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THE DANISH
ZOOGEOGRAPHICAL INVESTIGATIONS IN GREENLAND

# THE AGROMYZIDAE (DIPTERA) OF GREENLAND

BY

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WITH 21 FIGURES IN THE TEXT

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## Abstract

1. Nine species of Agromyzidae (Diptera) are recorded from Greenland, of which two are described as new. The new species are *Cerodontha* (*Dizygomyza*) *thulensis*, described from Thule in the Northwest, and *Phytomyza vibeana*, a species closely related to the holarctic *P. ranunculi* (SCHRANK), described from Upernavik in Northwest Greenland and Hekla Havn in Continental East Greenland.

2. The following three species are considered to have reached Greenland through Iceland over a land-bridge from Europe during an interglacial period:

*Phytomyza opacella* HENDEL
– *ranunculi* (SCHRANK)
– *varipes* MACQUART

3. Four species are considered to represent a Nearctic element in the fauna, of which two are considered to be higharctic species which have reached Northwest Greenland from Ellesmere Island. These are:

*Cerodontha* (*Dizygomyza*) *thulensis* sp. nov.
*Napomyza parvicella* (COQUILLET)

The following two species are widespread in Greenland, and their route of arrival is not clear:

*Phytoliriomyza arctica* (LUNDBECK)
*Phytomyza fuscula* ZETTERSTEDT

4. The origin of the remaining two species—*Cerodontha* (*Dizygomyza*) *lindrothi* GRIFFITHS and *Phytomyza vibeana* sp. nov.—is not clear. The former species occurs also in Iceland. The latter may occur in central Europe, but confirmation of this is needed.

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# INTRODUCTION

This paper is mainly based on new material from Greenland collected by Mr. CHR. VIBE and has been written at the suggestion of Mr. LEIF LYNEBORG (both of the University Zoological Museum at Copenhagen). It is a natural sequel to my work on the Agromyzidae of Iceland and the Faroes (GRIFFITHS, 1964). The identity of the species recorded has, as in that paper, been established by examination of the male genitalia (except in the case of *Phytomyza varipes* MACQUART of which only females were available). I have figured the aedeagus of all species except *Phytomyza varipes* MACQ. and *P. ranunculi* (SCHRANK), both of which have been figured previously in the literature.

The first record of an Agromyzid species from Greenland is in STAEGER (1845), who recorded "*Phytomyza obscurella* FALLÉN". I have seen his specimen and refer it to *Phytomyza opacella* HENDEL. VANHÖFFEN (1897) again records "*obscurella*" and another unidentified *Phytomyza* sp. from Qarajaqnunataq (CW) and Umanak (NW), but I have not traced these specimens, and have not included them in this paper. LUNDBECK (1900) records five species, including a new species which he describes as *Agromyza arctica*. In writing this paper I have re-examined all LUNDBECK's material, except for the single specimen which he called *Phytomyza affinis* FALLÉN, which cannot be traced. I am in full agreement with LUNDBECK's division of his material into species, but the application of the names he has used for all his *Phytomyza* species requires revision. This is hardly surprising in view of the confusion prevailing at specific level before HENDEL's work.

Since LUNDBECK's paper no new Greenland material appears to have been worked. DEMEIJERE's (1910) "Die Dipteren der arktischen Inseln" merely summarises the earlier records. HENDEL (1931–6) erroneously transferred LUNDBECK's *Agromyza arctica* to *Icteromyza* (obviously without seeing any specimens), but SHEWELL (1953) correctly ascribed it to *Phytoliriomyza*. In this he has been followed by FRICK (1957 and 1959) and Spencer (1963).

The following table shows the names used in LUNDBECK (1900) and in the present paper:

| LUNDBECK (1900) | Present paper |
|---|---|
| not recorded | *Cerodontha* (*Dizygomyza*) *lindrothi* GRIF. |
| not recorded | – – *thulensis* sp. nov. |
| *Agromyza arctica* n. sp. | *Phytoliriomyza arctica* (LUNDBECK) |
| not recorded | *Napomyza parvicella* (COQ.) |
| *Phytomyza affinis* FALLÉN | not known |
| – *nigritella* ZETT. | *Phytomyza fuscula* ZETT. |
| – *obscurella* FALL. | – *opacella opacella* HENDEL |
| – *Zetterstedtii* SCHIN. | – *ranunculi* (SCHRANK) |
| not recorded | – *varipes* MACQ. |
| not recorded | – *vibeana* sp. nov. |

The records of each species in this paper have been listed according to the floristic provinces proposed by BÖCHER, HOLMEN and JAKOBSEN (1957). The boundaries of these are shown on the distribution map of *Phytomyza ranunculi* (SCHRANK) and *P. vibeana* sp. nov. (fig. 17). They are the result of extensive studies of the distribution of the Greenland flora, and are clearly also appropriate for treating phytophagous insects.

