STUDIES ON BOREAL AGROMYZIDAE (DIPTERA), IV. *PHYTOMYZA* MINERS ON *ANGELICA, HERACLEUM, LASERPITIUM* AND *PASTINACA* (UMBELLIFERAE)

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Quaestiones entomologicae
9: 219-253 1973

Nine species of the Phytomyza albiceps *group and five of the* Phytomyza angelicae *group are recorded as miners of* Angelica, Heracleum, Laserpitium *and* Pastinaca. *These include one new species on* Heracleum, P. tlingitica *n. sp. (type-locality Chilkat peninsula, Alaska). The identity of* P. spondylii *Robineau-Desvoidy is clarified.* P. archangelicae *Hering and* P. angelicae *Kaltenbach are recorded for the first time in North America; and the North American* P. heracleiphaga *Spencer is considered a subspecies of the true* P. spondylii *Robineau-Desvoidy. Two names are newly synonymized,* P. angelicella *Frost (=* P. pastinacae *Hendel) and* P. laserpitii *Hendel (=* P. angelicae *Kaltenbach).* P. kibunensis *Sasakawa, described as a subspecies of* angelicae, *is considered a full species.*

Neuf espèces du groupe Phytomyza albiceps *et cinq espèces du groupe* Phytomyza angelicae *sont signalées comme mineuses de l'*Angelica, *de l'*Heracleum, *du* Laserpitium *et de la* Pastinaca. *Une espèce nouvelle est inclue,* P. tlingitica *n. sp. sur l'*Heracleum *(localité-type Péninsule de Chilkat, Alaska). L'identité de* P. spondylii *Robineau-Desvoidy est clarifié.* P. archangelicae *Hering et* P. angelicae *Kaltenbach sont signalées pour la première fois en Amérique du nord; et* P. heracleiphaga *Spencer d'Amérique du nord est considérée comme sous-espèce de la vraie* P. spondylii *Robineau-Desvoidy. Deux noms sont de nouveau synonymisés,* P. angelicella *Frost (=* P. pastinacae *Hendel) et* P. laserpitii *Hendel (=* P. angelicae *Kaltenbach).* P. kibunensis *Sasakawa, décrite comme sous-espèce d'*angelicae, *est considérée comme espèce proprement dite.*

Neun Arten der Phytomyza albiceps-*Gruppe und fünf Arten der* Phytomyza angelicae *-Gruppe werden als Minierer von* Angelica, Heracleum, Laserpitium *und* Pastinaca *besprochen. Unter diesen wird eine Art an* Heracleum, P. tlingitica *n. sp. (Fundort vom Typus Chilkathalbinsel, Alaska) neu beschrieben. Die Identität von* P. spondylii *Robineau-Desvoidy wird geklärt.* P. archangelicae *Hering und* P. angelicae *Kaltenbach werden zum ersten Mal für Nordamerika nachgewiesen; die nordamerikanische* P. heracleiphaga *Spencer wird als Unterart der echten* P. spondylii *Robineau-Desvoidy angesehen. Zwei Namen werden neu synonymisiert:* P. angelicella *Frost (=* P. pastinacae *Hendel) und* P. laserpitii *Hendel (=* P. angelicae *Kaltenbach).* P. kibunensis *Sasakawa, als Unterart von* angelicae *beschrieben, wird als volle Art angesehen.*

The present paper deals with all known *Phytomyza* miners of four genera of Umbelliferae, *Angelica, Heracleum, Laserpitium* and *Pastinaca.* These belong to two groups, the *albiceps* group and the *angelicae* group.

The terms and abbreviations used in my descriptions were explained in the first paper of this series (Griffiths, 1972a). Names of North American plants are used in the sense of

Hultén (1968), and of European plants in the sense of Tutin (1968). Following the latter the names *Heracleum sphondylium* L. and *Angelica archangelica* L. are here used in wide senses, including subspecies which have been listed as full species in some previous host-plant records. Japanese plants are listed in the form used by Sasakawa (1961a, 1961b).

The holotype of the new species described in this paper will be deposited in the Canadian National Collection (Ottawa).

DIAGNOSIS

Keys with worldwide coverage to the mines of *Phytomyza* species on *Angelica, Heracleum, Pastinaca* and *Laserpitium* are given below. The only other agromyzid species recorded as a leaf-miner on these plant genera is the polyphagous *Liriomyza strigata* Meigen, recorded (rarely) on *Heracleum* in Europe by Hering (1957:524). The larvae of this species feed mainly in the leaf midrib, producing mines very distinct from those of the *Phytomyza* species here treated. Larvae of two other *Liriomyza* species (*L. lutea* Meigen and *L. wachtli* Hendel) are known to feed on the seeds, and those of *Napomyza carotae* Spencer and several *Melanagromyza* and *Ophiomyia* species in the stems.

The species of *Phytomyza* treated in this paper belong to critical groups, in which the male aedeagus must be studied for reliable identification. Some cannot be separated on the basis of their mines and larvae. Amendments to Spencer's (1969) key to the *Phytomyza* species of Canada and Alaska to incorporate additional species are as follows. These expand amendments already proposed by Sehgal (1971) and in my previous paper (Griffiths, 1973).

13. Upper ors shorter than lower or lacking 13a
– Both ors equal 14
13a. Third antennal segment with conspicuously long pubescence; aedeagus as Sehgal's Fig. 121 . . . . . *riparia* Sehgal
– Third antennal segment with short pubescence 13b
13b. Sutural triangle entirely whitish; humeral callus partly so (infuscated only at centre). Aedeagus as Figs. 8, 9 . . . . . *tlingitica* n. sp.
– Sides of mesonotum with less pale coloration (at most on upper part of sutural triangle and at corners of humeral callus). 13c
13c. Aedeagus as Figs. 5, 6 . . . . . *spondylii heracleiphaga* Spencer
– Aedeagus as Figs. 2, 3 . . . . . *pastinacae* Hendel

84. Tarsi yellow; aedeagus as Spencer's Figs. 402, 403 . . . . . *aralivora* Spencer
– Tarsi dark 84a
84a. Distal section of aedeagus long 84b
– Distal section of aedeagus very short 84c
84b. Basal section of aedeagus with two rows of conspicuous spinules (Griffiths, 1973, Fig. 7). . . . . *sitchensis* Griffiths
– Basal section of aedeagus without spinules (Spencer's Figs. 473, 474). . . . . *osmorhizae* Spencer
84c. Aedeagus as Figs. 17, 18, with medial lobe scarcely differentiated . . . . . *archangelicae* Hering
– Medial lobe of aedeagus well differentiated, with left sclerite expanded (Griffiths, 1973, Figs. 4, 5). . . . . *conioselini* Griffiths

Key to *Phytomyza* mines on *Angelica*

1. Anal lobes of puparium prominent 2
– Anal lobes of puparium not prominent 3
2. Mine (Fig. 43) primary blotch, without initial linear channel, normally communal (produced by more than one larva). Holarctic . . . . . *P. angelicae* Kaltenbach
– Mine primarily linear, with irregular blotchy areas terminally, produced by single larva. Japan . . . . . *P. kibunensis* Sasakawa
3. Mine entirely on upper surface of leaf (without initial channel on lower surface), linear throughout 4
– Mine with short initial channel on lower surface of leaf, linear throughout or with blotchy areas 5
4. Posterior spiracles of puparium and third instar larva with slender horns (Sasakawa, 1955, Fig. 7b). Japan . . . . . *P. polycladae* Sasakawa
– Posterior spiracles of puparium and third instar larva without distinct horns. Holarctic . . . . . *P. pastinacae* Hendel
5. Puparia very small, 1.5-1.6 mm long. Mine becoming blotchy terminally, following leaf margin. Eastern Europe. On *Angelica palustris* (Besser) . . . . . *P. angelicivora* Hering
– Puparia normally larger. On other *Angelica* species 6
6. Mine (Fig. 42) linear throughout; posterior spiracles of puparium and third instar larva with 20-28 bulbs (Fig. 39). Holarctic . . . . . *P. archangelicae* Hering
– Mine basically linear, but normally convolute, with secondarily blotchy areas (Fig. 41) 7
7. Posterior spiracles of puparium and third instar larva with 30-35 bulbs. Japan. . . . . *P. arnaudi* Sasakawa
– Posterior spiracles of puparium and third instar larva with 22-28 bulbs (Fig. 37). Europe . . . . . *P. angelicastri* Hering

Key to *Phytomyza* mines on *Heracleum* and *Pastinaca*

1. Anal lobes of puparium prominent. Mine primary blotch 2
– Anal lobes of puparium not prominent. Mine basically linear, although with blotchy areas in some species 3
2. Mine (Fig. 44) interparenchymal throughout, with marbled appearance caused by scattered holes eaten in palisade parenchyma, produced by single larva. Europe . . . . . *P. heracleana* Hering
– Mine (Fig. 43) largely of uniform depth on upper surface of leaf, with only limited area of interparenchymal feeding (by first-instar larvae), normally communal (produced by more than one larva). Holarctic . . . . . *P. angelicae* Kaltenbach
3. Mine interparenchymal (pale green when fresh), basically linear but in most cases with blotchy areas (Fig. 40B) 4
– Mine on upper surface of leaf (whitish when fresh), linear throughout (Fig. 40A). 5
4. Europe . . . . . *P. sphondyliivora* Spencer
– Alaska . . . . . *P. tlingitica* **n.** sp.
5. Europe . . . . . *P. spondylii spondylii* Robineau-Desvoidy . . . . . or *P. pastinacae* Hendel

– North America. . . . . .*P. spondylii heracleiphaga* Spencer
. . . . . .or *P. pastinacae* Hendel
. . . . . or *P. lanati* Spencer

Key to *Phytomyza* mines on *Laserpitium*

1. Mine primary blotch, without initial linear channel, normally communal (produced by more than one larva) . . . . . .*P. angelicae* Kaltenbach
– Mine linear, produced by single larva . . . . . *P. latifolii* Groschke

TREATMENT OF SPECIES

(a) the *Phytomyza albiceps* group

See my previous discussion of this group (Griffiths, 1972b). Nowakowski (1926: 105) has discussed the relationships of the Umbelliferae-feeding members of this group. Six of the species here treated belong to Nowakowski's "fourth subgroup", which I propose to call the *spondylii* subgroup. These are yellow-fronted species characterized by a large but mostly unpigmented distal section of the aedeagus without paramesophalli. I refer to this subgroup the following species treated in this paper: *P. spondylii* Robineau-Desvoidy, *P. pastinacae* Hendel, *P. sphondyliivora* Spencer, *P. tlingitica* n. sp., *P. angelicastri* Hering and *P. lanati* Spencer. Other species known to belong to this subgroup are *P. sii* Hering (Nowakowski, 1962), *P. cicutae* Hendel (Nowakowski, 1962), *P. conii* Hering (Spencer, 1971) and *P. oenanthes* Sasakawa. All species of this subgroup are very similar, and study of the male aedeagus is usually necessary for identification.

In addition to species of the *spondylii* subgroup, two dark-fronted species with highly modified aedeagus, *P. archangelicae* Hering and *P. arnaudi* Sasakawa, also occur on *Angelica*. Their affinities doubtless lie with some of the dark-fronted species of the *albiceps* group on other genera of Umbelliferae; but too few of these have been critically studied to define a subgroup at this time.

The relationships of *P. polycladae* Sasakawa cannot be determined until males are obtained from the original host-plant. My listing of this species under the *albiceps* group is only provisional.

Nowakowski (1962: 105) has included *P. angelicae* Kaltenbach and its relatives (among which I also include *P. heracleana* Hering) as a subgroup of the *albiceps* group. I am doubtful whether this is correct, and treat the *angelicae* group separately below.

Phytomyza spondylii Robineau-Desvoidy 1851

(synonymy below under subspecies)

Adult. – Head with orbits narrowly projecting above eye in lateral view; genae in middle 1/3 to 1/2 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 variably developed, ranging from only slightly shorter than anterior ors to completely absent (short in most specimens); anterior ori short or absent, at most half as long as posterior ori; orbital setulae numerous, irregularly distributed, more or less two-rowed posteriorly. Peristomal margin with vibrissa and 4-6 upcurved peristomal setulae. Third antennal article rounded distally, with short white pubescence.

3 + 1 dc; acr in 3-4 irregular rows; 5-12 presutural ia; 4-8 postsutural ia; inner pa 1/2 to 2/3 as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4 3.4-4.8 (mean 3.85).

Centre of frons clear yellow, contrasting with dark ocellar plate and vertex (both vt on dark ground); orbits partly infuscated (at least along eye margins and around bases of orbital setae; in some specimens broadly infuscated from eye margin to level of orbital setae). Face largely infuscated. Genae yellow. Occiput dark. Antennae with first article yellow-brown or brown, second and third articles dark brown to black. Palpi dark brown; labella yellow or white. Mesonotum weakly shining, finely grey-dusted, largely dark but with patches of brown or yellow-brown coloration on sides (especially at corners of humeral callus and on upper part of sutural triangle); scutellum dark; mesopleuron largely dark, with whitish dorsal band (very narrow in most specimens, at most 1/4 of height of mesopleuron); other pleura largely dark, but with some pale coloration along sutures. Wing base and squamae whitish, latter with contrastingly dark fringe. Legs largely dark, with tips of front femora contrastingly yellow; tips of other femora less contrasting, yellow-brown to reddish. Abdomen largely brown. Basal cone of ovipositor (♀) grey dusted on basal third to half.

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres not clearly delimited from periandrium, bearing dense group of setulae. Pregonites weakly pigmented, extending ventrally (shielding base of aedeagus at rest). Aedeagal hood with two pairs of lateral sclerites (the more dorsal pair rather ill-defined). Aedeagus as Fig. 5, 6; 1-3 dorsal spinules on left side of basal section near apex of left basal sclerite; 0-6 similar dorsal spinules on right side near apex of right basal sclerite (see below under subspecies); main sclerites of medial lobe in some specimens fused to form loop (as in *pastinacae),* but more commonly separate distally, turned forward in many specimens (as in Fig. 5); additional short sclerite at left basal corner of medial lobe (in some specimens weakly spiniform); smaller more or less spiniform sclerite in similar position on right side; distal section long, without pigmented sclerites, with ventral notch or spinule (in most specimens with dark tip) on right side. Ejaculatory apodeme as Fig. 7.

