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STUDIES ON BOREAL AGROMYZIDAE (DIPTERA). III.  
PHYTOMYZA MINERS ON CNIDIUM AND CONIOSELINUM (UMBELLIFERAE)

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Quaestiones entomologicae

9 : 3-11 1973

*Phytomyza sitchensis* n. sp. (type-locality Sitka, Alaska) and *P. conioselini* n. sp. (type-locality Chilkat Peninsula, Alaska) are recorded as miners of *Conioselinum chinense* (L.); and *P. cnidii* n. sp. (type-locality Atkinson Point, Northwest Territories) as miner of *Cnidium cnidiifolium* (Turcz.). No agromyzid miners of these plant genera were previously described.

*Phytomyza sitchensis* n. sp. (localité-type Sitka, Alaska) et *P. conioselini* n. sp. (localité-type Péninsule de Chilkat, Alaska) sont rapportées comme mineuses du *Conioselinum chinense* (L.); et *P. cnidii* n. sp. (localité-type Atkinson Point, Territoires du nord-ouest) comme mineuse du *Cnidium cnidiifolium* (Turcz.). Aucune Agromyzide mineuse de ces genres de plantes n'a été décrite auparavant.

*Phytomyza sitchensis* n. sp. (Fundort vom Typus Sitka, Alaska) und *P. conioselini* n. sp. (Fundort vom Typus Chilkathalbinsel, Alaska) werden als Minierer von *Conioselinum chinense* (L.) besprochen; *P. cnidii* n. sp. (Fundort vom Typus Atkinson Point, Northwest Territories) als Minierer von *Cnidium cnidiifolium* (Turcz.). Agromyziden-Minierer dieser Pflanzengattungen sind bisher nicht beschrieben worden.

In the present paper three new species of *Phytomyza* are described from Alaska and northwest Canada. All belong to the *Phytomyza albiceps* group, in the sense explained in my previous paper (Griffiths, 1972b). These are the first agromyzid species described as miners of *Cnidium* and *Conioselinum*, although there are previous records for Europe of miners which were not bred (see below). Both host-plants of the agromyzid species here described, *Conioselinum chinense* (L.) and *Cnidium cnidiifolium* (Turcz.), occur in northeast Asia, as well as in North America (Hultén, 1968). The former is mainly a coastal plant, ranging on the Pacific coast of North America from the Bering Straits to Washington State; elsewhere it occurs on the eastern seaboard of North America, and in Asia on Hokkaido, Sakhalin, the Kuril Islands and Kamchatka. *Cnidium cnidiifolium* is an arctic plant, not reaching below the 60th parallel in North America; it has an extensive distribution in eastern Siberia, as well as in Alaska, Yukon and along the arctic coast of the Northwest Territories.

The terminology and abbreviations used in my descriptions were explained in the first paper of this series (Griffiths, 1972a). My use of the above plant names follows Hultén (1968). The holotypes of the new species will be deposited in the Canadian National Collection (Ottawa).

#### PREVIOUS RECORDS

An unknown *Phytomyza* species produces linear mines on *Cnidium dubium* (Schkuhr) (= *venosum* Koch) in Poland and Germany. Recorded localities are Crossen-an-Oder (Krosno), Poland (Hering, 1936), Blumerode, Silesia, Poland (viii-ix.1934; Buhr, 1941) and Boizenberg-an-Elbe, Mecklenburg, Germany (Buhr, 1932). Hering (1957:311, no. 1523) describes the mine as follows.

“Channel begins in leaflet-centre, follows first one, then the other leaflet margin, finally filling the entire leaflet; likewise 1-2 further leaflets are mined out; the early channel is finally no longer recognizable. Mine whitish green when fresh, but soon becomes brownish.

Faeces in fine black particles, which in places are linked in beaded fashion, deposited irregularly or in two rows. Semicircular slit on upper surface.”