## ORIGIN OF MATERIAL

Nearly all the material recorded in this paper was sent from the University Zoological Museum at Copenhagen. In returning it I have retained a few duplicates for my personal collection. The only material obtained elsewhere were 8 specimens belonging to the Hope Department of Zoology, Oxford, and a single specimen from the British Museum (Natural History). In giving the records of each species I have indicated which specimens came from Oxford or the British Museum.

Most of the material was collected by LUNDBECK in 1889 and 1890, by DEICHMANN in 1891 and 1892, and by Mr. CHR. VIBE from 1948 to 1953. In giving the records the names of these three collectors have generally been omitted, but material from other collectors has been indicated in every case by the collector's name.

## SYSTEMATIC TREATMENT AND RECORDS

### *Cerodontha (Dizygomyza) lindrothi* GRIFFITHS.

S Holotype ♂, Eqaluitlandet, near Julianehåb, 16.vii.48: ♂ (in alcohol), same locality, 17.vii.48: 2 ♂♂ paratypes, 1 ♀ (in alcohol), Frederiksdal, 30.vi.48.

CE Paratype ♀, Hekla Havn, 24.vii.1892.

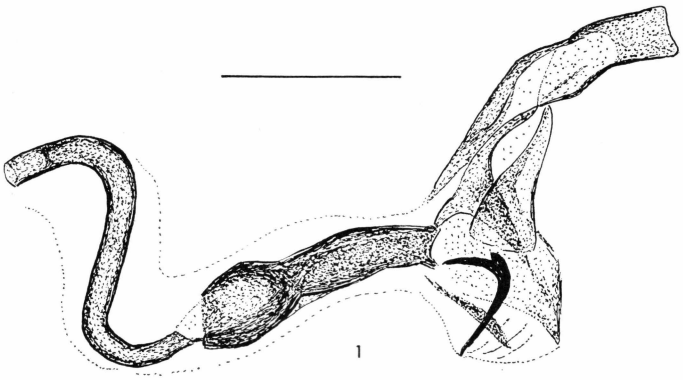
The description of this species has been given in my paper on the Agromyzid fauna of Iceland and the Faroes (GRIFFITHS, 1964). Externally it is very similar to the palaearctic species *C.* (*D.*) *luctuosa* MEIGEN and *C.* (*D.*) *effusi* KARL, but can clearly be distinguished by examination of the male aedeagus (figs. 1 and 2). The female has a somewhat enlarged third antennal segment, approaching that of the male, in contrast to the female of *C.* (*D.*) *thulensis* sp. nov. (see fig. 15).

#### Biology.

Unknown. The most likely larval food-plant seems to be *Carex*.

#### Distribution.

Outside Greenland the species is so far known only from two localities in North and South-East Iceland (see GRIFFITHS, 1964). As Dr. J. T. NOWAKOWSKI, who has studied the European members of this group in detail, does not know this species from Europe, it is possible that it is not of European origin. In my paper on the Agromyzid fauna of Iceland and the Faroes (GRIFFITHS, 1964) I concluded that it was the only Agromyzid species in Iceland which was probably of Greenlandic/American origin. Unfortunately the Agromyzid fauna of the parts of North America which show the greatest faunistic affinity with South Greenland—Baffin Island and Labrador— is still completely unknown. The few *Dizygomyza* specimens from North America which I have been able to examine have all come from much further south. The possible occurrence of this species in North America is thus a completely open question.



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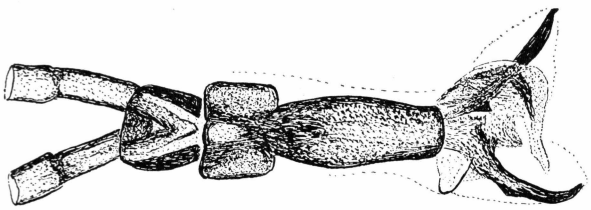

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Figs. 1–2. *Cerodontha* (*Dizygomyza*) *lindrothi* GRIFFITHS: 1, aedeagus in lateral view; 2, aedeagus in ventral view. (Scale 0.1 mm).