Puparium and third instar larva. – Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with two short horns, with 8-12 bulbs in widely open ellipse; posterior spiracles on short conical processes, with 18-21 bulbs in narrow ellipse. Puparia brown or black, 1.7 - 2.0 mm long, strongly arched, with intersegmental boundaries distinctly impressed; anal lobes not prominent.

Mine. – Larvae leaf-miners on *Heracleum* and *Pastinaca.* Mine (Fig. 40A) entirely linear, 6-10 cm long, 2-3 mm wide terminally; faeces deposited as fine particles, mostly separated by less than 1 mm, in some mines forming beaded strips on alternate sides of mine; mine formed entirely on upper surface of leaf, conspicuous, appearing white or greenish white in reflected light when fresh; larvae leaving leaf through semicircular slit on lower surface before puparium formation.

Remarks. – There are significant differences between European and North American material of this species in respect of size (for which wing length is here used as an indicator) and in the number of dorsal spinules on the right side of the aedeagus near the apex of the right basal sclerite (Fig. 1). Of course the available material does not demonstrate whether these differences are the result of discontinuous variation or a cline. Pending such clarification, I propose to regard the name proposed by Spencer (1969) for the North American populations as denoting a subspecies.

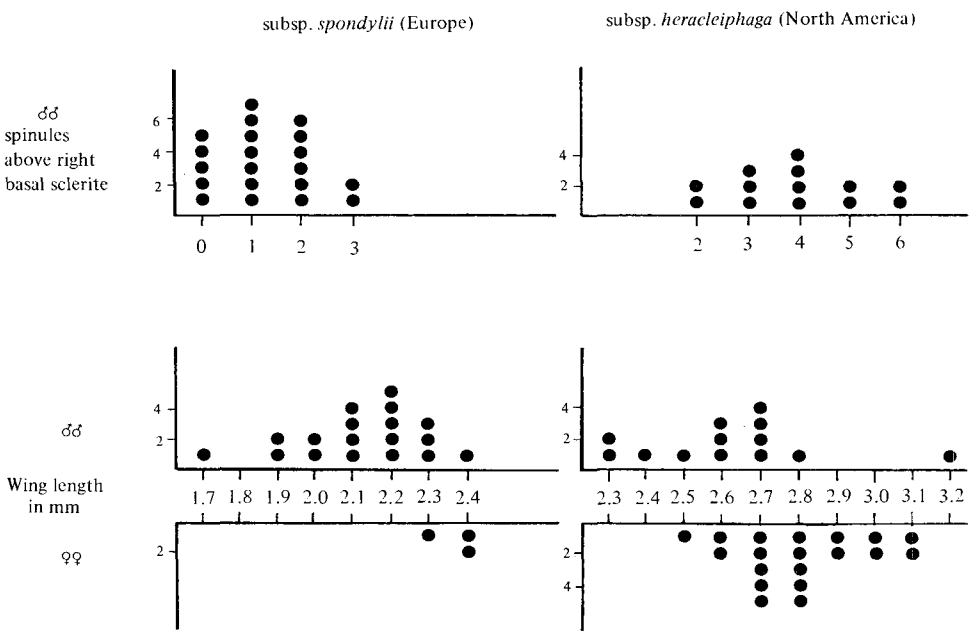

Fig. 1. Statistical differences between *Phytomyza spondylii spondylii* Robineau-Desvoidy and *P. s. heracleiphaga* Spencer, in respect of numbers of spinules near apex of right basal sclerite of aedeagus (♂) and wing length (♂♀). In addition to material examined, this figure includes information supplied in correspondence by von Tschirnhaus on 4♂♂1♀subsp. *spondylii* and Spencer's (1969) data on the type series of *heracleiphaga*.

Phytomyza spondylii spondylii Robineau-Desvoidy 1851

"Phytomyza nigra Meigen". Goureau, 1851: 147.

Phytomyza spondylii Robineau-Desvoidy. Goureau, 1851: 147. Robineau-Desvoidy, 1851: 400. Hendel, 1935: 483 (as *sphondylii*). Lectotype ♂ by present designation, France, in University Museum, Oxford.

Phytomyza heraclei Kaltenbach. Kaltenbach, 1862: 33. – 1874: 284. Types lost; type-locality, Germany.

Adult. – Wing length 1.7-2.4 mm (Fig. 1). Aedeagus (♂) with 0-3 dorsal spinules on right side near apex of right basal sclerite (Fig. 1).

Material examined. – Lectotype ♂, 1♂ paratype bred by Goureau from *Heracleum sphondylium* L., France. 1♂ from Hendel collection (without data, presumably bred from *Heracleum sphondylium* L. in Austria). 3♂♂ from larvae on *Pastinaca sativa* L., Bredow bei Nauen, Germany, emerged 6-8.vii.23, leg. M. Hering (no. 2220). 1♂ from larva on *Heracleum sphondylium* L., Güntersberg an Oder, Germany, 1920, leg. M. Hering (no. 1325). 4♂♂ from larvae 22.v.66 on *Pastinaca sativa* L., Wittenberg, Germany, leg. K. H. Zoerner. 1♂ from larva 2.viii.56 on *Heracleum sphondylium* L., Berisal, Valais, Switzerland, emerged 23. viii.56, leg. K. A. Spencer. 1♂ (caught), Darenth, Kent, England, 9.v.54, leg. G. C. D. Griffiths. 1♂ 1♀ from larvae 15.viii.53 on *Heracleum sphondylium* L., Bookham, Surrey, England, emerged 4-5.ix.53, leg. G. C. D. Griffiths. 1♂ from larva 20.vi.54 on *Heracleum sphondylium* L., Betchworth, Surrey, emerged 14.vii.54, leg. G. C. D. Griffiths. 1♂ 1♀ from larvae

15.viii.54 on *Pastinaca sativa* L., Guildford, Surrey, emerged 4-6.ix.54, leg. G. C. D. Griffiths.

Other records. – Von Tschirnhaus (in correspondence) has supplied the following records, after study of my description and figures: 2♂♂ 1♀ from larvae 10.vii.70 on *Heracleum sphondylium* L., Borstel/Elbe, W of Hamburg, Niedersachsen, Germany, emerged 28.vii.70; 2♂♂ (caught), Kaiserstuhl/Rheintal, Baden-Württemberg, Germany.

Remarks. – Hendel's correction of the species name to "*sphondylii*" was unjustified according to the current rules of nomenclature, as the original spelling *spondylii* follows classical precedent and was not a lapsus. The name of the host-plant was in fact latinized as "spondylium" in Pliny's Natural History. Hering (Hering and Spencer, 1968: 220, 226) has also emphasized that Robineau-Desvoidy's original spelling was intentional.

Kaltenbach's name *heraclei* could equally well refer to this subspecies or to *pastinacae.* To avoid nomenclatural complications I follow Hendel in regarding the name as a synonym of *spondylii.*

Spencer (1969, 1971) has incorrectly applied the name *spondylii* to the species here called *pastinacae*. Following dissection of type material I am forced to change this interpretation. Until recently it was assumed that linear mines on *Heracleum* in Europe are all produced by a single monophagous species (*spondylii*), while those on *Pastinaca* are all produced by *pastinacae.* These names do in fact refer to different species, but both species occur on both these host plants. So the numerous records of these species in the European literature are in complete confusion, and we must start anew in attempting to assess their distribution. Thus the only reliable records of the true *spondylii* in Europe are those listed above. Hendel (1923, 1935) claimed to have found external differences between these species, but I cannot confirm them. As far as I can see, reliable diagnosis is only possible through study of the male aedeagus.

It is not known whether the descriptions of larvae and puparia given by de Meijere (1926, 1928, 1941) and Allen (1957) refer to this species or to *pastinacae.* Nowakowski (1962: 127) has figured the posterior larval spiracles of "*spondylii*" as having 15 bulbs, and those of *"pastinacae"* as having 25 bulbs. I can find no such distinction in the material before me, in which the number of bulbs on the posterior spiracles of *both* species lies between these numbers.

Phytomyza spondylii heracleiphaga Spencer 1969, new status

Phytomyza heracleiphaga Spencer. Spencer, 1969: 297. Holotype ♂, Berkeley Hills (California), in U. S. National Museum.

Adult. – Wing length 2.3-3.2 mm (Fig. 1). Aedeagus (♂) with 2-6 dorsal spinules on right side near apex of right basal sclerite (Fig. 1).

Material examined. – 12♂♂ 14♀♀ from larvae 26-30.vi.68 on *Heracleum lanatum* Michx., Chilkat peninsula (near Haines), Alaska, emerged 22-28.vii.68 (2♂♂ 1♀) and 3-8.v.69, leg. G. C. D. Griffiths.

Other records. – Spencer's (1969) description was based on 3♂♂ 5♀♀ bred by M. J. & C. A. Tauber from *Heracleum lanatum* Michx. at Strawberry Canyon, Berkeley Hills, California (emerged 27.iii-23.v.64). I have included data for these specimens on Fig. 1.

Remarks. – Spencer (1969: 251) suggests that the life-history information on "*lanati*" in papers by Tauber & Tauber (1966, 1968) in fact refers to *heracleiphaga.* I am not convinced of this, since those authors report the length of the leaf mines to be 25-29.5 cm, over twice as long as the mines produced by my Alaskan specimens. Additional studies are needed to clarify the distinction between mines of *heracleiphaga* and *lanati.*

Phytomyza pastinacae Hendel 1923

Phytomyza pastinacae Hendel. Hendel, 1923: 388.–1935: 449. Lectotype ♂ by present designation, Austria, in Naturhistorisches Museum, Vienna.

Phytomyza angelicella Frost. Frost, 1927: 218. Holotype ♂, Ithaca (New York), in U. S. National Museum, Washington. New synonymy.

"*Phytomyza spondylii* Robineau-Desvoidy". Spencer, 1969: 275.–1971: 187.

Adult. – As described for *spondylii*, except as follows.

3-4 upcurved peristomal setulae. Costal ratio mg_2/mg_4 3.3-4.5 (mean 3.8). Wing length 2.0-2.5 mm.

Orbits infuscated along eye margins and around bases of orbital setae. Antennae with first article yellow-brown or brown, second article yellow-brown to dark brown, third article dark brown to black. Patches of pale coloration on sides of mesonotum variably developed, ranging from brown to contrastingly white. Basal cone of ovipositor (♀) grey dusted to variable extent, only narrowly at base on dorsal surface in Albertan specimens, on basal third to half in European specimens.

Aedeagus as Fig. 2, 3: conspicuous group of 6-11 dorsal spinules towards left side near apex of basal section; 1-5 similar dorsal spinules on right side near apex of right basal sclerite; medial lobe with asymmetrically oriented loop of sclerotization near left corner of which lies additional spiniform sclerite; no similar spiniform sclerite on right side (contrast *spondylii*); distal section without ventral notch, with small pigmented mesophallus differentiated near its base. Ejaculatory apodeme as Fig. 4.

Puparium and third instar larva. – Similar to those of *spondylii*. Posterior spiracles with 17-22 bulbs. Puparia 1.5-1.9 mm long.

Mine. – Larvae leaf-miners on *Pastinaca, Heracleum* and *Angelica,* forming linear upper-surface mines 6-9 cm long; otherwise as described for *spondylii.*

Material examined. – Lectotype ♂ from larva on *Pastinaca sativa* L., Vienna district, Austria, leg. F. Hendel. 1♂ from larva 28.v.66 on *Heracleum sphondylium* L., Dessau (- Mosigkau), Germany, emerged 26.vi.66, leg. K. H. Zoerner. 1♂ from larva 17.iii.53 on *Heracleum sphondylium* L., Sintra, Portugal, emerged 22.iv.53, leg. K. A. Spencer. 1♂ from larva 29.vii. 53 on *Heracleum sphondylium* L., Woodside Park, Middlesex, England, emerged 18.viii.53, leg. G. C. D. Griffiths. 1♂ from larva 31.vii.54 on *Heracleum sphondylium* L., Chilworth, Surrey, England, emerged 18.viii.54, leg. G. C. D. Griffiths. 4♂♂ 4♀♀ from larvae 6.ix.66 on *Heracleum sphondylium* L., Killarney, Ireland, emerged 26.ix-3.x.66 and 6-10.iii.67, leg. G. C. D. Griffiths.

1♂ from larva on *Angelica atropurpurea* L., Ithaca, New York, leg. A. S. Mills (paratype of *angelicella).* 4♂♂ 13♀♀ from larvae 19-27.vi.71 on *Heracleum lanatum* Michx., Elk Island National Park, Alberta, emerged 11-18.vii.71, leg. G. C. D. Griffiths.

Other records. – Other Alberta records of this species (as "*spondylii*") are given by Spencer (1969) and Sehgal (1971). These refer to localities in the Edmonton area and George Lake (near Busby). Von Tschirnhaus (in correspondence) has supplied the following record after study of my description and figures: 1♂ from larva 3.vii.71 on *Heracleum sphondylium* L., Neuhof, N of Lübeck, Schleswig-Holstein, Germany, emerged 21.viii.71. All European records except those stated here must be regarded as doubtful because of possible confusion with *spondylii* (see above under that species).

Phytomyza sphondyliivora Spencer 1957

Phytomyza sp. Hering, 1956: 280.

Phytomyza sphondyliivora Spencer. Spencer, 1957: 23. Holotype ♀, Wiltshire (England), in K. A. Spencer's collection.

Adult. – As described for *spondylii*, except as follows.

Orbits more distinctly projecting above eye in lateral view. Posterior ors half to almost as long as anterior ors; two or three pairs of ori. Costal ratio mg_2/mg_4 2.7-3.4. Wing length 2.4 - 2.7 mm.

Thorax colour as in darkest specimens of *spondylii;* mesonotum entirely dark, with sutural triangle scarcely paler (at most dark brown); mesopleuron with only narrow dorsal strip of whitish coloration.

Aedeagus as Fig. 11, 12; basal section with dense strip of dorsal spinules towards right side; medial lobe with pair of long sclerites (not forming loop), without additional small sclerites; distal section without ventral notch, unpigmented except for small mesophallus (strongly pigmented in Dorset specimen, but only weakly so in other specimens). Ejaculatory apodeme as Fig. 13.

