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.


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 ........................................... pastinaceae 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 .......................................................... arachangelicae Hering
    – Medial lobe of aedeagus well differentiated, with left sclerite expanded (Griffiths, 1973, Figs. 4, 5) .................................. conisellini 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 ....................................... 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. spondylitivora Spencer
   - Alaska .................................................................................................................  P. tlingitica n. sp.

5. Europe ................................................................................................................. P. spondylitii spondylitii Robineau-Desvoidy, or  P. pastinacae Hendel
North America

*P. spondylia 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

2. Mine linear, produced by single larva
   
   *P. latifolii* Groschke

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**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 *spondylia* 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. spondylia* Robineau-Desvoidy, *P. pastinacae* Hendel, *P. sphondylitivora* Spencer, *P. tlingitica* n. sp., *P. angelicasri* Hering and *P. lanati* Spencer. Other species known to belong to this subgroup are *P. sii* Hering (Nowakowski, 1962), *P. cicuta* 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 *spondylia* 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 spondylia** 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 mgj/mg4 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 contrasting yellow; tips of other femora less contrasting, yellow-brown to reddish. Abdomen largely brown. Basal cone of ovipositor (9) 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 spine (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.
Phytomyza spondylia spondylia Robineau-Desvoidy 1851

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

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).


Fig. 1. Statistical differences between Phytomyza spondylia spondylia 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♂♂ subs. spondylia and Spencer's (1969) data on the type series of heracleiphaga.
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


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).


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


Adult. — As described for spondylii, except as follows.

3-4 upcurved peristomal setulae. Costal ratio mg₄/mg₃ 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 (9) 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.


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 spondylium L., Neuhof, N of Lübeck, Schleswig-Holstein, Germany, emerged 21.vii.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


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.


Remarks. — Additional English localities are Hampstead, London (30.v.53 and 3.vii.58) and Luccombe, Isle of Wight (4.vi.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 tingitica 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 mg₂/mg₄ 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 orient-ed 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 lan-atum 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 r₂₃ and r₄₅, 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 Agromyzidæ (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


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 para-
type); 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
(bboth 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 med­
ial lobe, but no similar sclerite on right side; distal section without ventral notch, partly un-
pigmented, but with conspicuous black mesophallus at base and paired narrow bands of dis­
tal 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 con­
volute (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; lar­
vae leaving leaf through semicircular slit (on upper or lower surface) before puparium forma­
tion.

_Material examined._— 1\( \delta \) 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\( \delta \) from larva on _Angelica_ sp., München (-Freimann), Germany, emerged 25.i.53, leg. F. Groschke. 1\( \delta \) from
larva vii.53 on _Angelica sylvestris_ L., Grantown, Inverness, Scotland, emerged 26.viii.53, leg.
K. A. Spencer. 299 from larvae 10-17.ix.53 on _Angelica sylvestris_ L., Rickmansworth, Herts.,

_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, _Angel­
ica 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\( \delta \delta \) 599, Dobersdorfer See, 2.vi.68; 1\( \delta \),
Ilkate, 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),

_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


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


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 about 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 uncurred 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 $mg_2/\text{mg}_4$ 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 (9) 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 Her- ing (1956: 275) (as nilssoni). Mandibles slender, with two more or less alternating teeth; right mandible slightly longer than left. Ventral process of paracylindrical 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).


4♂ 4♀ from larvae 26-30.vi.68 on Angelica genuflexa Nutt., Chilkat peninsula (near Haines), Alaska, emerged 24-28.vi.68 and 8.x.68 (19), 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.vii.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 (Rää near Hälsingborg, 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 arnudi* Sasakawa 1955


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


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


**Adul**—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. Peristomial 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 mg₃/mg₄ 2.5-3.5 (mean 2.95). Wing length 2.0-3.1 mm (means: δ, 2.55 mm; 9, 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 (9) largely shining, grey dusted only narrowly at base on dorsal surface.

Male postabdomen with 8th sternum fused with 6th tergum. Telomeris not delimited from periantrium, 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 larva 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.


999 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 99 from larvae on *Angelica genuflexa* Nutt., same dates and locality, emerged 10.v.69, leg. G. C. D. Griffiths; 14 99 from larvae on *Angelica lucida* L., same dates and locality, emerged 8.v-22.vi.69, leg. G. C. D.

**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).


**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; Rohden-dorf, 1960).

**Remarks.** — Hendel (1935:424) has already cast doubt on his previous separation of laser-pitii 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


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 mg₂/mg₄ 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 (268 599) was bred from Angelica polyclada Franch. and A. kiustana 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


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.
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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 for-
mation.

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

Material examined. — Holotype 6 from larva 11.vii.51 on Laserpitium latifolium L., Kess-
el am Königssee (near Berchtesgaden), Bavaria, Germany, emerged 28.iv.52, leg. F. Gros-
chke.

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 associa-
tion (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

type 6, 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 2/3 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. Peris-
tomal 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 mg₂/mg₄ 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 su-
tural triangle), with traces of yellow coloration only at corners of humeral callus; scutellum
dark; mesopleuron largely dark, with narrow yellowish-white dorsal strip; 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 con-
trasting yellow; tips of other femora less contrasting, dull yellow to brown. Abdomen dark
brown. Basal cone of ovipositor (9) largely shining, without grey-dusting on dorsal surface.

Male postabdomen as described for angelicae, except as follows. Telomeres partly delimit-
ed from periandrum 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.


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 Rydéén (1952).


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; Buhr, 1941a, 1941b and 1954: Hering, 1957), *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 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 squa-

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: Gütersberg-an-Oder (Hering, 1924), Nauen (de Meijere, 1938, as Phytomyza sp.), Pasewalk (Buhr, 1954) and Bräsenbruch (Zoerner, 1969). De Meijere's (1937:211) re-

Material of 'Phytomyza obscurella' described 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: Gütersberg-an-Oder (Hering, 1924), Nauen (de Meijere, 1938, as Phytomyza sp.), Pasewalk (Buhr, 1954) and Bräsenbruch (Zoerner, 1969). De Meijere's (1937:211) re-

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,
Griffiths

1926: 279). Sønderup’s (1949) records for Denmark were not accepted by Rydén, Lynenborg & Nielsen (1963). Records for Ljungskile, Sweden (Rydén, 1947) and Poland (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 angelicasteri.

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”.

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 (AED AD 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 alingirica 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 decurrens* 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 latifoli* 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.
Fig. 33-35. *Phytomyza angoelica* 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 ilingitica* n. sp. (paratype ♀), showing cross-veins between r\_2 + 3 and r\_4 + 5 and truncate wing tip. Fig. 37. *Phytomyza angeloelastri* Hering (England), posterior spiracle of puparium in caudal view. Fig. 38. *Phytomyza angeloelica* Kaltenbach (Germany), posterior spiracle of puparium in caudal view. Fig. 39. *Phytomyza archangelica* Hering (Alaska), posterior spiracle of puparium in caudal view.
Fig. 40. Leaf of *Heracleum lanatum* Michx. with mines of *Phytomyza spondylil 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.