### ***Cerodontha (Dizygomyza) thulensis*** sp. nov.

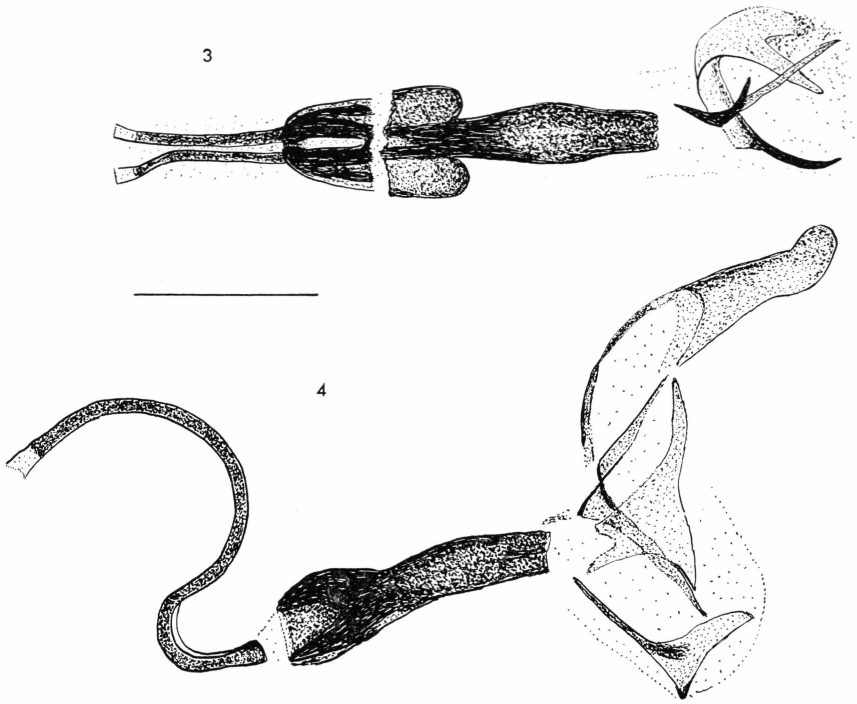
NW ♂ holotype, Thule, 27.vii.51: ♀ paratype, Thule, 6.vii.52. Both holotype and paratype are in the Zoological Museum, Copenhagen.

#### External Morphology.

Frons parallel-sided, about twice as wide as an eye. In profile the cheeks and orbits are narrowly visible in the female (fig. 15) (not describable in the holotype ♂ because the head is shrunken). Upper three orbital bristles of about equal length. Orbital setulae very few, near the bases of the lower orbital bristles. Antennae strongly sexually dimorphic: the third segment is large and quadrate in the male (as in *C.* (*D.*) *lindrothi* GRIF.), but small and rounded in the female (fig. 15): in both sexes it bears a fringe of white hairs. ♂ arista a little swollen at its base, but less so than in *lindrothi.*

Dorsocentrals (3 + 1) decreasing in length forwards. Acrostichals in about 5 irregular rows, reaching the hind dorsocentral. About 6 postsutural intra-alar hairs.

Wing not significantly different from that figured by HENDEL (1931–6) for *luctuosa* MEIGEN. Costal segments 2 and 3 are in a ratio




Figs. 3–4. *Cerodontha* (*Dizygomyza*) *thulensis* sp. nov. holotype: 3, aedeagus in ventral view; 4, aedeagus in lateral view. (Scale 0.1 mm).

of 3.9–4.0; segment 4 is a little shorter than segment 3. Last segment of $m_{3+4}$ slightly longer than the penultimate. The *r–m* cross-vein lies a little beyond the middle of the discal cell. Wing-length: ♂, 2.0 mm; ♀, 2.3 mm.

**Colour.**

Predominantly black. Frons and mesonotum grey-dusted over a black subshine. Legs dark except for the reddish-yellow tips of the front femora. Squamal fringe yellow-white.

♂ **genitalia** (figs. 3 and 4).

Distiphallus long and characteristically shaped, its tubules not divergent in ventral view (fig. 3). Ejaculatory bulb not examined.