Puparium and third instar larva. – Described and figured by Hering (1956: 280) (as *Phytomyza* sp.). Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles two-horned, with 10-12 bulbs; posterior spiracles on short broad processes, with 18 - 22 bulbs in narrow ellipse. Puparia dark brown to black, 2.2-2.4 mm long, strongly arched, with intersegmental boundaries distinctly impressed; anal lobes weakly prominent.

Mine. – Larvae leaf-miners on *Heracleum.* Mine (Spencer, 1957, Fig. 3) interparenchymal, pale green when fresh, later turning yellowish; channel broadly linear, in most cases with irregular blotchy areas; faeces deposited as discrete, sparsely scattered particles (Hering, 1957: 525); larvae leaving leaf through semicircular slit before puparium formation.

Material examined. – 1♂ paratype from larva 6.vi.54 on *Heracleum sphondylium* L., Corsham, Wilts., England, emerged 11.iv.55, leg. K. A. Spencer. 1♂ from larva 7.vi.63 on *Heracleum sphondylium* L., Portland, Dorset, England, emerged 18.iii.64, leg. K. A. Spencer. 1♂ 1♀ from larvae 20.vi.54 on *Heracleum sphondylium* L., Betchworth, Surrey, England, emerged 17.v and 21.vi.55, leg. G. C. D. Griffiths. Preparations of three larvae, 14.v.61, on *Heracleum sphondylium* L., Cambridge, England, leg. G. C. D. Griffiths.

Remarks. – Additional English localities are Hampstead, London (30.v.53 and 3.vii.58) and Luccombe, Isle of Wight (4.vii.64) (sheets in Hering's mine herbarium). I have seen no material of this species from outside southern England. However Hering has referred to it the following herbarium sheets for Austria and Germany (all of *Heracleum sphondylium* L.): Linz (Donau, Austria), 6.vii.29; Straubing (Bavaria, Germany), 11.vi.66; Berlin Botanical Gardens, 15.vi.60; and Jägersburger Wald, near Lorsch (Hessen, Germany), 11.vi.52.

This species is the only *Phytomyza* miner of *Heracleum* which is univoltine in southern England. Its characteristic interparenchymal mines can be confused only with those of the new species next to be described.

Phytomyza tlingitica new species

Adult. – As described for *spondylii*, except as follows.

Orbital setae very variable between individuals; posterior ors ranging from almost as long as anterior ors to absent (absent in many cases); anterior ori ranging from absent to fully as long as posterior ori (with small third ori on one side in one male). 2-7 peristomal setulae.

Costal ratio mg_2/mg_4 3.9-4.9. Wing length: ♂, 2.5-3.1 mm (mean 2.8 mm); ♀, 2.7-3.4 mm (mean 3.2 mm).

Face paler, largely yellow or yellow-brown, strongly infuscated only along central keel or immediately below antennal bases. Sides of mesonotum contrastingly pale, with sutural triangle entirely whitish or whitish yellow and humeral callus partly so (infuscated only at centre); mesopleuron with broad whitish or whitish yellow dorsal yellow area (about 1/4 of height of mesopleuron); pteropleuron also partly whitish or whitish yellow.

Aedeagus as Fig. 8, 9; basal section without spinules; medial lobe with pair of sclerites, of which the left is longer and more or less confluent at its base with small horizontally oriented sclerite; distal section without ventral notch, unpigmented except for small mesophallus. Ejaculatory apodeme slender (Fig. 10).

Puparium and third instar larva. – Mandibles with two more or less alternating teeth; right mandible slightly longer than left. Anterior spiracles with two short horns, with about 10 bulbs in open ellipse; posterior spiracles on short conical processes, with 17-27 bulbs in irregular narrow ellipse. Puparia dark brown or black, 2.3-2.6 mm long, strongly arched, with intersegmental boundaries distinctly impressed; anal lobes not prominent.

Mine. – Larvae leaf-miners on *Heracleum.* Mine (Fig. 40B) interparenchymal, pale green when fresh (scarcely contrasting with rest of leaf in reflected light), later indicated by areas of red-brown discoloration; channel basically linear, but broad and strongly convolute, in most cases forming irregular secondary blotch; faeces deposited as fine particles irregularly throughout mine, mostly separated by less than 1 mm; larvae leaving leaf through semicircular slit on lower surface before puparium formation.

Types. – Holotype ♂, 10♂♂ 9♀♀ paratypes from larvae 29.vi-7.vii.68 on *Heracleum lanatum* Michx., Chilkat peninsula (near Haines), Alaska, emerged 5.xi-27.xii.68 (forced) and 10-20.v.69, leg. G. C. D. Griffiths.

Remarks. – The species-name *tlingitica* is based on the name of the Tlingit tribe, which inhabits the Alaska Panhandle.

A remarkable feature of the type series is the frequency of abnormal wing development. Seven of the twenty specimens have one or more complete cross-veins between r_{2+3} and r_{4+5}, and others have partial cross-veins or stubs on one of these veins; in addition some specimens have a truncate wing tip. Both types of anomaly are shown by the wing figured (Fig. 36). Only seven specimens (35%) lack all such deviations from the normal *Phytomyza* wing-type. Specimens with venational abnormalities have been reported for many other species of Agromyzidae (see Hering, 1934 and Nowakowski, 1958), but are very rare. The high frequency of their occurrence in *tlingitica* is unprecedented, and must surely indicate that the genes concerned have beneficial effects which offset the disadvantage of reduced flight efficiency. The type series was obtained from two samples of leaves collected at points 5 miles apart (Portage Cove and Paradise Cove); the same anomalies are shown in flies from both samples.

Phytomyza angelicastri Hering 1932

Phytomyza angelicastri Hering. Hering, 1932: 576. Hendel, 1934:346. De Meijere, 1938: 88. Syntypes ♂♀, Crossen an Oder (Poland), in Zoologisches Museum, Humboldt Universität, Berlin.

Adult. – As described for *spondylii*, except as follows.

Genae in middle 1/4 to 1/3 of eye height. Posterior ors normally about 2/3 as long as anterior ors (but fully as long in some specimens, absent on one side in one male); anterior ori 1/3 to 2/3 as long as posterior ori; orbital setulae one-rowed. 3-4 upcurved peristomal setulae.

Acr in 4-5 irregular rows. Costal ratio mg_2/mg_4 3.0-3.8. Wing length 2.2-2.4 mm.

Centre of frons largely greyish white to ochreous yellow (infuscated anteriorly in paratype); orbits ochreous to brownish; genae yellow or ochreous yellow. Pale dorsal band on mesopleuron very narrow in all specimens.

Aedeagus as Fig. 14, 15; basal section with pair of serrate dorsal strips of sclerotization (about equally developed on both sides) above basal sclerites; main sclerites of medial lobe fused distally, forming point; additional sclerite (not spiniform) at left basal corner of medial lobe, but no similar sclerite on right side; distal section without ventral notch, partly unpigmented, but with conspicuous black mesophallus at base and paired narrow bands of distal pigmentation (distiphallus). Ejaculatory apodeme as Fig. 16.

Puparium and third instar larva. – Similar to those of *spondylii*, but with, on average, more numerous spiracular bulbs. Anterior spiracles with 12-18 bulbs; posterior spiracles with 22-28 bulbs (Fig. 37). See also the description of de Meijere (1938:88).

Mine. – Larvae leaf-miners on *Angelica*. Mine (Fig. 41) basically linear, but normally convolute (in some cases forming irregular secondary blotch), conspicuous (appearing white in reflected light), formed mainly on upper surface of leaf but with short initial linear channel on lower surface; faeces deposited as fine particles, mostly separated by less than 1 mm; larvae leaving leaf through semicircular slit (on upper or lower surface) before puparium formation.

Material examined. – 1♂ paratype from larva 24.viii.32 on *Angelica sylvestris* L., Krosno (Crossen an Oder), Poland, emerged 12.ix.32, leg. M. Hering (no. 4030). 1♂ from larva on *Angelica* sp., München (-Freimann), Germany, emerged 25.i.53, leg. F. Groschke. 1♂ from larva vii.53 on *Angelica sylvestris* L., Grantown, Inverness, Scotland, emerged 26.viii.53, leg. K. A. Spencer. 2♀♀ from larvae 10-17.ix.53 on *Angelica sylvestris* L., Rickmansworth, Herts., England, emerged 5-11.x.53, leg. G. C. D. Griffiths. Preparation of larva, 21.vi.61, on *Angelica sylvestris* L., Woodwalton Fen, Hunts., England, leg. G. C. D. Griffiths.

Other records. – The known distribution of this species is summarized as follows. Except where otherwise stated, all records refer to specimens bred from, or mines found on, *Angelica sylvestris* L.

Britain – Widespread and common from South-East England to Inverness (Scotland) and the West coast of Ireland; locality records given by Spencer (1955), Allen (1956), Manning (1956) and Griffiths (1963, 1966, 1968). There are probably three generations a year in southern England (see Allen, 1956 and Griffiths, 1963).

France – Calvados, Normandy (sheet in Hering's mine herbarium).

Belgium – Rixensart (Collart, 1942).

Germany – Probably widespread; in addition to the above record for München, collected by Zoerner (1969) in the Middle Elbe region and by H. Buhr at Mühlhausen, Thuringia (Griffiths, 1966: 873); also sheets in Hering's mine herbarium for Saxony (Görlitz, Lausitz, Bad Elster), Rheinland (Rhöndorf), Mecklenburg (Ribnitz) and Berlin. Von Tschirnhaus (in correspondence) has caught this species near Kiel (Schleswig-Holstein) (6♂♂ 5♀♀, Dobersdorfer See, 2.vi.68; 1♂, Ihlkate, 22.vi.69).

Austria – Sheets in Hering's mine herbarium for Linz (Donau) and Güssen bei St. Georgen.

Poland – Widespread; records additional to the type locality given by Kubska (1961), Beiger (1965a, 1965b, 1970), Griffiths (1966: 873) and Michalska (1970).

Bulgaria – West Rila mountains (Buhr, 1941b).

Denmark – Lolland (Rydén, Lyneborg & Nielsen, 1963).

Norway – Collected at Voss by Grönlien (Hering, 1932).
Sweden – Widespread in the South; records given by Rydén (1937) and Griffiths (1966: 873).
Finland – Recorded by Frey (1946), but the records seem based on caught flies and require checking.

Phytomyza lanati Spencer 1966

Phytomyza lanati Spencer. Spencer, 1966: 108.–1969: 250. Holotype ♂, Berkeley Hills (California), in U. S. National Museum, Washington.

I have not seen material of this species, of which only two specimens are known. Spencer's descriptions suggest that it is not separable from *spondylii* on external characters. His figures of the aedeagus (♂) indicate the following differences from *spondylii*:– basal section without spinules; pair of additional serrate strips of sclerotization below main sclerites of medial lobe; distal section without ventral notch, partly unpigmented but with small pigmented mesophallus (more widely separated from basal section than in other species of *spondylii* subgroup) and paired narrow bands of distal pigmentation (distiphallus).

This species was originally described (Spencer, 1966) from a mixed sample containing also specimens of *spondylii heracleiphaga.* Some of the paratypes were later found to belong to the latter taxon. Only the holotype male (bred by M. J. & C. A. Tauber from *Heracleum lanatum* Michx. at Strawberry Canyon, Berkeley Hills, California, emerged 7.vi.64) and a specimen caught at Jasper, Alberta (19.vi.66) are correctly referred to this species (Spencer, 1969).

The holotype is believed to have been bred from linear upper-surface mines similar to those of *spondylii.* Owing to the previous confusion between this species and *spondylii heracleiphaga,* it is not clear whether the life-history information published by Tauber & Tauber (1966, 1968) in fact refers to this species. Their work needs to be supplemented by further studies to clarify the identity of the species concerned.

Phytomyza archangelicae Hering 1937

Phytomyza archangelicae Hering. Hering, 1937: 566. De Meijere, 1937: 212. Griffiths, 1964: 400. Syntypes ♂♀, Mecklenburg (Germany), in Zoologisches Museum, Humboldt Universität, Berlin.

Phytomyza nilssoni Rydén. Hering, 1956: 275. Rydén, 1956: 199. Holotype ♂, Abisko (Sweden), in Zoological Institute, University of Lund. Synonymy after Griffiths, 1964: 400.

Adult. – Head with orbits not or only narrowly projecting above eye in lateral view; genae in middle 1/4 to 1/3 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 half to almost as long as anterior ors (about half in most specimens); anterior ori 1/2 to 3/4 as long as posterior ori in most specimens, but weak or absent in a few; orbital setulae few (1-4), in one row. Peristomal margin with vibrissa and 4-5 upcurved peristomal setulae. Third antennal article rounded distally, with short pubescence.

2 + 1 or 3 + 1 dc (see note in Griffiths, 1964); acr in four irregular rows; 6-10 presutural ia; 3-8 postsutural ia; inner pa about half as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4 3.0-3.7. Wing length 2.3-2.7 mm.

Colour almost entirely dark. Centre of frons dark brown; genae brown or yellow-brown. Labella yellow. Thorax grey-dusted over black ground colour, only weakly shining, with pale coloration only along notopleural and mesopleural sutures and at posterior corner of humeral callus. Wing base and squamae yellowish white, latter with dark fringe. Legs largely dark with tips of front femora contrastingly yellow; tips of other femora less contrasting, yellow-brown to virtually black. Basal cone of ovipositor (♀) grey dusted on dorsal surface on about basal third.

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres partly delimited from periandrium by suture on outer side, bearing dense group of setulae. Pregonites large, weakly pigmented, extending ventrally (shielding base of aedeagus at rest). Aedeagal hood with two pairs of lateral sclerites (the more dorsal pair rather ill-defined). Aedeagus as Fig. 17, 18; basal sclerites very long, with left basal sclerite appearing sinuate in lateral view; three spinules on left side near apex of basal section; medial lobe scarcely differentiated, but its right sclerite retained (small slender sclerite near apex of right basal sclerite); distal section very short, with small unpaired sclerite (mesophallus) near base. Ejaculatory apodeme small (Fig. 19).

Puparium and third instar larva. – Described in detail by de Meijere (1937: 212) and Hering (1956: 275) (as *nilssoni*). Mandibles slender, with two more or less alternating teeth; right mandible slightly longer than left. Ventral process of paraclypeal phragma short. Anterior spiracles two-horned, with 8-14 bulbs in widely open ellipse; posterior spiracles on short broad processes, with 20-28 bulbs in narrow open ellipse (Fig. 39). Puparia dark brown to black, 1.6-2.0 mm long, strongly arched, with intersegmental boundaries distinctly impressed; anal lobes not prominent.

Mine. – Larvae leaf-miners on *Angelica.* Mine (Fig. 42) entirely linear, 7-10 cm long, about 2 mm wide terminally; faeces deposited as fine particles or in beaded strips on alternate sides of mine channel; mine conspicuous, appearing white in reflected light, formed mainly on upper surface of leaf but with short initial channel on lower surface; larvae leaving leaf through semicircular slit (on upper or lower surface) before puparium formation.

A figure of the leaf mine has previously been published by Rydén (1956).

Material examined. – 1♂ paratype from larvae 17.vi.36 on *Angelica archangelica* L., Neuhaus, Mecklenburg, Germany, emerged 6.vii.36, leg. H. Buhr. 3♂♂ 4♀♀, Kirkjubǿur and Kirkjubǿurhólmur, Streymoy, Faroe Islands, 3.vi.26 (caught), leg. P. J. Kryger. 4♂♂ from larvae vii.54 on *Angelica archangelica* L., Abisko and Kopparåsen, Torne Lappmark, Sweden, emerged 4-11.viii.54, leg. N. Rydén (holotype and paratypes of *nilssoni).*

4♂♂ 4♀♀ from larvae 26-30.vi.68 on *Angelica genuflexa* Nutt., Chilkat peninsula (near Haines), Alaska, emerged 24-28.vii.68 and 8.x.68 (1♀), leg. G. C. D. Griffiths; also parasitized larvae, same dates and locality, on *Angelica lucida* L. Empty mines on *Angelica genuflexa* Nutt. at Starrigavan, Sitka, Alaska (24.viii.69).

Remarks. – For discussion of synonymy and types, see my previous paper (Griffiths, 1964).

In addition to localities listed above, this species is reported on *Angelica archangelica* L. in North-West Poland; common in the Stettin district (Hering, 1937), Isle of Wolin and Dziwnów Peninsula (Nowakowski, 1954), and at Międzyzdroje and Drawsk-on-Noteć (Beiger, 1958). There is also a sheet of the same plant from southern Sweden (Råå near Hälsinborg, 14.viii.50) in Hering's mine herbarium. The discovery of this species in Alaska suggests that it is widely distributed at high latitudes. Whether it occurs in the mountains of Central Europe requires confirmation. Buhr (1964) has recorded it on *Angelica sylvestris* L. in the mountains of Saxony, presumably on the basis of mines similar to those recorded from South Moravia (Czechoslovakia) by Hering (1935) as *Phytomyza* spec. (no. 201). The figure

of mines attributed to *archangelicae* by Hering (1957) is based on this Moravian material (the same figure as on page 60 of his 1935 work). I have traced no flies bred from these collections in Moravia and Saxony, and regard the identity of the species concerned as unconfirmed.

Phytomyza arnaudi Sasakawa 1955

Phytomyza arnaudi Sasakawa. Sasakawa, 1955: 93.–1961a:441. Holotype ♂, Kyoto (Japan), in Entomological Laboratory, Saikyo University.

Described by Sasakawa (1955) on the basis of 10♂♂ 13♀♀ bred from *Angelica miqueliana* Maxim. at Kibune, Kyoto. In his 1961 work he also lists *Osmorhiza aristata* Makino & Yabe as a host, but gives no details of this record. Unless based on dissection of bred males, this record should be regarded as doubtful. In North America *Osmorhiza* and *Angelica* do not have any *Phytomyza* miners in common where they grow together.

I have seen no material of this species. The form of its aedeagus (Sasakawa, 1961a, Fig. 112d) suggests that it is very close to *archangelicae*. I base this opinion particularly on the presence of spinules in similar position near the apex of the basal section and the similarity of the very short distal section in both species.

Phytomyza polycladae Sasakawa 1955

Phytomyza polycladae Sasakawa. Sasakawa, 1955:95.–1961a:465. Holotype ♀, Hokkaido (Japan), in Entomological Laboratory, Saikyo University.

Described by Sasakawa (1955) on the basis of a female bred from *Angelica polyclada* Franch. at Sapporo, Hokkaido. In his 1961 work he records additional material bred from *Sanicula elate* Ham. var. *chinensis* Makino. Unfortunately it is not stated whether the new figures in this work (including those of the male genitalia) are based on material from *Angelica* or *Sanicula*. These plant genera have no *Phytomyza* miners in common in Europe and North America. Unless the genitalia of males bred from both hosts have been compared, the reference of the material from *Sanicula* to *polycladae* is suspect. If no male from *Angelica* was available, we cannot be sure that Sasakawa's (1961a) figures of the male genitalia refer to the true *polycladae*. I have seen no material referred to this species.

(b) the *Phytomyza angelicae* group

The species referred to this group all show a uniform type of aedeagus in which the distal section contains a pair of slender tubules arising from a cylindrical basal area of sclerotization; the spine-like processes (spinules) characteristic of most species of the *albiceps* group are lacking. The species of this group treated in this paper are *P. angelicae* Kaltenbach, *P. kibunensis* Sasakawa, *P. latifolii* Groschke, *P. heracleana* Hering and *P. angelicivora* Hering. Other species known to belong to this group are *P. pauliloewi* Hendel (Nowakowski, 1962), *P. selini* Hering (Nowakowski, 1962), *P. silai* Hering and *P. aconiti* Hendel. The reference of the last species (feeding on the ranunculaceous *Aconitum* and *Delphinium*) to this group may seem surprising, since all the other species feed on Umbelliferae. But the similarity between *aconiti* and the other species in the form of the aedeagus (Spencer, 1969, Fig. 390, 391) is clear enough, and the possibility of this relationship was already suggested by my report that the parasitoid *Dacnusa fuscipes* Griffiths (Hymenoptera, Braconidae) develops both on *aconiti* and *angelicae* (Griffiths, 1966:818).

Nowakowski (1962:105) has included the *angelicae* group as a subgroup of the *albiceps*

group, but gives no characterization in support of this classification. I prefer to separate the *angelicae* group from the *albiceps* group, since it is possible that the former is more closely related to some of the groups of Ranunculaceae-feeders. Further studies on the latter are needed to clarify this point.

I have previously drawn attention (Griffiths, 1972b) to the high variability in the length of the posterior ors in the *albiceps* group. In the species of the *angelicae* group treated in this paper, the length of this bristle is less variable. I think that a valid distinction can be drawn between species with strong posterior ors (*angelicae, pauliloewi, latifolii* and *aconiti)* and those in which this is less than half as long as the anterior ors (*heracleana, kibunensis, angelicivora, silai* and *selini).*

Phytomyza angelicae Kaltenbach 1874

Phytomyza angelicae Kaltenbach. Kaltenbach, 1874:279. Brischke, 1880:255. Hendel, 1920:159.–1934:344. De Meijere, 1926:243. Hering, 1927:115. Allen, 1956:125.–1957: 172. Griffiths, 1964:400. Types lost; type-locality Germany.

Phytomyza laserpitii Hendel. Hendel, 1924: 140.–1935: 424. De Meijere, 1926: 270.–1938: 91. Hering, 1927: 115. Syntypes ♂♀, Walchsee (Austria), in Naturhistorisches Museum, Vienna. New synonymy.

Adult.– Head with orbits not or only very narrowly projecting above eye in lateral view; genae in middle 1/4 to 1/3 of eye height; eyes with only sparse fine pubescence. Frons at level of front ocellus 2-2½ times width of eye. At least four well-developed pairs of orbital setae (two ors and two ori) present; posterior ors posteriorly directed, half to fully as long as anterior ors, anterior ors directed posteriorly or inwardly (normally only two pairs of ors present, but third ors present on one side in a few specimens); two pairs of long, inwardly directed ori present and in some specimens also shorter third pair; orbital setulae one-rowed. Peristomal margin with vibrissa and 3-6 upcurved peristomal setulae. Third antennal article rounded distally, with short pubescence. Palpi large, somewhat expanded.

3 + 1 dc; acr in 4 irregular rows; presutural ia numerous; 2-9 postsutural ia; inner pa 1/2 to 2/3 as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4 2.5-3.5 (mean 2.95). Wing length 2.0-3.1 mm (means: ♂, 2.55 mm; ♀, 2.8 mm).

Frons and orbits yellow, except dark vertex and ocellar plate (vte on dark ground, vti on boundary between dark and yellow ground). Face yellow at sides, with variable degree of infuscation in antennal pits. Genae yellow. Occiput dark. Antennae entirely dark, at most with first article and outer side of second article brown. Palpi black; labella yellow. Mesonotum densely grey-dusted, not shining, almost entirely dark, at most with traces of brown or yellow coloration on upper part of sutural triangle, at corners of humeral callus and on postalar callus; scutellum dark; mesopleuron largely dark, with only narrow dorsal strip of pale coloration; other pleura dark, but with some pale coloration along sutures (especially mesopleural suture). Wing base and squamae yellowish white, latter with dark fringe. Legs dark, with tips of femora yellow (in some specimens only those of front femora distinctly contrasting). Abdomen largely dark brown, in some specimens with narrowly yellow hind margins of terga. Basal cone of ovipositor (♀) largely shining, grey dusted only narrowly at base on dorsal surface.

Male postabdomen with 8th sternum fused with 6th tergum. Telomeres not delimited from periandrium, bearing only fine setulae. Pregonites large,distinctly pigmented, extending ventrally (shielding base of aedeagus at rest). Aedeagal hood with two pairs of lateral sclerites. Aedeagus as Fig. 20, 21; right basal sclerite expanded at base; left basal sclerite varia-

ble in width (compare Fig. 21 and my figure of an Icelandic specimen (Griffiths, 1964, Fig. 2)); medial lobe with pair of well-defined sclerites; distal section with pair of slender tubules arising from cylindrical basal area of sclerotization. Ejaculatory bulb and apodeme as Fig. 22, with sides of bulb distinctly pigmented.

Puparium and third instar larva.– Described by de Meijere (1926:243, 270 and 1938: 91) and Allen (1957). Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with 10-13 bulbs in widely open ellipse; posterior spiracles (Fig. 38) on short conical processes, with 15-22 bulbs in broad ellipse (nearly circular). Puparia brown or black, 1.9-2.5 mm long, strongly arched, with intersegmental boundaries distinctly impressed; anal lobes prominent.

Mine.– Larvae leaf-miners on *Angelica, Heracleum* and *Laserpitium.* Mine (Fig. 43) primary blotch (without initial linear channel) on upper surface of leaf, with faeces irregularly deposited as particles throughout mine; mine appearing largely whitish or light green in reflected light, but with area consumed by first-instar larvae yellow or brownish; most mines communal, formed by more than one larva; larvae leaving leaf through semicircular slits (on upper or lower surface) before puparium formation.

The yellowish or brownish area produced by first-instar larvae is not always in the centre of the mine, as implied in Hering's (1957) key to miners of *Angelica.* A figure of mines of this species on *Angelica* is included in that work. Beiger (1960) gives a figure of a mine on *Laserpitium.* Spencer's (1969:286) figure of a mine on *Heracleum* from George Lake (Alberta) also refers to this species.

Material examined. – 8♂♂ 10♀♀ from larvae 9.viii.53 on *Angelica sylvestris* L., Pangbourne, Berks., England, emerged 26-30.viii.53, leg. G. C. D. Griffiths. 2 ♀♀ from larvae 15. viii.53 on *Angelica sylvestris* L., Bookham, Surrey, England, emerged 7.ix.53, leg. G. C. D. Griffiths. 1♂ 1♀ from larvae 8.xi.53 on *Angelica sylvestris* L., Brookman's Park, Herts., England, emerged 11.v and 2.vi.54, leg. G. C. D. Griffiths; 2♂♂ 1♀ from larvae 17.vi.62, same plant and locality, emerged 10-11.vii.62, leg. G. C. D. Griffiths.

4 ex. from larvae 30.vii.62 on *Angelica sylvestris* L., Skaftafell, Iceland, emerged 18.ii-9. iii.63, leg. H. Andersson (Griffiths, 1964).

1♂ 1♀ from larvae on *Laserpitium latifolium* L., Walchsee, Tirol, Austria, emerged 15.viii. 23 and 18.iii.24, leg. F. Hendel (syntypes of *laserpitii).* 1♂ from larva 25.vii.55 on *Laserpitium latifolium* L., Névache, Hautes Alpes, France, emerged 26.v.56, leg. K. A. Spencer. 1♂ from larva on *Laserpitium latifolium* L., Vals, Switzerland, emerged 7.iii.30, leg. W. Hopp. 1♂ from larva on *Laserpitium latifolium* L., Schwäbische Jura, Germany, emerged 2. iv.23, leg. M. Hering (no. 2254) (paratype of *laserpitii*). 1♂ from larva on *Angelica sylvestris* L., Bredow bei Nauen, Germany, emerged 8.vii.23, leg. M. Hering (no. 2221). 1♂ from larva 3.vii.29 on *Angelica sylvestris* L., Berlin (Rüdersdorf), Germany, emerged 21.ix.29, leg. M. Hering. 1♂ from larva 14.v.66 on *Angelica sylvestris* L., Möst (near Dessau), Germany, emerged 25.vi.66, leg. K. H. Zoerner. 6♂♂ 4♀♀ from larvae 18.viii.65 on *Angelica sylvestris* L., Mühlhausen (Stadtwald), Thuringia, Germany, emerged 6-10.ix.65, leg. H. Buhr (no. 2609); 6♂♂ 7♀♀ from larvae 4.x.65, same plant and locality, emerged 22-23.x.65, leg.H. Buhr (nos. 2691 & 2692); 19♂♂ from larvae 7.viii.67, same plant and locality, emerged 24-31.viii.67, leg. H. Buhr (no. 3561). 1♂ 1♀ from larvae 4.viii.24 on *Angelica archangelica* L., Stettin, Poland, emerged 28.viii.24, leg. Enderlein.

9♂♂ 9♀♀ from larvae 26-30.vi.68 on *Heracleum lanatum* Michx., Chilkat peninsula (near Haines), Alaska, emerged 5-28.v.69, leg. G. C. D. Griffiths; 1♂ from larvae on *Angelica genuflexa* Nutt., same dates and locality, emerged 10.v.69, leg. G. C. D. Griffiths; 14♂♂ 26♀♀ from larvae on *Angelica lucida* L., same dates and locality, emerged 8.v-22.vi.69, leg. G. C. D.

Griffiths. 47♂♂ 30♀♀ from larvae 19-22.vi.71 on *Heracleum lanatum* Michx., Elk Island National Park, Alberta, emerged 10-17.vii.71 (74 ex.) and 10-11.v.72 (2♂♂ 1♀), leg. G. C. D. Griffiths.

Other records. – Other records of this species for Europe are summarized as follows. The records listed above are the first for North America.

Britain – Widespread and common on *Angelica sylvestris* L., from South-East England to the West coast of Ireland (northern limit not known); locality records given by Allen (1956), Manning (1956) and Griffiths (1966, 1968).

France – Forges d'Abel, Pyrenees (1200 metres), on *Angelica razulii* Gouan (sheet in Hering's mine herbarium).

Holland – Collected on *Angelica sylvestris* L. by de Meijere (1926: 243).

Germany – Widespread and common on *Angelica* and *Laserpitium;* locality records given by Voigt (1929), Buhr (1932, 1941a, 1960, 1964), Griffiths (1966: 796, 810, 873) and Zoerner (1969); also numerous sheets in Hering's mine herbarium. Von Tschirnhaus (in correspondence) has taken this species at Dobersdorfer See, near Kiel (Schleswig-Holstein).

Austria – Collections on *Laserpitium* recorded by Hendel (1924) and de Meijere (1938: 91); also sheets for *Angelica sylvestris* L. and *Laserpitium* in Hering's mine herbarium.

Italy – Alto Adige, on *Laserpitium* (Hartig, 1939).

Poland – Widespread, on *Angelica* and *Laserpitium;* locality records given by Brischke (1880), Karl (1936), Nunberg (1947), Nowakowski (1954), Beiger (1960, 1965a, 1965b, 1970), Kubska (1961), Griffiths (1966: 796, 856) and Michalska (1970).

Czechoslovakia – On *Angelica sylvestris* L. (Starý, 1930).

Denmark – Collected on *Angelica* by Sønderup (1949).

Sweden – Widespread, on *Angelica* and *Laserpitium;* locality records given by Rydén (1937, 1940, 1951, 1952) and Lundqvist (1949).

Finland – Photograph of mines on *Angelica sylvestris* L. in Linnaniemi (1913, Tafel VII); recorded on *Angelica* and *Laserpitium* by Frey (1937, 1946).

Russia – Livny and Moscow regions, on *Angelica sylvestris* L. (Braschnikow, 1897; Rohdendorf, 1960).

Remarks. – Hendel (1935:424) has already cast doubt on his previous separation of *laserpitii* as a distinct species. I can find no difference between flies bred from *Angelica* and *Laserpitium,* and therefore formally synonymize *laserpitii* with *angelicae.*

The taxon from Japan described by Sasakawa (1953, 1961a) as *Phytomyza angelicae kibunensis* is in my opinion a distinct species (see below). The Japanese vicariant of *angelicae* is more probably represented by specimens bred by M. Kuroda from communal blotch-mines on *Angelica decursiva* Franch. & Savat. (1♂ 2♀♀, Tottori prefecture, vi.67, now in K.A. Spencer's collection). These agree with the above description of *angelicae*, except as follows:– genae narrower, 1/6-1/4 of eye height; palpi more strongly enlarged; frons and genae orange-yellow; distal section of aedeagus (♂) with shorter distal tubules (Fig. 23). It is possible that these specimens are referable to the taxon described by Sasakawa (1961a: 443) as *Phytomyza bifida,* on the basis of caught specimens from Hokkaido. However the sclerites of the medial lobe in the bred male are not fused with the basal sclerites as indicated in the description of *bifida.* Until more material has been obtained, I must leave open the questions of whether Kuroda's specimens represent a distinct species or a race of *angelicae,* and of whether Sasakawa's name *bifida* refers to the same taxon.

Phytomyza kibunensis Sasakawa 1953, new status

Phytomyza angelicae kibunensis Sasakawa. Sasakawa, 1953: 13.–1961a:440. Holotype ♂, Kyoto (Japan), in Entomological Laboratory, Saikyo University.

See the detailed descriptions of Sasakawa (1953, 1961a). I have noted the following differences from *angelicae:*– posterior ors short or absent, only two ori present (anterior ori shorter than posterior ori); palpi smaller; costal ratio mg_2/mg_4 higher, 3.5-3.9; aedeagus (♂) (Fig. 24, 25) with distal tubules and sclerites of medial lobe shorter. The puparium and third instar larvae have a similar range of spiracular bulb numbers to that of *angelicae* (anterior spiracles with about 10 bulbs; posterior spiracles with 17-20 bulbs) (Sasakawa, 1953). Mine (Sasakawa, 1961a, Fig. 110) primarily linear, formed by single larva, with irregular blotchy areas terminally; faeces deposited as fine particles, arranged in strips on alternate sides of linear parts of mine; larvae leaving leaf through semicircular slit (on upper or lower surface) before puparium formation.

Material examined. – 1♂ paratype from larva v.51 on *Angelica polyclada* Franch., Kibune, Kyoto, Japan, emerged 5.vi.51, leg. M. Sasakawa.

Remarks.– The type series (2♂♂ 5♀♀) was bred from *Angelica polyclada* Franch. and *A. kiusiana* Maxim. at Kibune (Sasakawa, 1953). Subsequently Sasakawa (1961b) has listed *Heracleum lanatum* Michx. as a host, but I do not know whether this record has been authenticated by study of bred flies.

While *kibunensis* clearly belongs to the *angelicae-group,* I do not accept Sasakawa's interpretation that it is a subspecies of *angelicae.* The true *angelicae* is characterized by large palpi and at least four strong orbital setae, while in *kibunensis* the posterior ors and anterior ori are weak and the palpi smaller. In these respects *kibunensis* more closely resembles *heracleana* than *angelicae.* The mines of *kibunensis* are also very different from those of *angelicae.* Since flies more closely resembling *angelicae* have recently been obtained in Japan from communal blotch-mines similar to those of *angelicae* (see above under that species), I think it must be concluded that *kibunensis* is not the Japanese vicariant of *angelicae.* Full specific rank is therefore accorded.

Phytomyza latifolii Groschke 1957

Phytomyza spec. Hering, 1936: 299 (no. 1467). Hartig, 1939:454.

Phytomyza latifolii Groschke. Groschke and Hering, 1957: 128. Hering, 1957: 597. Holotype ♂, Bavaria (Germany), in Staatliches Museum für Naturkunde, Ludwigsburg.

Adult. – External form of holotype as described by Groschke (Groschke and Hering, 1957), differing clearly from *angelicae* as follows: only one ori present; palpi relatively smaller; head darker, with frons and genae deep golden yellow and face largely infuscated. Wing length 2.2 mm (not 1.2 as stated in the original description).

Male postabdomen as described for *angelicae,* except as follows. Telomeres partly delimited from periandrium by suture on outer side. Aedeagus (Fig. 27, 28) with sclerites of medial lobe longer, almost forming loop; terminal tubules of distal section larger, curved upwards so that their apices are posteriorly directed. Ejaculatory apodeme larger (Fig. 29).

Puparium and third instar larva. – Puparium of holotype very similar to that of *angelicae,* 2.2 mm long, with prominent anal lobes; anterior spiracles with 10 bulbs; posterior spiracles with 16 bulbs in broad ellipse.

Mine. – Larvae leaf-miners on *Laserpitium latifolium* L. Mine (Hering, 1936 and 1957) linear, confined to upper surface of leaf, initially narrow and convolute but strongly widened

to about 2 mm terminally, in many cases branched; faeces deposited as discrete particles in two rows; larvae leaving leaf through semicircular slit on upper surface before puparium formation.

Photographs or figures of the leaf mines have been published by Hartig (1939), Hering (1957) and Beiger (1960).

Material examined. – Holotype ♂ from larva 11.viii.51 on *Laserpitium latifolium* L., Kessel am Königssee (near Berchtesgaden), Bavaria, Germany, emerged 28.iv.52, leg. F. Groschke.

Other records. – Additional records of this species are as follows.

Austria – Kunatal, Tirol (1500 metres), 27.vii.47, leg. Klimesch (sheet in Hering's mine herbarium); Stanzach im Lechtal (Tirol), 25-26.viii.37, leg. H. Buhr (de Meijere, 1938:95).

Italy – Madonna di Campiglio, Alto Adige (Hartig, 1939).

Poland – Ojców National Park (Góra Koronna), larvae common in June in shrub association (Beiger, 1960).

Spencer's (in Groschke and Hering, 1957) record for France (Névache, Hautes Alpes) is doubtful, as the only adult fly obtained from his sample belongs to *angelicae*.

Phytomyza heracleana Hering 1937

Phytomyza heracleana Hering. Hering, 1937:582.–1957:525. De Meijere, 1937: 219. Syntype ♂, Ribnitz (Germany), in K. A. Spencer's collection.

Adult. – Head with orbits not or only very narrowly projecting above eye in lateral view; genae in middle 1/4 to 1/3 of eye height; eyes with only sparse fine pubescence. Frons at level of front ocellus 2-2½ times width of eye. At most four orbital setae (two ors and two ori) present; posterior ors not more than half as long as anterior ors, absent in some specimens; anterior ori 1/2 to 2/3 as long as posterior ori; orbital setulae more or less one-rowed. Peristomal margin with vibrissa and 3-4 upcurved peristomal setulae. Third antennal article rounded distally, with short pubescence. Palpi relatively smaller than in *angelicae*.

3 + 1 dc; acr in 3-4 irregular rows; 3-6 presutural ia; 1-7 postsutural ia; inner pa at most half as long as outer pa (absent in one specimen).

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4 2.8-3.8. Wing length 1.9-2.3 mm.

Frons and orbits yellow, except dark vertex and ocellar plate (vte on dark ground, vti on boundary between dark and yellow ground). Face largely yellow, only weakly infuscated in antennal pits. Genae yellow. Occiput dark. Antennae with first article yellow-brown, second article brown, third article black. Palpi black; labella yellow. Mesonotum scarcely shining, densely grey dusted over black ground-colour centrally, brownish at sides (especially on sutural triangle), with traces of yellow coloration only at corners of humeral callus; scutellum dark; mesopleuron largely dark, with narrow yellowish-white dorsal strip; other pleura dark, but with some pale coloration along sutures (especially mesopleural suture). Wing base and squamae yellowish white, latter with dark fringe. Legs dark, with tips of front femora contrastingly yellow; tips of other femora less contrasting, dull yellow to brown. Abdomen dark brown. Basal cone of ovipositor (♀) largely shining, without grey-dusting on dorsal surface.

Male postabdomen as described for *angelicae*, except as follows. Telomeres partly delimited from periandrium by suture on outer side. Aedeagus (Fig. 30, 31) with sclerites of medial lobe longer, broadened ventrally, almost forming loop; distal section with terminal tubules conspicuously angled and curved upwards distally. Ejaculatory apodeme much larger (Fig. 32).

Puparium and third instar larva. – Described by de Meijere (1937:219), very similar to those of *angelicae.* Anterior spiracles with about 10 bulbs; posterior spiracles with 14-20 bulbs in broad ellipse. Puparia 1.8-2.0 mm long, with prominent anal lobes.

Mine. – Larvae leaf-miners on *Heracleum.* Mine (Hering, 1957:525) (Fig. 44) with short initial linear channel on lower surface; then becoming largely interparenchymal blotch (pale green when fresh) produced by larval feeding on upper layer of spongy parenchyma, with marbled appearance caused by scattered holes eaten in palisade parenchyma; old mines indicated by red-brown or yellowish discoloration; faeces deposited as fine particles throughout mine; larvae leaving leaf through semicircular slit on lower surface before puparium formation.

Material examined. – 4♂♂ from larvae on *Heracleum sphondylium* L., Berlin Botanical Gardens, Germany, emerged 22.ii-9.iii.51, leg. E. M. Hering (no. 5690). 1♂ from larva 21. viii.56 on *Heracleum sphondylium* L., Grasmere, Westmorland, England, emerged 23.v.57, leg. K. A. Spencer.

Other records. – The distribution of this species, based on collections of larvae on *Heracleum* (*sphondylium* where not otherwise stated), is summarized as follows.

Britain – Localities additional to that stated above given by Spencer (1953) and Griffiths (1966:792); also sheet for Hull in Hering's mine herbarium.

France – Verson near Caen, 30v.42 (sheet in Hering's mine herbarium).

Germany – Additional localities given by Buhr (1941a). Von Tschirnhaus (in correspondence) has supplied the following record: 7♂♂ 8♀♀ from larvae 3.vii.71 on *Heracleum sphondylium* L., Neuhof, N of Lübeck (Schleswig-Holstein), emerged 23.iii-3.iv.72.

Austria – Tirol (Buhr, 1941a).

Hungary – Collected by Spencer at Janoshegy near Budapest (Griffiths, 1966:792).

Bulgaria – West Rila mountains (Buhr, 1941b).

Poland – Localities given by Buhr (1941a),Nowakowski (1954), Beiger (1960) and Griffiths (1966:835).

Denmark – Bornholm (Buhr, 1941a).

Sweden – Localities given by Lundqvist (1949), Hering (1951) (on *Heracleum mantegazzianum* Sommier & Levier) and Rydén (1952).

Norway – Oslo Botanical Gardens (Rydén, 1955).

Remarks. – This species has been reported on various other genera of Umbelliferae additional to *Heracleum,* as follows: *Angelica* (Hering, 1957), *Caucalis* (Hering, 1957), *Laser* (Hering, 1957), *Laserpitium* (Hering, 1957; Beiger, 1960), *Pastinaca* (Buhr, 1941a, 1941b and 1954: Hering, 1957), *Peucedanum* (Hering, 1957; Beiger, 1960), *Pimpinella* (Buhr, 1941a; Hering, 1957; Beiger, 1960 and 1965a) and *Seseli* (including *Libanotis*) (Buhr, 1941a; Hering, 1957; Rohdendorf, 1960; Beiger, 1960 and 1965a). The validity of all these records should be checked, since I have not traced any flies bred from these plants.

There is no evidence of the occurrence of *heracleana* in North America, for the mines on *Heracleum* which Spencer (1969:275) suggested were produced by this species have proved to be produced by *angelicae.*

Phytomyza angelicivora Hering 1924

Phytomyza n.sp.? Braschnikow, 1897:30.

Phytomyza angelicivora Hering. Hering, 1924:225.–1927: 126. De Meijere, 1926:244. Hendel, 1934:347. Holotype ♂, Berlin (Germany), in Zoologisches Museum, Humboldt Universität, Berlin.

Phytomyza sp. De Meijere, 1938:94.

Adult. – Head with orbits only very narrowly projecting above eye in lateral view; genae in middle about 1/3 of eye height; eyes with only sparse fine pubescence. Frons at level of front ocellus about twice width of eye. Only one strong ors (posteriorly directed) present; posterior ors vestigial or absent; anterior ori less than half as long as posterior ori; 2-4 weak orbital setulae in one row. Peristomal margin with vibrissa and 2-4 upcurved peristomal setulae. Third antennal article rounded distally, with short white pubescence. Palpi somewhat expanded.

3 + 1 dc; acr few, in two rows; 2-4 presutural ia; only 1-2 postsutural ia; inner pa about half as long as outer pa.

Second cross-vein (m-m) absent. Costal ratio mg_2/mg_4 2.6-3.0. Wing length 1.5-2.3 mm.

Frons and orbits yellow, except dark ocellar plate; dark colour of vertex extending only to base of vte (vti on yellow ground). Face entirely yellow, without trace of infuscation. Genae yellow. Occiput largely dark, but yellow at sides ventrally. Antennae with first article yellow, second article yellow-brown or reddish, third article dark brown to black. Palpi black; labella yellow. Mesonotum densely grey-dusted, not shining, dark centrally but with broad yellow side bands (humeral callus yellow with brown area in centre; sutural triangle completely yellow); scutellum largely dark, with traces of pale coloration at basal corners; mesopleuron broadly yellow on dorsal half to two-thirds; other pleura dark, but with yellow or whitish coloration along sutures. Wing base and squamae yellowish white (including squamal fringe). Coxae dark; femora largely dark, with contrastingly yellow tips; tibiae and tarsi brown. Abdomen brown, with contrasting narrow yellow band along sides of terga. Basal cone of ovipositor (♀) largely shining, grey dusted only narrowly at base on dorsal surface.

Male postabdomen as described for *angelicae,* except as follows. Aedeagus (Fig. 33, 34) with sclerites of medial lobe relatively longer, almost forming loop; distal section with terminal tubules shorter and cylindrical basal area more closed ventrally. Ejaculatory apodeme as Fig. 35.

Puparium and third instar larva. – Described by de Meijere (1926:244, and 1938:94). Mandibles with two alternating teeth; right mandible longer than left. Anterior spiracles with 8-16 bulbs; posterior spiracles with 13-22 bulbs in rounded, partly open ellipse. Puparia dark brown, 1.5-1.6 mm long, strongly arched, with intersegmental boundaries distinctly impressed; anal lobes not prominent.

Mine. – Larvae leaf-miners on *Angelica palustris* (Besser). Mine (Hering, 1924 and 1927) with initial linear channel on lower surface, then with broader whitish channel following leaf margin on upper surface (becoming more or less blotchy terminally); faeces irregularly distributed, in places forming beaded strips; larvae leaving leaf through semicircular slit before puparium formation.

Material examined. – Holotype ♂, 1♀ paratype from larvae 24.vi.23 on *Angelica palustris* (Besser), Berlin (Brieselang), Germany, emerged 15.vii.23, leg. M. Hering (no. 2285); 1♂, same plant and locality, emerged 26.vi.24, leg M. Hering (no.2454) (incorrectly labelled as type by Hendel, for the emergence date is later than publication of the description); 1♂ from larva 5.vi.29, same plant and locality, emerged 27.vi.29, leg M. Hering (no. 3395).

Other records. – This species can be reliably recorded only for Russia (Livny district; Braschnikow, 1897) and East Germany. Published German localities in addition to the type locality are: Güntersberg-an-Oder (Hering, 1924), Nauen (de Meijere, 1938, as *Phytomyza* sp.), Pasewalk (Buhr, 1954) and Bräsenbruch (Zoerner, 1969). De Meijere's (1937:211) record for Holland is probably incorrect, as based on larvae from *Angelica sylvestris* L. with more numerous spiracular bulbs (described as "*Phytomyza obscurella* Fallén" by de Meijere,

1926: 279). Sønderup's (1949) records for Denmark were not accepted by Rydén, Lyneborg & Nielsen (1963). Records for Ljungskile, Sweden (Rydén, 1947) and Poland (Nunberg, 1947; Nowakowski, 1954) are also doubtful, as they were based on mines on *Angelica sylvestris* L. Such records could well be due to confusion with mines of *angelicastri.*

Remarks. – This species is very close to *Phytomyza selini* Hering and *P. silai* Hering. Hering originally reported the host-plant as *Angelica sylvestris* L., but later revised his identification to *A. palustris* (Besser) (Hering & Spencer, 1968: 180). The latter plant was stated by Braschnikow (1897) to be the host of an unidentified *Phytomyza* species, whose description can refer to no known *Angelica*-miner other than *angelicivora.*

Some unclarified or incorrect records

Additional unclarified or incorrect records, not mentioned in the preceding text, are as follows.

1. *Agromyza heraclei* Bouché (1847:143). The description cannot be referred to any known miner of *Heracleum.* I suspect that the flies were associated with incorrect data. I doubt whether Hendel (1936:540) was justified in suggesting that Bouché's species was the same as *Phytomyza spondylii* Robineau-Desvoidy, since flies without the second cross-vein (m-m) would hardly have been placed in *Agromyza.*

2. De Meijere (1941a:26) described larvae obtained by H. Buhr from mines on *Pastinaca sativa* L. in Mecklenburg (Germany). Hering (1957, no. 3587) described the mine as follows.

"Mine begins as short, lower-surface, very shallow channel near a leaf-vein; on upper surface it proceeds directly to the leaf-margin, and follows this for most of its course. The margins of the channel are irregularly sinuate. Faeces in a few widely separated particles. Semicircular slit on upper surface".

The species concerned remains unclarified.

3. Spencer (1969:285) has recorded linear mines on *Pastinaca sativa* L. in Quebec (Canada). Probably these were produced by *Phytomyza pastinacae* Hendel, but no flies were obtained.

4. Sehgal (1971:382) has described a female *Phytomyza* fly bred from linear mines on *Angelica arguta* Nutt. at Blairmore, Alberta. The species concerned cannot be determined until males are obtained.

5. Kuroda (1961: 70) has described *Phytomyza* larvae from linear mines on *Angelica decursiva* Franch. & Savat. in Japan. The identity of this species is still unclarified.

6. Entries nos. 373 and 376 in Hering's (1957) key to miners of *Angelica* should be deleted. They were based on records of Spencer's, who now considers them to be incorrect.

7. Hering (1957, no. 378) has doubtfully referred to *Phytomyza spondylii* Robineau-Desvoidy a linear mine collected by Spencer on *Angelica archangelica* L. at Kew Botanical Gardens, London. I have seen this mine, and think it was produced either by *P. spondylii* Robineau-Desvoidy or by *P. pastinacae* Hendel. There is no initial lower-surface channel (contra Hering, 1957), but only the oviposition scar on the lower surface of the leaf. An identification to species is not possible in the absence of bred flies.

ACKNOWLEDGEMENTS

For the loan of material for study my thanks are due to H. J. Hannemann (Zoologisches Museum, Humboldt University, Berlin), R. Lichtenberg (Naturhistorisches Museum, Vienna), E. Lindner (Staatliches Museum für Naturkunde, Ludwigsburg), K. A. Spencer (London, England), G. Steyskal (U. S. Department of Agriculture, Washington), E. Taylor (University

Museum, Oxford) and H. Zoerner (Dessau). M. von Tschirnhaus (University of Kiel, Germany) provided detailed information on his collections in correspondence. J. P. Dear of the British Museum (Natural History) provided information on the Hering mine herbarium. My wife Deirdre has again prepared the illustrations of leaf mines (Fig. 40-44). My field work in Alaska, Yukon and neighbouring areas in 1968-70 was supported by grants from the Boreal Institute of the University of Alberta.

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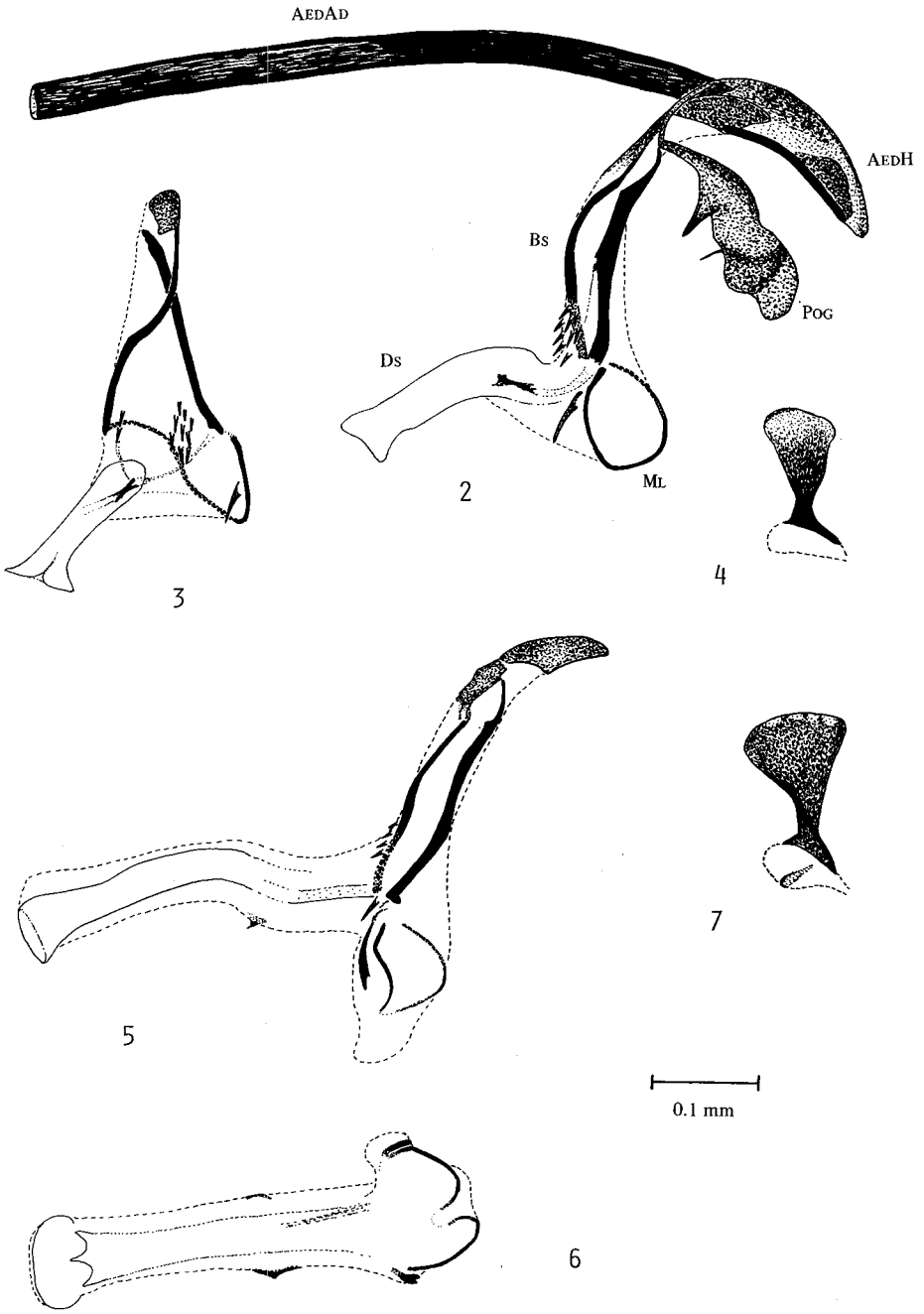


Fig. 2-4. *Phytomyza pastinacae* Hendel (♂), Ireland: 2, aedeagus and associated structures in lateral view (AEDAD aedeagal apodeme, AEDH aedeagal hood, BS basal section of aedeagus, DS distal section of aedeagus, ML medial lobe, POG postgonite); 3, aedeagus in ±anterodorsal view; 4, ejaculatory apodeme. Fig. 5-7. *Phytomyza spondylii heracleiphaga* Spencer (♂), Alaska: 5, aedeagus in lateral view; 6, distal section and medial lobe of aedeagus in ventral view; 7, ejaculatory apodeme.

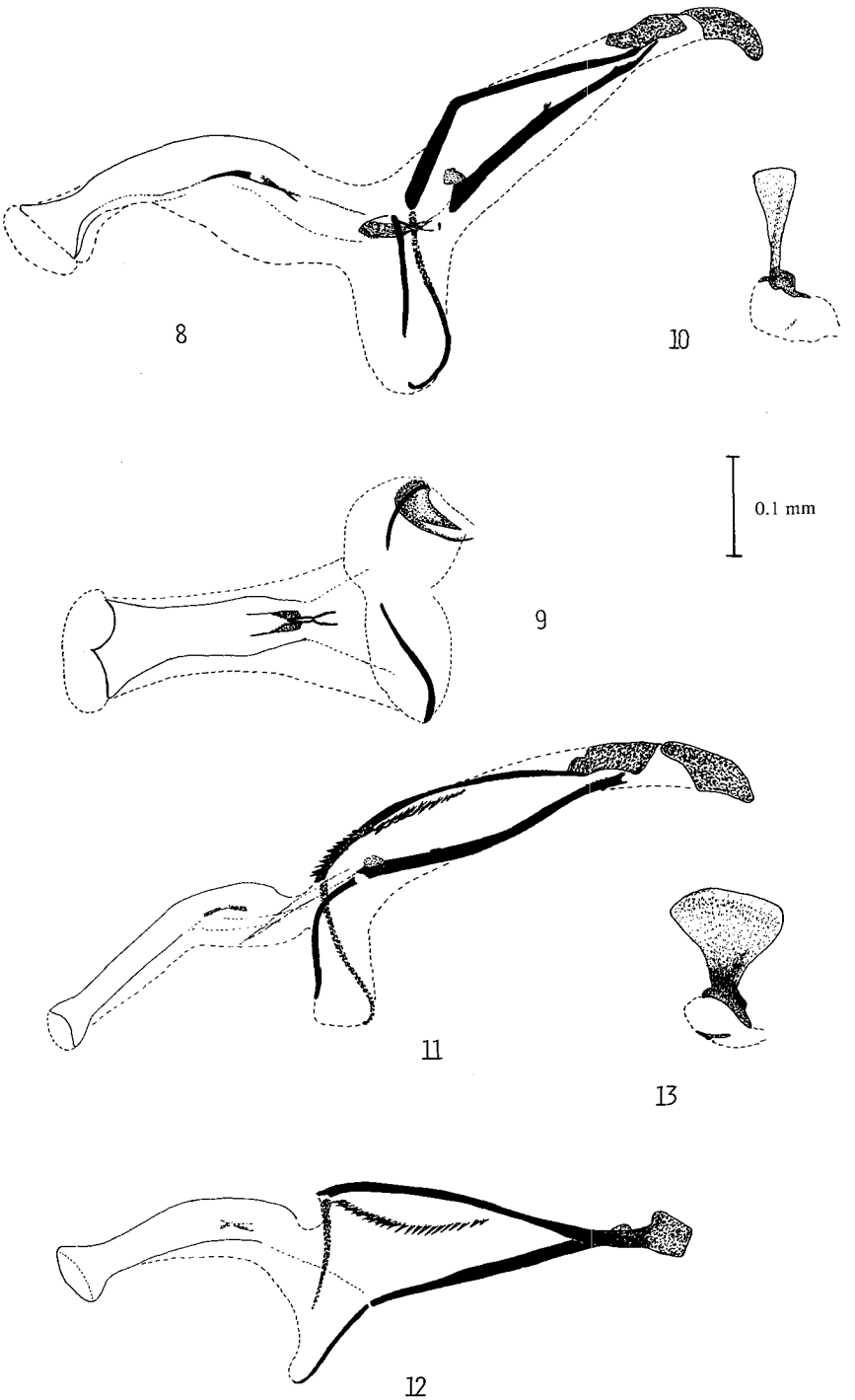


Fig. 8-10. *Phytomyza tlingitica* n. sp., holotype ♂: 8, aedeagus in lateral view; 9, distal section and medial lobe of aedeagus in ventral view; 10, ejaculatory apodeme. Fig. 11-13. *Phytomyza sphondyliivora* Spencer (♂), Surrey, England: 11, aedeagus in lateral view; 12, aedeagus in ±anterodorsal view; 13, ejaculatory apodeme.

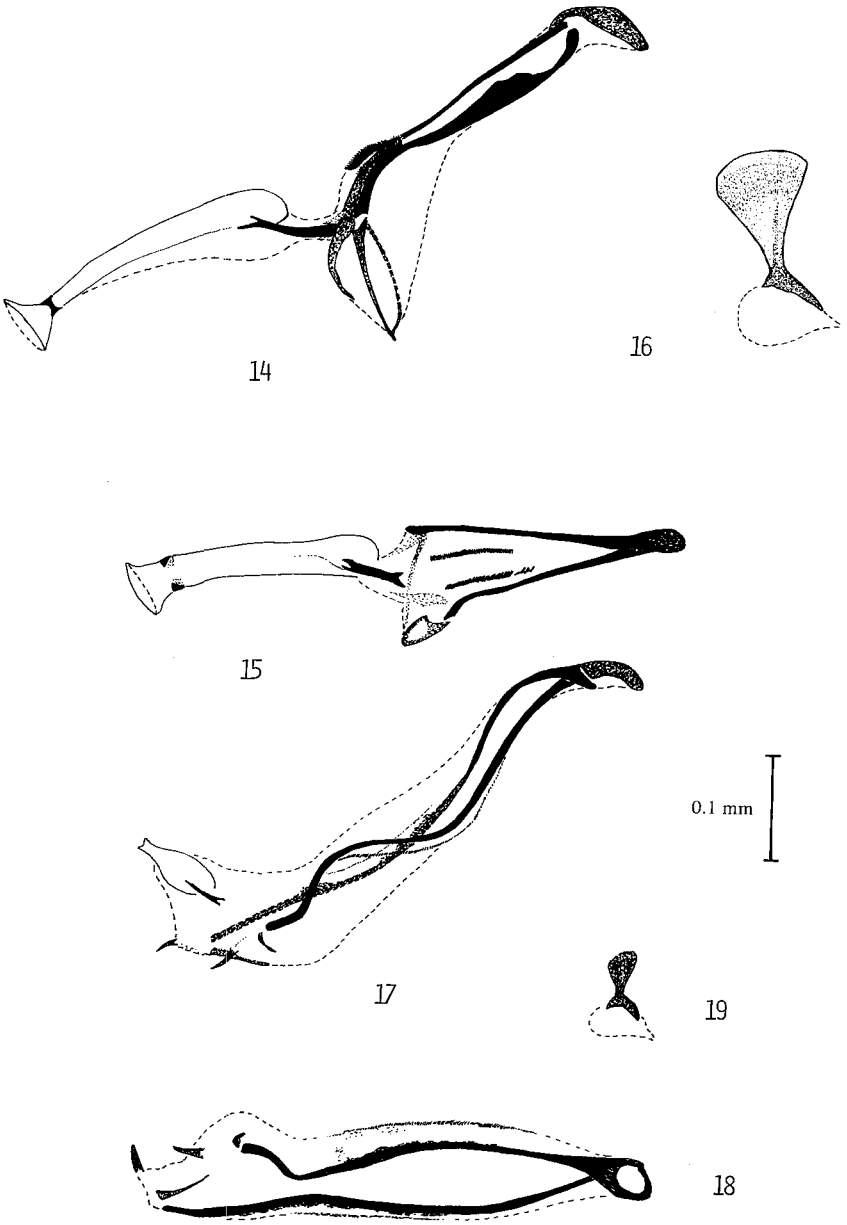


Fig. 14-16. *Phytomyza angelicastri* Hering (♂), München, Germany: 14, aedeagus in lateral view; 15, aedeagus in ± antero-dorsal view; 16, ejaculatory apodeme. Fig. 17-19. *Phytomyza archangelicae* Hering (♂), Alaska: 17, aedeagus in lateral view; 18, basal section of aedeagus (without phallophore) in ventral view; 19, ejaculatory apodeme.

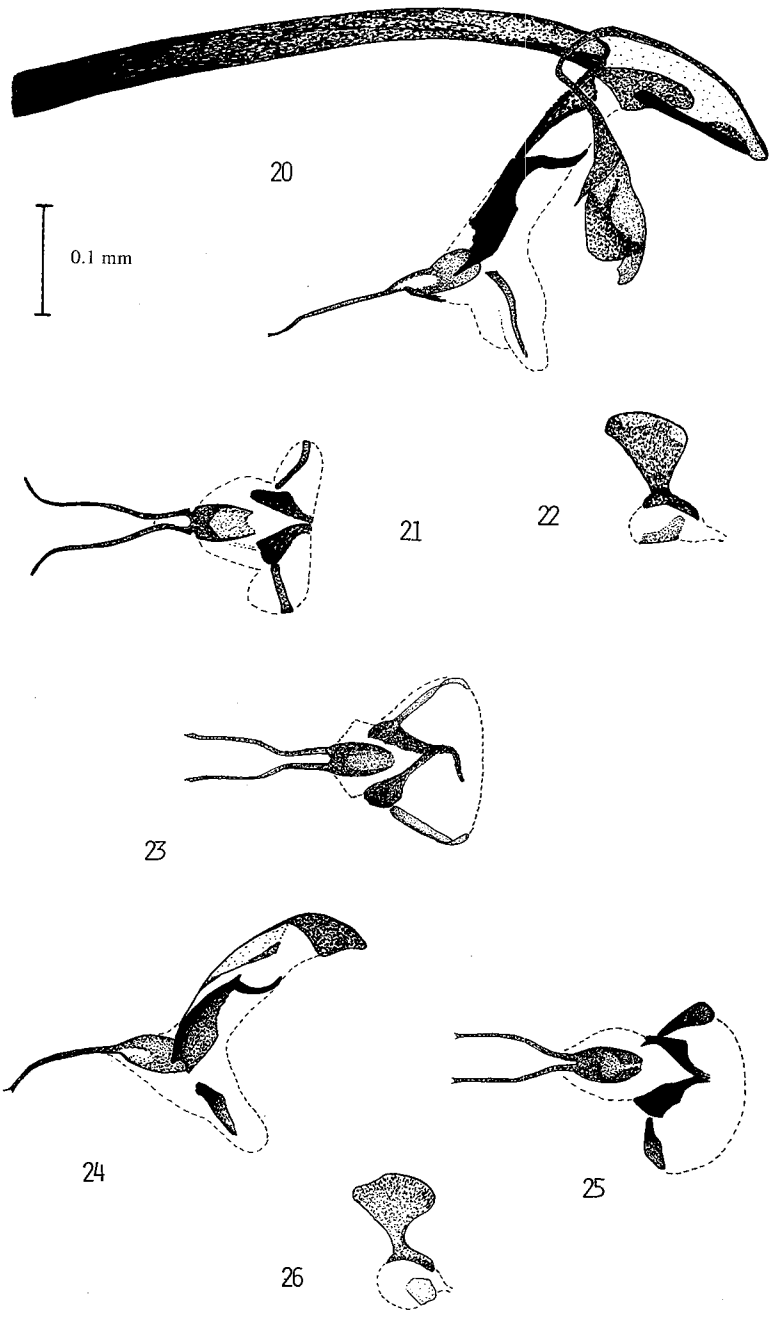


Fig. 20-22. *Phytomyza angelicae* Kaltenbach (♂), Herts., England: 20, aedeagus and associated structures in lateral view; 21, distal section and medial lobe of aedeagus in ventral view; 22, ejaculatory apodeme. Fig. 23. *Phytomyza* sp. ex *Angelica decursiva* Franch. & Savat. (Japan) (♂), distal section and medial lobe of aedeagus in ventral view. Fig. 24-26. *Phytomyza kibunensis Sasakawa,* paratype ♂: 24, aedeagus in lateral view; 25, distal section and medial lobe of aedeagus in ventral view; 26, ejaculatory apodeme.

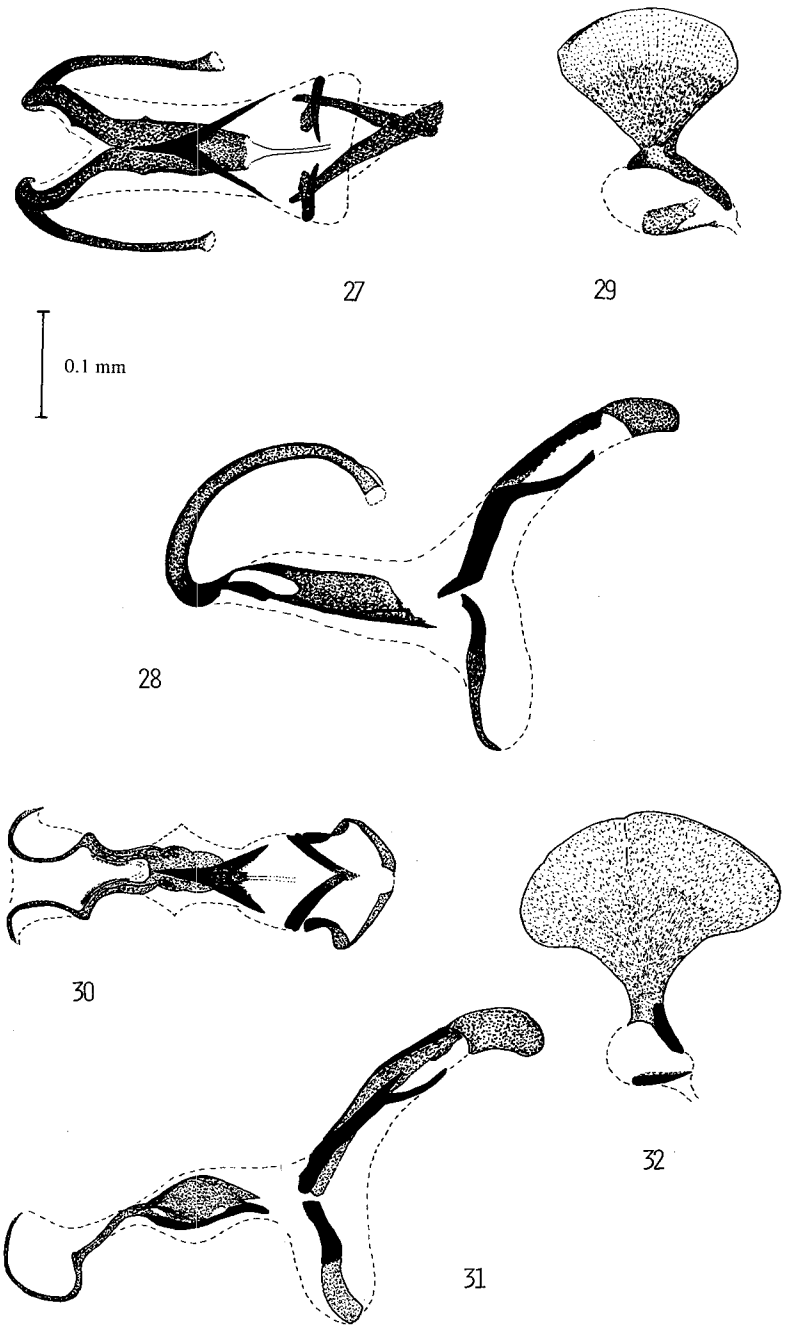
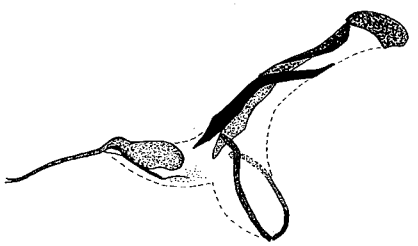


Fig. 27-29. *Phytomyza latifolii* Groschke, holotype ♂: 27, aedeagus in ventral view; 28, aedeagus in lateral view; 29, ejaculatory apodeme. Fig. 30-32. *Phytomyza heracleana* Hering (♂), Berlin, Germany: 30, distal section and medial lobe of aedeagus in ventral view; 31, aedeagus in lateral view; 32, ejaculatory apodeme.



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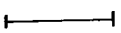

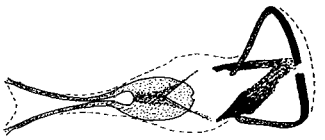

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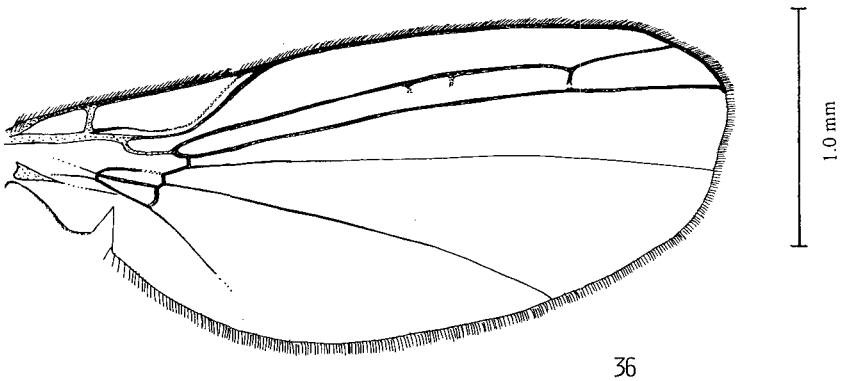

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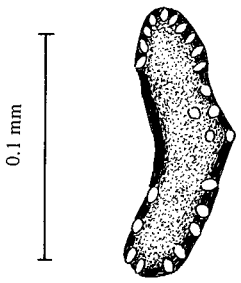

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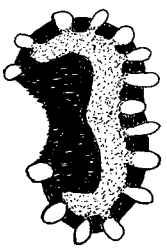

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Fig. 33-35. *Phytomyza angelicivora* Hering (♂), Berlin, Germany: 33, aedeagus in lateral view; 34, distal section and medial lobe of aedeagus in ventral view; 35, ejaculatory apodeme. Fig. 36. Wing of *Phytomyza tlingitica* n. sp. (paratype ♀), showing cross-veins between r_{2+3} and r_{4+5} and truncate wing tip. Fig. 37. *Phytomyza angelicastri* Hering (England), posterior spiracle of puparium in caudal view. Fig. 38. *Phytomyza angelicae* Kaltenbach (Germany), posterior spiracle of puparium in caudal view. Fig. 39. *Phytomyza archangelicae* Hering (Alaska), posterior spiracle of puparium in caudal view.

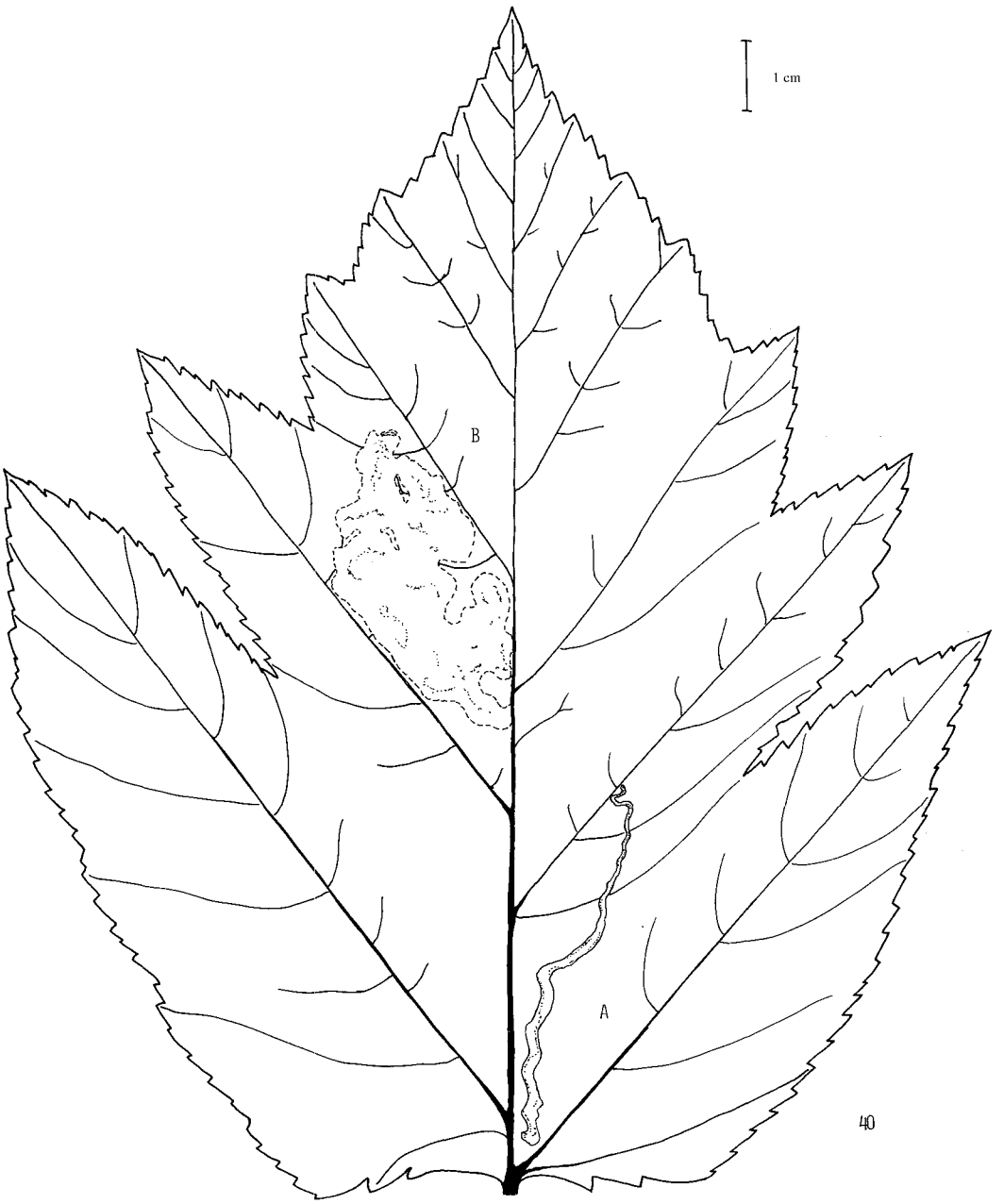

Fig. 40. Leaf of *Heracleum lanatum* Michx. with mines of *Phytomyza spondylii heracleiphaga* Spencer (A) and *P. tlingitica* n. sp. (B).

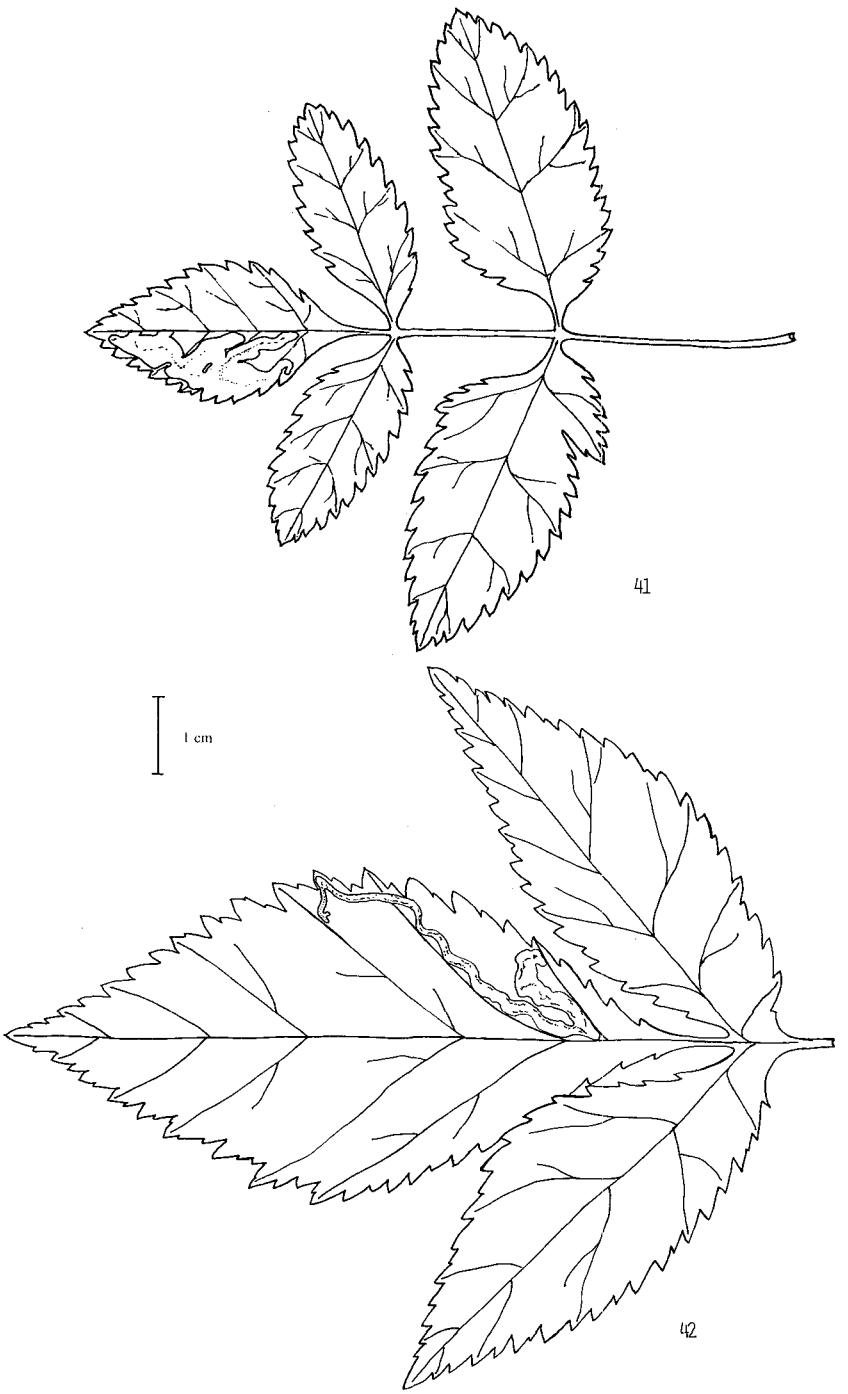

Fig. 41. Leaf of *Angelica sylvestris* L. with mine of *Phytomyza angelicastri* Hering. Fig. 42. Leaflet of *Angelica genuflexa* Nutt. with mine of *Phytomyza archangelicae* Hering.

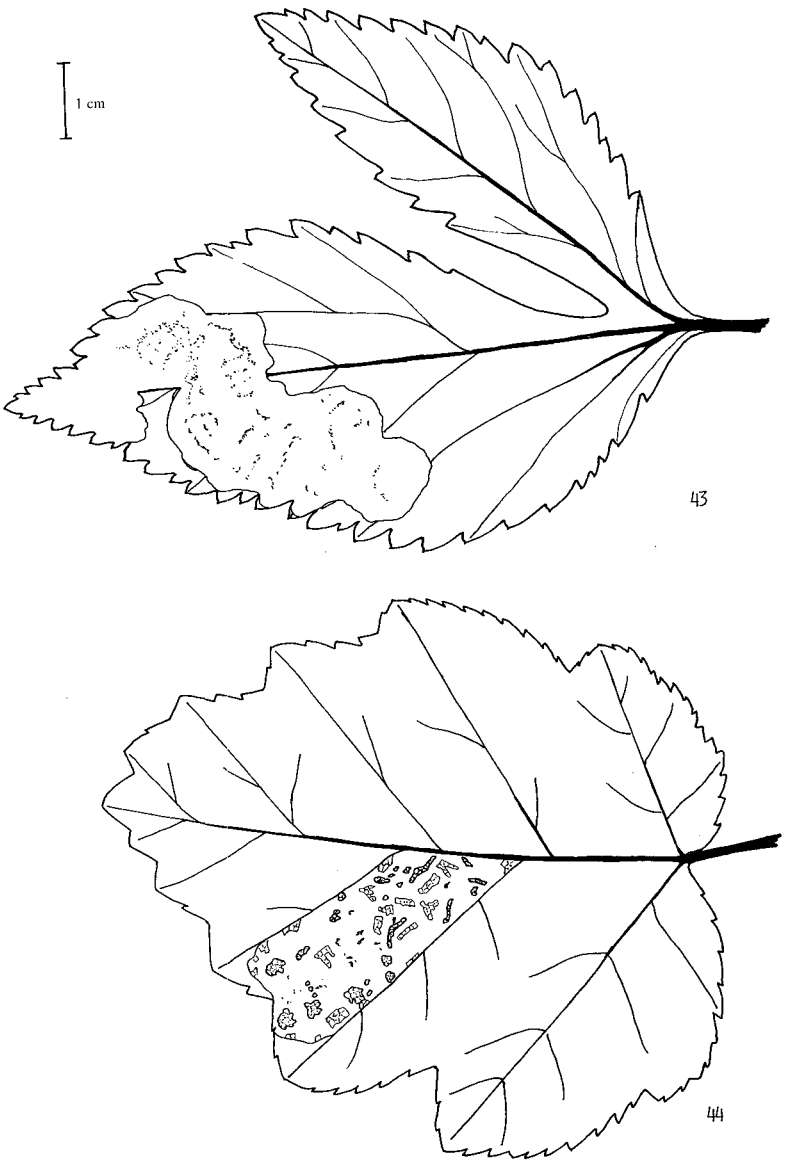

Fig. 43. Leaflet of *Angelica lucida* L. with communal mine of *Phytomyza angelicae* Kaltenbach. Fig. 44. Leaf of *Heracleum sphondylium* L. with mine of *Phytomyza heracleana* Hering.