Hering suggests that similar mines in Berlin Botanical Gardens were caused by *Phytomyza mylini* Hering, but this was not confirmed by breeding. Linear mines of the type described are produced on Umbelliferae by many different species of the *Phytomyza albiceps* group. In the absence of any morphological information on larvae or adults, the species concerned cannot be determined.

De Meijere (1937:238) has described and figured a larva collected by H. Buhr from mines on *Conioselinum tataricum* Fisch. at Leningrad (Russia). This larva had only five bulbs on its anterior spiracles, but about 16, arranged more or less in a circle, on its posterior spiracles. This description is not appropriate to the third instar larva of any of the three species found by me on *Conioselinum* in Alaska, for all have more numerous spiracular bulbs. Hering's (1957:315, no. 1546) statement that the mines from Leningrad are “large, taking in a large part of a point of the leaf, only on upper-surface” suggests that they are blotch-mines; but he does not state this explicitly.

#### DIAGNOSIS

Caught adults of the *Phytomyza albiceps* group can be reliably identified only by dissection of the male genitalia. Fortunately the form of the aedeagus is strongly differentiated between species of this group, allowing confident identification of many species which are inseparable on external characters. The three new species described in this paper may be included in Spencer's (1969) key to *Phytomyza* species of Canada and Alaska by the extensions given below. The second of these extensions (to couplet 88) incorporates an extension previously proposed by Sehgal (1971).

- |      |  |       |                           |
|------|--|-------|---------------------------|
| 84.  | Tarsi yellow; aedeagus as Spencer's Figs. 402, 403                         | ..... | <i>aralivora</i> Spencer  |
| —    | Tarsi dark   | ..... | 84a                       |
| 84a. | Aedeagus as Spencer's Figs. 473, 474                                       | ..... | <i>osmorhizae</i> Spencer |
| —    | Aedeagus as Fig. 7   | ..... | <i>sitchensis</i> n. sp.  |
| —    | Aedeagus as Figs. 4, 5   | ..... | <i>conioselini</i> n. sp. |
| 88.  | Third antennal segment distinctly enlarged; aedeagus as Spencer's Fig. 468 | ..... |                           |
| —    | .....  | ..... | <i>nepetae</i> Hendel     |
| —    | Third antennal segment not enlarged  | ..... | 88a                       |
| 88a. | Aedeagus as Spencer's Figs. 504, 505                                       | ..... | <i>sehgali</i> Spencer    |
| —    | Aedeagus as Sehgal's Figs. 110, 111  | ..... | <i>mertensiae</i> Sehgal  |
| —    | Aedeagus as Figs. 1, 2   | ..... | <i>cnidii</i> n. sp.      |

The following key will facilitate identification of mines and immature stages of *Phytomyza* species on *Conioselinum*. No other genera of Agromyzidae are known to attack this plant genus.

#### Key to *Phytomyza* mines on *Conioselinum*

1. On *C. tataricum* Fisch. Anterior spiracles of third instar larva (and puparium) with five bulbs; posterior spiracles with about 16 bulbs . . . . . *P.* sp. (de Meijere, 1937:238)
- On *C. chinense* (L.). Spiracular bulbs of third instar larva and puparium more numerous . . . . . 2

2. Mine primary blotch (Fig. 14A). Puparium with prominent anal lobes; posterior spiracles of puparium and third instar larva with 21-22 bulbs in broad ellipse (nearly circular) (Fig. 11) ..... *P. sp.* (compare *angelicae* Kaltenbach)
- Mine basically linear, though portions of the channel may coalesce in narrow leaf lobes (Fig. 14B). Puparium without prominent anal lobes; posterior spiracles of puparium and third instar larva with bulbs in narrow ellipse (Fig. 12, 13) ..... 3
3. Puparium smoothly rounded, with intersegmental boundaries scarcely impressed (Fig. 9) ..... *P. sitchensis* n. sp.
- Puparium as Fig. 10, with intersegmental boundaries distinctly impressed ..... *P. conioselini* n. sp.

#### TREATMENT OF SPECIES

##### *Phytomyza cnidii* new species

*Adult.* – Head with orbits narrowly projecting above eye in lateral view; genae in middle 1/3 to 1/4 of eye height; eyes with only sparse fine pubescence. Frons at level of front ocellus 2-2½ times width of eye. Ors directed posteriorly, ori directed inwardly; posterior ors about 2/3 as long as anterior ors; anterior ori variably developed, ranging from very short to 2/3 as long as posterior ori; orbital setulae few (3-5), in one row. Peristomal margin with vibrissa and 2-3 upcurved peristomal setulae. Third antennal article rounded distally, with short pubescence.

3 + 1 dc; acr in 4-5 rows; 5-10 presutural ia; 4-7 postsutural ia; inner pa about half as long as outer pa.

Second cross-vein (m-m) absent;  $m_{1+2}$  weak, absent from centre of wing in two females (although they retain its terminal portion at wing tip). Costal ratio  $mg_2/mg_4$  2.2-2.4. Wing length 1.8-2.0 mm.

Colour largely dark. Centre of frons dark brown, only slightly paler than black ocellar plate, vertex and orbits; genae brown. Antennae black. Palpi black; labella orange-yellow. Thorax finely grey-dusted, weakly shining, largely black with pale coloration only along notopleural and mesopleural sutures (and in one specimen also at corners of humeral calli); wing base yellow; squamae pale or somewhat infuscated, with dark fringe. Legs largely black, with tips of front femora not contrasting, yellow-brown or red-brown. Basal cone of ovipositor (♀) largely shining, grey-dusted on dorsal surface only narrowly at base.

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres not clearly delimited from perianthrium, bearing dense group of setulae. Pregonites inconspicuous (weakly pigmented), extending ventrally, shielding base of aedeagus at rest. Aedeagal hood with two pairs of lateral sclerites. Aedeagus as Fig. 1, 2; basal section with group of very small spinules on dorsal surface between basal sclerites; medial lobe with well-defined loop of sclerotization; distal section largely unpigmented, with distiphallus represented by slender strip of sclerotization. Ejaculatory apodeme as Fig. 3.

*Puparium and third instar larva.* – Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with 8-10 bulbs in irregular ellipse. Posterior spiracles on short conical processes, with 14-15 bulbs in narrow ellipse. Puparia dark brown or black, 1.7-1.8 mm long, strongly arched, with clearly impressed intersegmental boundaries; anal lobes weakly developed.

*Mine.* – Larvae leaf-miners on *Cnidium cnidiifolium* (Turcz.), leaving leaf before puparium formation. A description of the mine cannot be given, as the leaves from which the type series was bred decomposed while in transit.

*Types.* — Holotype ♂, 3 ♀♀ paratypes from larvae 26.vii.70 on *Cnidium cniidiifolium* (Turcz.), 4 miles S Atkinson Point (on pingo), Northwest Territories, Canada, emerged 2.v.71, leg. P. G. Kevan.

*Phytomyza sitchensis* new species

*Adult.* — Head with orbits not projecting above eye in lateral view; genae in middle 1/3 to 1/4 of eye height; eyes with only sparse fine pubescence. Frons at level of front ocellus about twice width of eye. Ors directed posteriorly, ori directed inwardly; posterior ors 3/4 to almost as long as anterior ors; anterior ori short or absent; orbital setulae few (4-6), in one row. Peristomal margin with vibrissa and 3-5 upcurved peristomal setulae. Third antennal article rounded distally, with short pubescence.

3 + 1 dc; acr in 3-4 rows; 5-6 presutural ia; 6-7 postsutural ia; inner pa about half as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio  $mg_2/mg_4$  3.4-3.5. Wing length 2.4-2.6 mm.

Colour almost entirely dark. Centre of frons and genae dark brown, scarcely paler than rest of head. Labella orange-yellow. Thorax grey-dusted over black ground colour, only weakly shining, with pale coloration only along notopleural and mesopleural sutures. Wing base and squamae yellowish white, latter with dark margin and fringe. Legs largely dark, with tips of front femora contrastingly yellow; tips of other femora less contrasting, yellow-brown or dark. Basal cone of ovipositor (♀) grey-dusted on about basal third.

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres partly delimited from perianthrium by suture on outer side, bearing numerous fine setulae. Pregonites extending ventrally (shielding base of aedeagus at rest), but inconspicuous (weakly pigmented). Aedeagal hood with two pairs of lateral sclerites (the more dorsal pair rather ill-defined). Aedeagus as Fig. 7; right basal sclerite expanded at base; both basal sclerites with row of conspicuous spinules distally above their dorsal margins; medial lobe with pair of slender well-defined sclerites; distal section long, at its base with well-defined sclerite (mesophallus) enclosing ejaculatory duct, largely membranous distally with only weak traces of terminal pigmentation (distiphallus). Ejaculatory apodeme as Fig. 8.

*Puparium and third instar larva.* — Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with two short horns, with about 14 bulbs in ellipse. Posterior spiracles on short broad processes, with 26-33 bulbs in long narrow ellipse with wide gap on inner side (Fig. 12). Puparia (Fig. 9) shining black, about 1.7 mm long, smoothly rounded with intersegmental boundaries scarcely impressed; anal lobes absent.

*Mine.* — Larvae leaf-miners on *Conioselinum chinense* (L.). Mine (Fig. 14B) entirely linear, mainly following sinuations of leaflet margins, about 5 cm long, 1-1½ mm wide terminally; faeces deposited as fine particles, mostly close together or forming beaded strips; mine entirely on upper surface of leaf, appearing whitish green in reflected light; larvae leaving leaf through semicircular slit on upper surface before puparium formation.

*Types.* — Holotype ♂, 1 ♀ paratype from larvae 20-30.viii.69 on *Conioselinum chinense* (L.), Starrigavan (on beach), Sitka, Alaska, emerged 11-14.v.70, leg. G. C. D. Griffiths. 1 ♀ paratype from larva 27-30.vi.68 on *Conioselinum chinense* (L.), Chilkat Peninsula (near Haines), Alaska, emerged 23.vii.68, leg. G. C. D. Griffiths.

*Remarks.* — The breeding data given above indicate that *sitchensis* is multivoltine. The smoothly rounded puparia are of the type described by Allen (1957) for *P. obscurella* Fallén and other European species. The other known miners of *Conioselinum* do not have puparia of this type.

*Phytomyza conioselini* new species (♂)

*Adult.* — Head with orbits only very narrowly projecting above eye in lateral view; genae in middle 1/4 of eye height; eyes with only sparse fine pubescence. Frons at level of front ocellus about 2½ times width of eye. Ors directed posteriorly, ori directed inwardly; posterior ors from 2/3 to fully as long as anterior ors; anterior ori 1/2 to 2/3 as long as posterior ori; orbital setulae numerous (8-10), irregularly arranged (a few lying between main row and level of orbital bristles). Peristomal margin with vibrissa and 5-8 upcurved peristomal setulae. Third antennal article rounded distally, with short pubescence.

3 + 1 dc (except 2 + 1 on one side in paratype); acr and ia long; acr in 3-4 rows; 5-9 presutural ia; 4-9 postsutural ia; inner pa about half as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio  $mg_2/mg_4$  3.3. Wing length 2.5 mm.

Colour largely dark. Centre of frons ochreous, somewhat contrasting with dark orbits, ocellar plate and vertex; genae ochreous to yellow-brown. Antennae dark. Palpi black; labella yellow. Thorax strongly grey-dusted, scarcely shining, largely dark with pale coloration only along notopleural and mesopleural sutures and on postalar callus (below outer pa). Wing base and squamae whitish, latter with dark margin and fringe. Legs largely dark, with tips of front femora contrastingly yellow; tips of other femora less contrasting, yellow-brown or reddish.

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres partly delimited from periandrium by suture on outer side, bearing dense group of fine setulae. Pregonites large, extending ventrally (shielding base of aedeagus at rest), but inconspicuous (weakly pigmented). Aedeagal hood with two pairs of lateral sclerites (the more dorsal pair rather ill-defined). Aedeagus as Fig. 4, 5; basal section without spinules; medial lobe with pair of asymmetrically developed sclerites, that on left side much expanded with projecting point; distal section very short, with complex sclerotization. Ejaculatory apodeme as Fig. 6.

*Puparium and third instar larva.* — Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with about 12 bulbs in irregular ellipse. Posterior spiracles (Fig. 13) on short conical processes, with 22-29 bulbs in narrow ellipse. Puparia (Fig. 10) dark brown or black, shining, 2.1-2.2 mm long, strongly arched, with intersegmental boundaries distinctly impressed; anal lobes absent.

*Mine.* — Larvae leaf-miners on *Conioselinum chinense* (L.). Mines linear, similar to those of *sitchensis*; larvae leaving leaf through semicircular slit before puparium formation.

*Types.* — Holotype ♂, 1 ♂ paratype from larvae 27.vi-2.vii.68 on *Conioselinum chinense* (L.), Chilkat Peninsula (near Haines), Alaska, emerged 12-13.x.68, leg. G. C. D. Griffiths.

*Remarks.* — Puparia of this species and of *sitchensis* were obtained from linear mines on *Conioselinum* collected on the Chilkat Peninsula. Unfortunately my records do not enable me to separate the pressed mines according to species. There seems no obvious basis for dividing them into two groups. However, the puparia are readily separable, for those of *conioselini* have impressed intersegmental boundaries (Fig. 10), while those of *sitchensis* are smoothly rounded (Fig. 9).

I do not know whether the late emergence of the two specimens indicates that this species has a second generation in autumn, or was a "forced" emergence caused by delay in my obtaining outdoor storage facilities.

The paratype male has an abnormal abdomen, with incomplete hypopygial rotation. The cause of this was evidently unsuccessful parasitoid attack, for in the abdomen was found a large capsule (0.325 x 0.15 mm) containing a hymenopterous larva. The aedeagus of the paratype agrees with that of the holotype except that the right (not left) sclerite of

the medial lobe is expanded. I interpret its condition as abnormal in this respect, since disturbances of the rotation process in cyclorrhaphous Diptera are often associated with anomalous development of asymmetrical structures.

*Phytomyza* sp. (compare *angelicae* Kaltenbach)

In addition to larvae of *sitchensis* and *conioselini*, I also collected on the Chilkat Peninsula larvae of a third species of *Phytomyza* on *Conioselinum chinense* (L.), these producing primary blotch-mines (Fig. 11, 14A). The mines and puparia of this species are similar to those of *P. angelicae* Kaltenbach (on *Angelica*). Unfortunately I have so far obtained only female flies. These are similar to *angelicae*, differing from the other *Conioselinum*-miners in having a bright yellow frons. I cannot determine whether they represent a distinct species until males are obtained for critical comparison.

#### ACKNOWLEDGEMENTS

I am most grateful to P. G. Kevan for collecting and sending me the material from *Cnidium*. My material from *Conioselinum* was collected on field trips supported by the Boreal Institute of the University of Alberta. My wife Deirdre kindly prepared the illustration of leaf mines (Fig. 14). I am grateful to M. von Tschirnhaus and K. A. Spencer for confirming that none of the species described in this paper was previously known to them.

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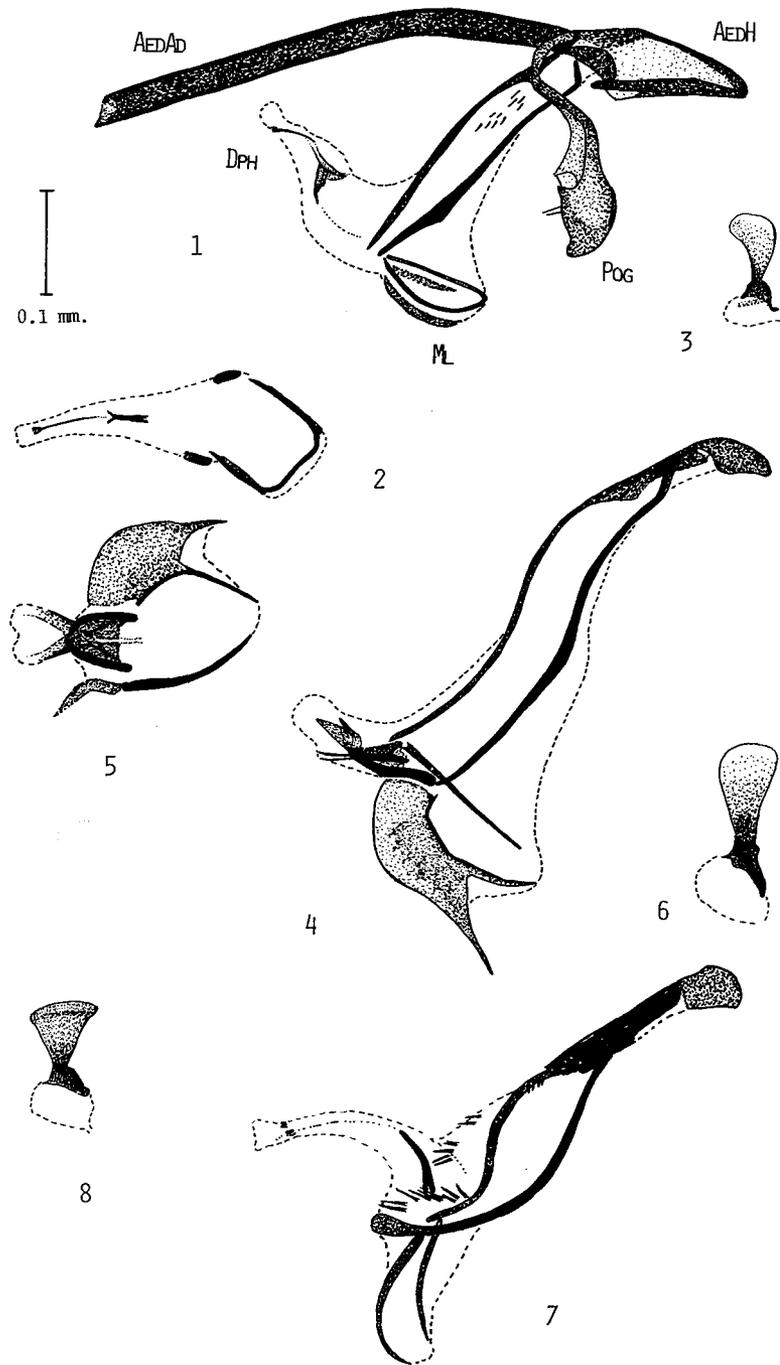


Fig. 1-3. *Phytomyza cnidii* n. sp., holotype ♂: 1, aedeagus and associated structures in lateral view (AEDAd aedeagal apodeme, AEDH aedeagal hood, DPH distiphallus, ML medial lobe, POG postgonite); 2, distal section and medial lobe of aedeagus in anteroventral view; 3, ejaculatory apodeme. Fig. 4-6. *Phytomyza conioselini* n. sp., holotype ♂: 4, aedeagus in lateral view; 5, distal section and medial lobe of aedeagus in  $\pm$  ventral view; 6, ejaculatory apodeme. Fig. 7-8. *Phytomyza sitchensis* n. sp., holotype ♂: 7, aedeagus in lateral view; 8, ejaculatory apodeme.

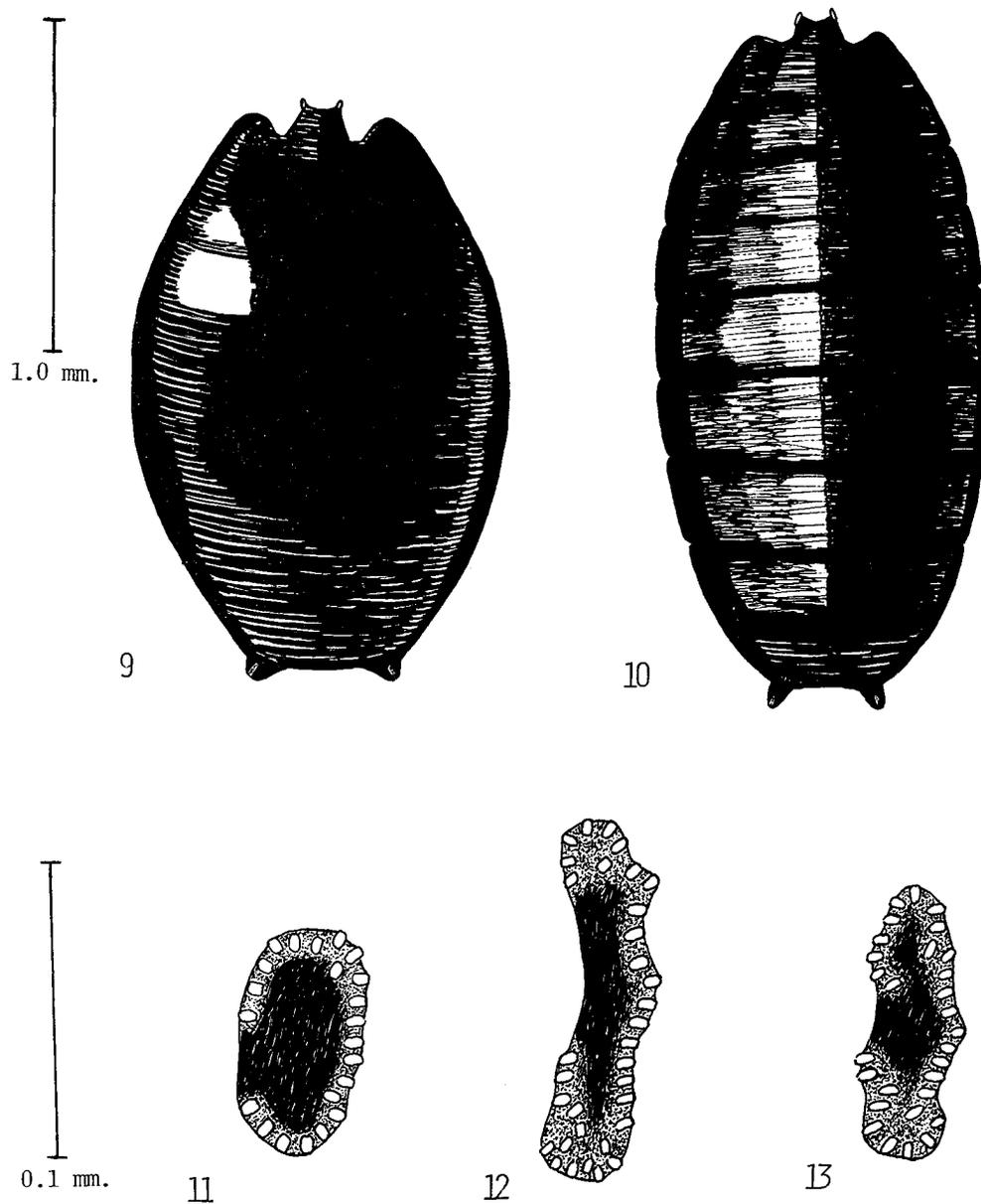


Fig. 9. *Phytomyza sitchensis* n. sp., puparium in dorsal view. Fig. 10. *Phytomyza conioselini* n. sp., puparium in dorsal view. Fig. 11. *Phytomyza* sp. (compare *angelicae* Kaltenbach), posterior spiracle of puparium in caudal view. Fig. 12. *Phytomyza sitchensis* n. sp., posterior spiracle of puparium in caudal view. Fig. 13. *Phytomyza conioselini* n. sp., posterior spiracle of puparium in caudal view.