Dr. J. T. NOWAKOWSKI, who is writing a monograph of the European species of *Cerodontha*, has confirmed (personal communication) that this species is not known to him from Europe. Externally the male appears very similar to that of *C.* (*D.*) *lindrothi* GRIF., although the head of the holotype is unfortunately too shrunken for close comparison. However the females of the two species, if I have correctly associated them, are

different in that the *lindrothi* female has andromorph antennae, but the *thulensis* female has a small rounded third antennal segment, as in the well-known holarctic species *C.* (*D.*) *luctuosa* (MEIGEN). According to the available material the wing of *thulensis* is more elongate than that of *lindrothi* (hence the differences in the costal ratio given in the descriptions), but it is doubtful if this character could be used for reliable specific diagnosis. The most reliable means of distinguishing the two species lies in the form of the male aedeagus, particularly the distiphallus.

### Biology.

Unknown. The most likely larval food-plant seems to be *Carex*.

### Distribution.

This species is not yet known outside Greenland, but in view of the close faunistic affinity of the North and North-West of Greenland with Ellesmere Island and other parts of the Canadian arctic, it will not be surprising if it will be found there.

## ***Phytoliriomyza arctica*** (LUNDBECK).

*Agromyza arctica* LUNDBECK, 1900, Vidensk. Medd. dansk naturh. Foren. Kbh. 5, p. 304.

*Dizygomyza* (*Icteromyza*) *arctica* (LUNDBECK), HENDEL, 1931–6, p. 57.

*Phytobia* (*Icteromyza*) *arctica* (LUNDBECK), FRICK, 1952, p. 393.

*Phytoliriomyza arctica* (LUNDBECK), SHEWELL, 1953, p. 469: FRICK, 1957, p. 204: FRICK, 1959, p. 414: SPENCER, 1963, p. 377.

NW 12 ex., Umanak, 3.viii.51: 1 ex., Qutdligssat, 5.vii.51 : 1 ex., Sarqaq, 26.vii.49.

CW 2 ex., Torssukátak, 27.vii.49: 10 ex., Jakobshavn, 6.viii.51: 2 paralectotypes, Kangersuneq, 24.vii.1890: 2 paralectotypes, Christianshåb, 1.viii.1890: 2 ex., Søndre Strømfjord (BW8), 19 and 26.vii.52: 3 ex., Søndre Strømfjord, "Camp Lloyd" at head of fjord, 24.viii.36 (leg. H. G. VEVERS – in Hope Dept., Oxford).

SW 2 ex., Holsteinsborg, 9.viii.51: 1 ex., Kapisigdlit, 8.viii.50: 1 paralectotype, Tasiussaq, 25.ix.1889.

S 9 ex., Eqaluit, near Julianehåb, 6.vii.–25.viii.51: lectotype ♂ (by designation of FRICK, 1957) and 16 paralectotypes, Ipiutat, near Julianehåb, 6.ix.1889: 6 paralectotypes, Mussartût, near Julianehåb, 2.ix.1889: 4 paralectotypes, Igaliko Fjord, 29.viii. 1889: 10 ex., Narssarssuaq (BW1), 22.v.49 (3 ex.), 30.v.49 (3 ex.) and 29.vii.52 (4 ex.).

SE 1 ex., Mikis Fjord, (internal part), 23.viii.33 (leg. JØRGENSEN).

CE 13 ex., Hekla Havn, 12.viii.1891, 20.v.1892 (6 ex.) and 24.v.1892 (6 ex.): 1 ex., Rødeø, 17.viii.1892: 5 ex., Fulachdal, Dickson Fjord, 9.viii.34 (leg. SØGAARD ANDERSEN).

NE 8 ex., Mesters Vig, 27.v.–2.vi.53.

The synonymy given above refers only to the Greenland references. The genus *Phytoliriomyza* has recently been studied by SPENCER (1963) and reference should be made to that work for the involved synonymy of this species in other areas.

I examined the aedeagus (fig. 5) of males from a number of localities and found no significant differences. In colour the Greenland specimens are variable, as LUNDBECK (1900) observed. The colour of the frons ranges from clear yellow to dark brown; and the third antennal segment

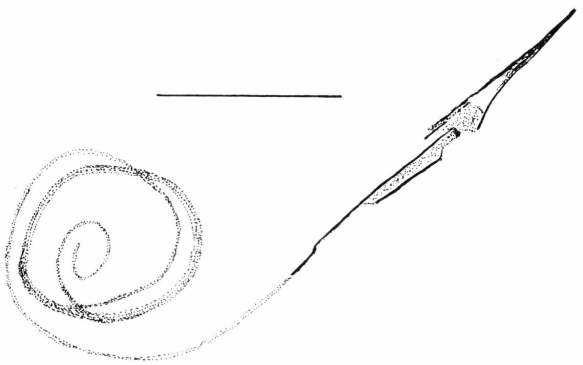


Fig. 5. *Phytoliriomyza arctica* (LUNDBECK), aedeagus in lateral view. (Scale 0.1 mm).

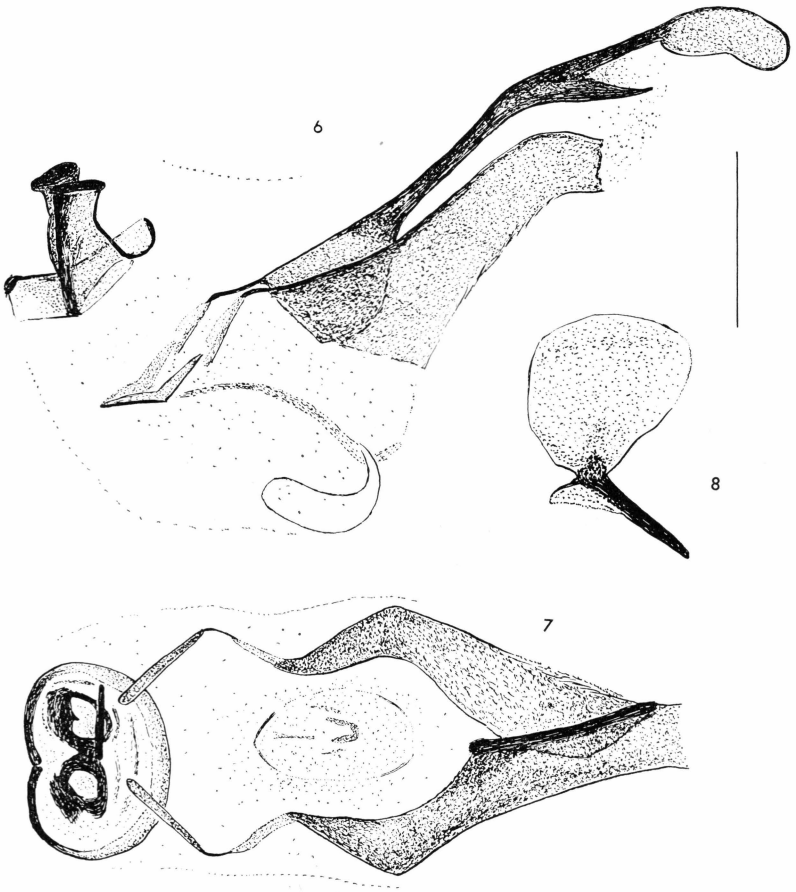
is yellow beneath in some specimens, but completely dark in others. This variation has no obvious association with latitude as the Julianehåb and Jakobshavn series for instance contain both light and dark specimens.

## Biology.

The larva is known to feed in stems of *Sonchus* in Europe, but the host in Greenland is probably some other genus of Compositae.

## Distribution.

SPENCER (1963) examined specimens from Europe (including England), the Azores, Madeira, the Canary Islands, Asia Minor, Formosa, North America and Brazil, as well as the Greenland material. The species thus has an unusually wide distribution and climatic tolerance. It has probably reached Greenland from North America, as it does not occur in Iceland or the Faroes. Its distribution in Greenland is extensive, but it has not been taken in the North or extreme North–West (Thule district).




Figs. 6–8. *Napomyza parvicella* (COQUILLET): 6, aedeagus in lateral view; 7, aedeagus in ventral view; 8, ejaculatory bulb. (Scale 0.1 mm).

### ***Napomyza parvicella*** (COQUILLET).

*Agromyza parvicella* COQUILLET, 1902, Jour. N. Y. ent. Soc. 10, p. 189: MALLOCH, 1913, p. 287.

*Napomyza parvicella* (COQUILLET), MELANDER, 1913, p. 273: FRICK, 1952, p. 421: FRICK, 1959, p. 420.

NW ♂, 3 ♀♀, Thule, 700 m. on *Papaver*, 4.vii.52: ♂, Thule, 8.vii.52: ♀, Thule, 5.vii.52 on *Papaver*, 650 m. above sea level.

The only previously known specimen of this species is the female holotype taken on St. Paul Island, Alaska, by Prof. T. KINCAID (type no. 6656 in the U. S. National Museum). This was redescribed in some detail, with figures of the head and wing, by MALLOCH (1913). Some of its characteristic features are the broadly visible cheeks and orbits in lateral view, the quadrate third antennal segment, setulose eyes, the

maxillary palpi expanded distally and the small discal cell. The Greenland series agrees fully in these respects with MALLOCH's (1913) and FRICK's (1959) descriptions of the holotype, and I have therefore considered it to represent the same species. The aedeagus of the Greenland males (figs. 6 and 7) is very characteristic and bears no close resemblance to that of any other species known to me. (The European *Napomyza palpata* HENDEL, which resembles *parvicella* in having expanded palpi, has a very different aedeagus).

### Biology.

The adults were taken by VIBE on *Papaver*, but it is not known whether this is the larval food-plant.

### Distribution.

The known distribution—North–West Greenland and Alaska—indicates that this species is associated with the dry higharctic region and is likely to have reached Greenland from Ellesmere Island. More material may be expected when the fauna of Arctic Canada can be studied.

### *Phytomyza fuscula* ZETTERSTEDT.

N ♀, South Coast of Jørgen Brønlund Fjord, Peary Land, 25.vi.49 (leg. JOHNSEN).

NW 1 ex., Thule, 2.vii.52: 3 ex., Upernavik, 12.vii.51 (2 ex.) and 2.viii.51 (1 ex.): 1 ex. Qaersorssuaq, 8.vii.51: 18 ex., Umanak, 3.viii.51: 1 ex., Marrait (Nûgssuaq), 19.vii.49: 10 ex., Sarqaq, 26.vi.–29.vii.49.

CW 6 ex., Torssukátak, 27.vii.49: 1 ex., Jakobshavn, 6.viii.51: 12 ex., Christianshåb, 1.viii.1890 (1 ex. in Hope Dept., Oxford): 3 ex., Orpigsôq, 16.vii.1890: 24 ex., Søndre Strømfjord (BW8), 2–29.vii.52: 3 ex., Søndre Strømfjord, "Camp Lloyd" at head of fjord, 24.viii.36 (leg. H. G. VEVERS – in Hope Dept., Oxford).

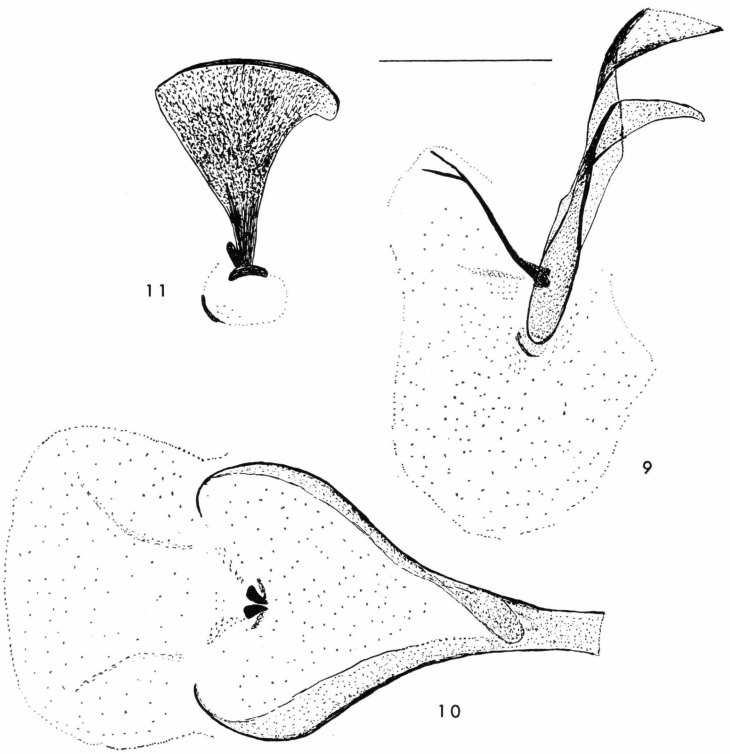
SW 1 ex., Holsteinsborg, 19.vi.1890: 3 ex., Holsteinsborg, 9.viii.51: 4 ex., Kangâmiut, 7.vi.52: 1 ex., Evighedsfjord, 11.vi.52: 5 ex., Kapisigdlit, 28.vii.–14.viii.50: 1 ex., Ivigtut, 17.viii.1889: 1 ex., Sukkertoppen, 6.vi.49: 1 ex., Sarqaq, 26.viii.48.

S 1 ex., Julianehåb, 22.viii.51: 5 ex., Eqaluit, near Julianehåb, 6.vii.48 (1 ex.), 25.vii.51 (2 ex.) and 23.viii.51 (2 ex.): 1 ex., Qanisartût, 20.vii.48: 3 ex., Narssarssuaq (BW1), 29.v.49 (2 ex.) and 29.vii.52.

CE 2 ex., Hekla Havn, 14.v. and 11.vi.1892: 1 ex., Rødeø, 17.viii.1892.

NE ♂, Hurry Inlet, near Scoresbysund, viii.33 (leg. LACK and BERTRAM – in the British Museum): 2 ex., Mesters Vig, 27.v.53.

The apical part of the aedeagus of this species (figs. 9 and 10) consists of a large membranous sac which is only feebly sclerotised. The distiphallus is slender and directed upwards. In addition to those of




Figs. 9–11. *Phytomyza fuscula* ZETTERSTEDT: 9, aedeagus in lateral view; 10, aedeagus in ventral view; 11, ejaculatory bulb. (Scale 0.1 mm).

many Greenland specimens I examined the genitalia of two males from Lappland in the Rydén collection at Lund, and two bred German specimens from Professor E. M. HERING's collection with the following data:

ex *Secale cereale*, Kunnersdorf, Görlitz, emerged 28.vi.56 (HERING no. 5894).
ex *Lolium perenne*, Badra-Kelbra. Thüringen, emerged 15.v (BUHR 1403, HERING 2061).

I have observed no differences between these other specimens and the Greenland material.

I have examined ZETTERSTEDT's type of this species, but being without abdomen and otherwise in bad condition it cannot be used to fix the identity of the species. However the name has a well-defined traditional usage, having been used for the species now under discussion in the works of HENDEL, DEMEIJERE and HERING. Clearly this sense should be retained in the interests of stable nomenclature.

On external characters this species has generally been considered close to *P. nigra* MEIGEN, but the strikingly different aedeagus must

cast doubt on this association. *P. nigra* MG. also possesses a minute ejaculatory bulb, suggesting (since this is an apomorph feature) that *nigra* may be monophyletic with the *milii* group (i. e. *P. milii* KALTENBACH, *P. luzulae* HERING and *P. opacella* HENDEL). *P. fuscula* ZETT. however retains a large ejaculatory bulb.

## Biology.

The larvae are leaf-miners of various Gramineae.

## Distribution.

*P. fuscula* ZETT. occurs in Northern and Central Europe (including Great Britain and Scandinavia as far as Torne Lappmark), and according to HENDEL (1931–6) also in Kamtschatka. In Greenland it is the commonest and most widespread species of Agromyzidae, having been taken from the extreme south to Pearyland in the far north. Its abundance in Greenland contrasts remarkably with its complete absence from Iceland and the Faroes (where the common Gramineae-feeding *Phytomyza* species are *P. nigra* MEIGEN and *P. milii* KALTENBACH, both absent from Greenland). It seems likely therefore that *fuscula* has reached Greenland from North America. The absence of records from that continent means little, as there is very little published information on the Agromyzid fauna of Northern Canada and Alaska.

### *Phytomyza opacella opacella* HENDEL.

NW ♂, Umanak, 3.viii.51.

CW 2 ex., Søndre Strømfjord, 21.vi. and 29.vii.52.

SW ♂, Ritenbenk, 20.viii.1890: ♀, Ikamiut, 14.vii.1890: 5 ex., Evighedsfjord, 11–13.vi.52: 2 ♀♀, Sermiligârssuk, 6.viii.1889: Kvanefjord, according to LUNDBECK, 1900 (specimen not traced).

S ♀, Eqaluitlandet, near Julianehåb, 15.vii.48: ♀, Frederiksdal, 30.vi.48: ♀, Igaliko Fjord, 29.viii.1889 (according to LUNDBECK, 1900 – specimen too damaged for confirming the identification).

Also one specimen without precise locality labelled "*Obscurella* FALL. Grønland Müs. