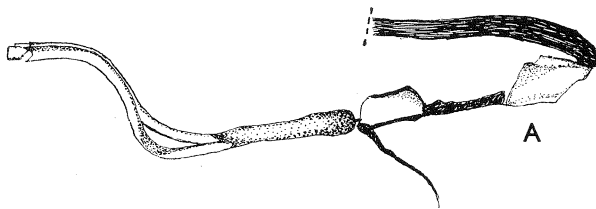
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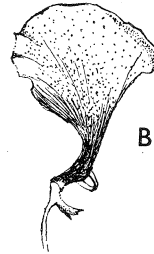
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43

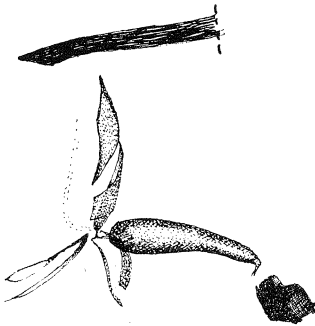
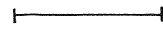


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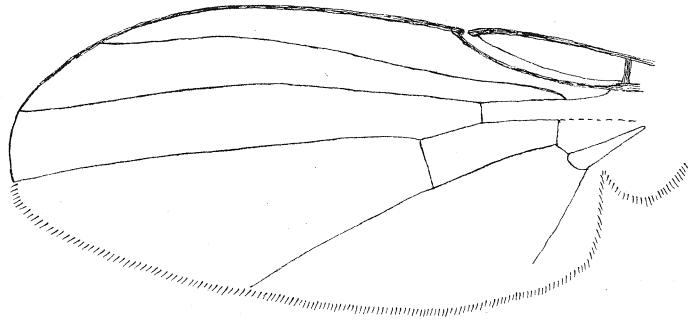
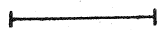


B

42



44



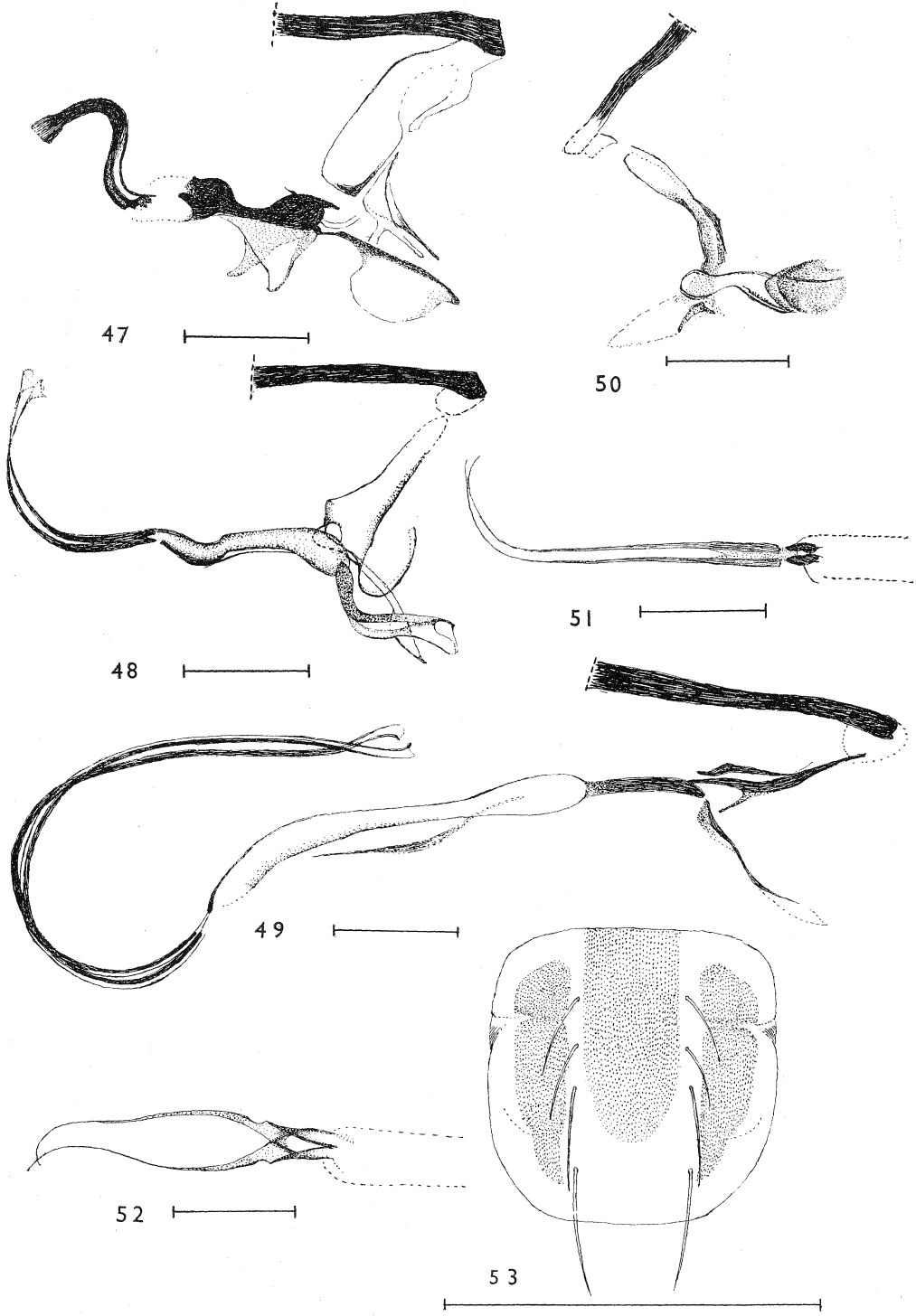
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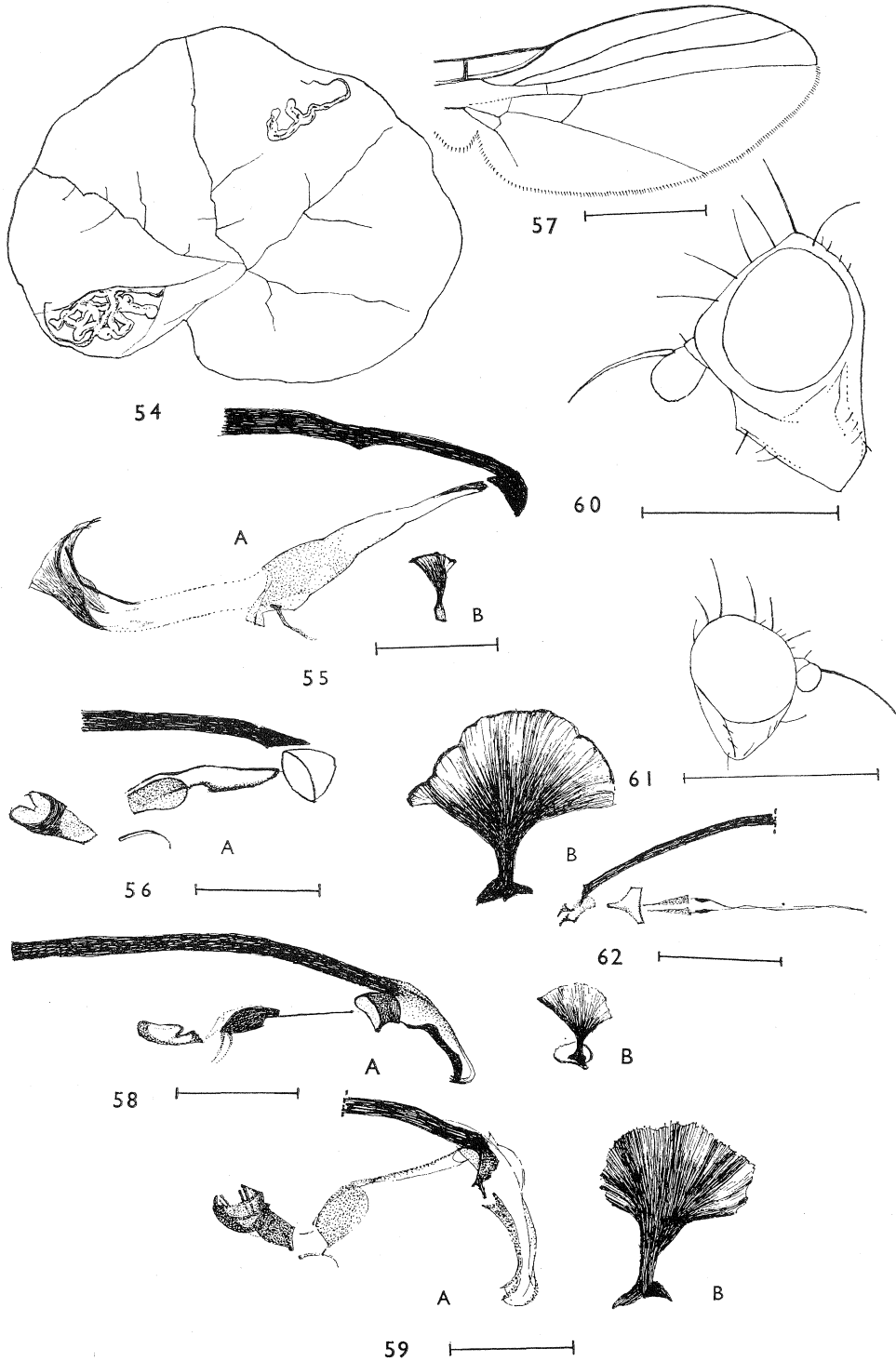
Figs. 40-46



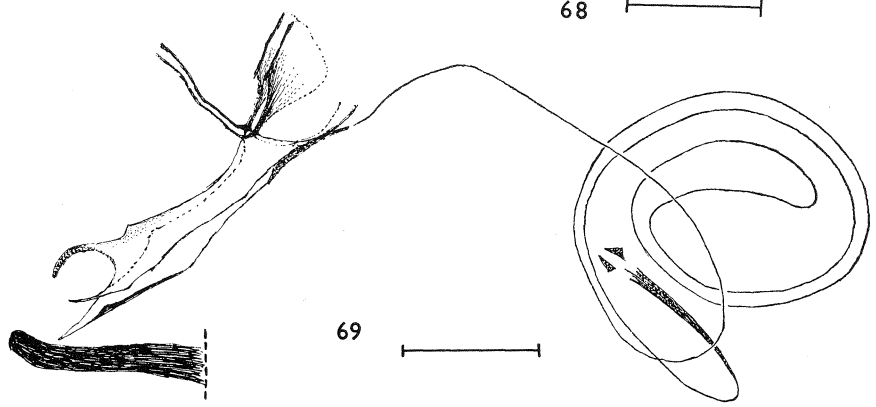
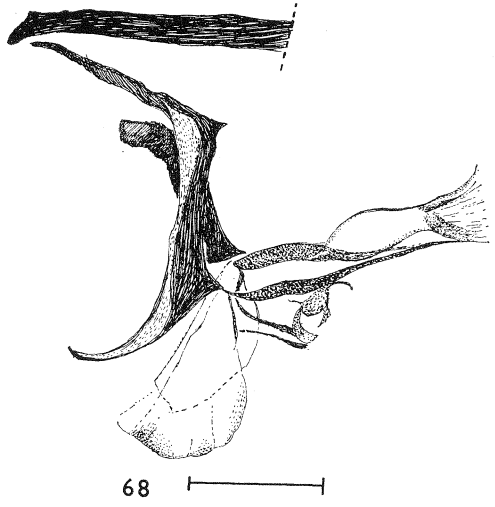
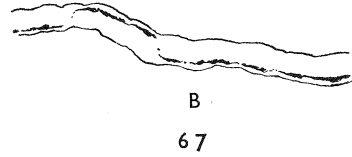
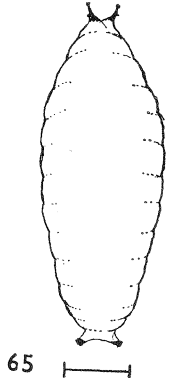
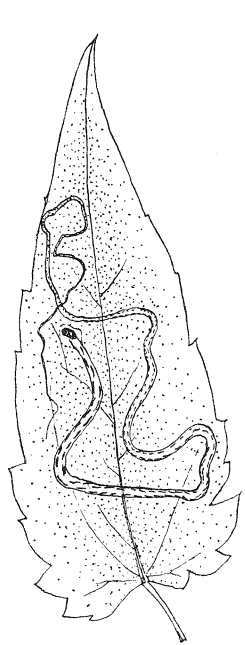
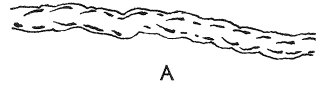
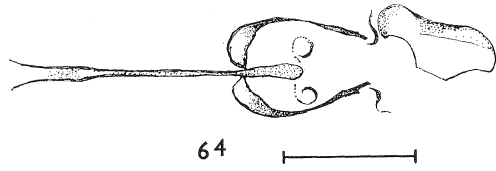
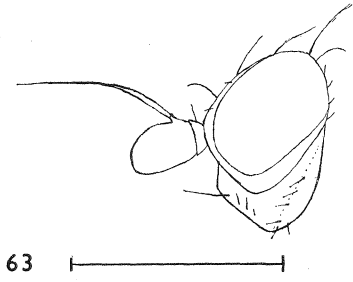
351



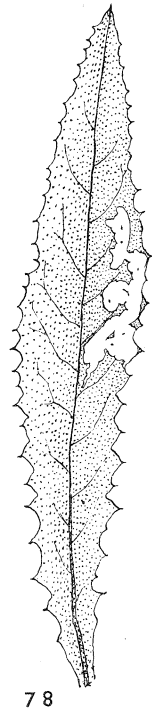
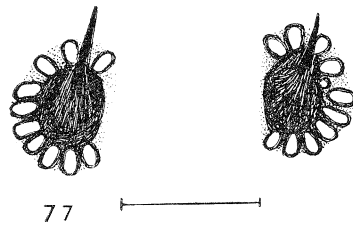
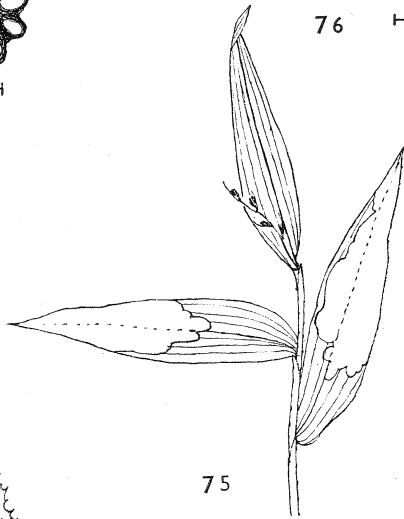
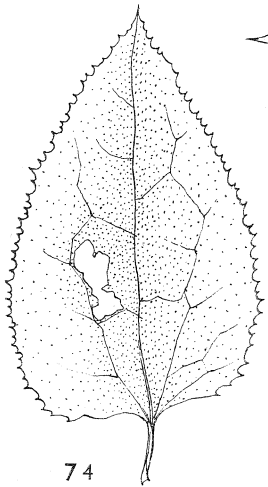
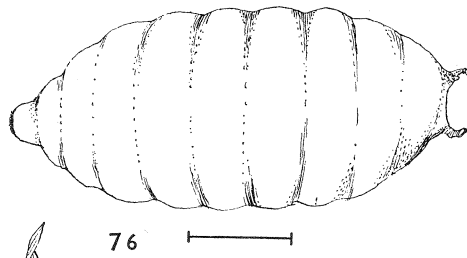
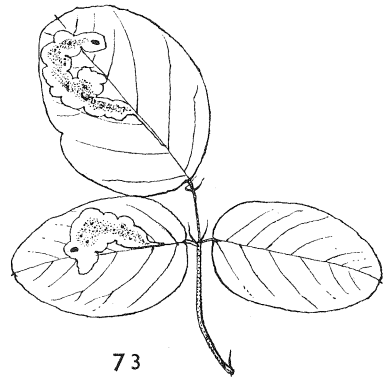
Figs. 47-53



Figs. 54-62



Figs. 63-69



Figs. 70-78

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