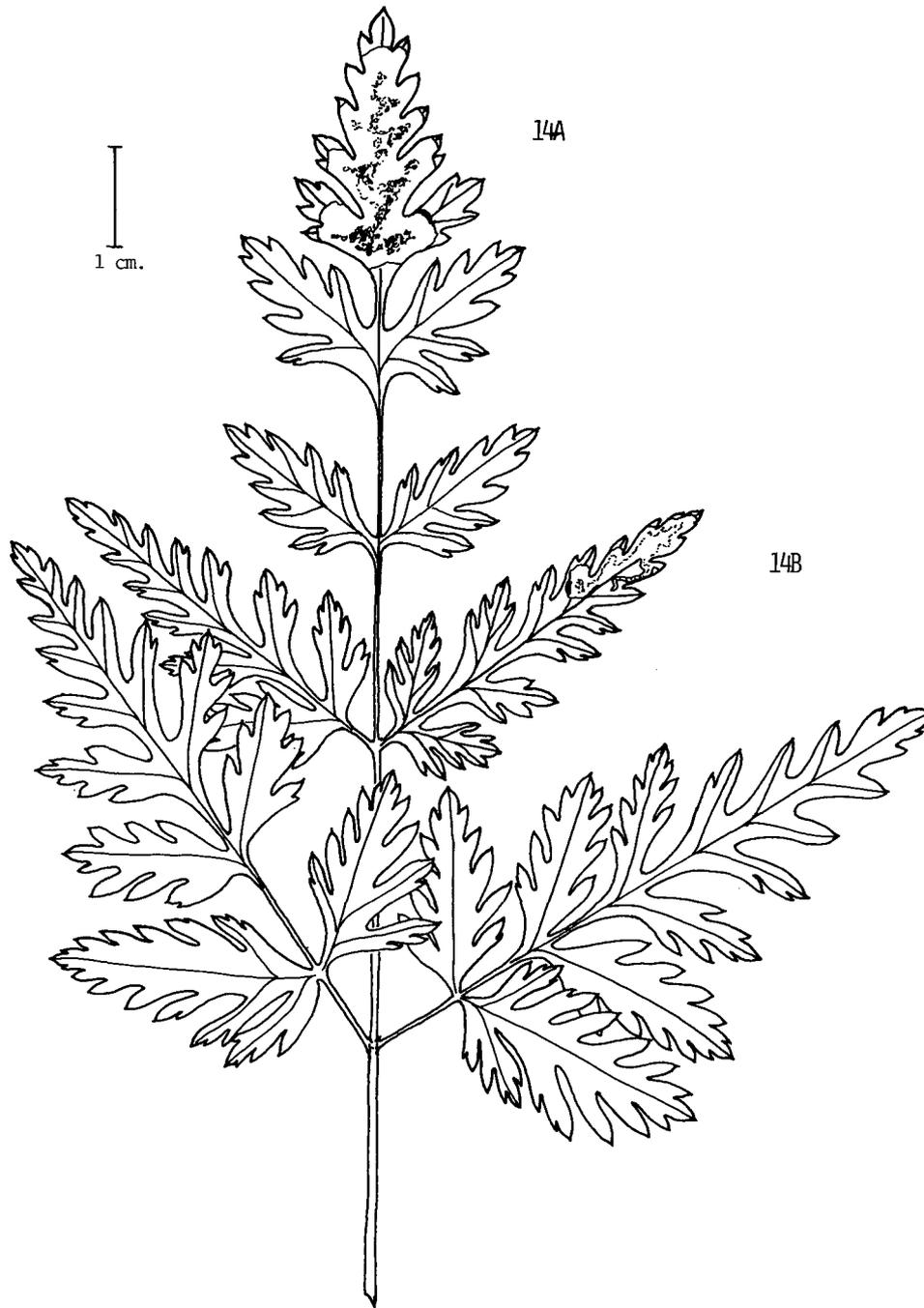


Fig. 14. Leaf of *Conioselinum chinense* (L.) with mines of *Phytomyza* sp. (compare *angelicae* Kaltenbach) (A) and *P. sitchensis* n. sp. (B).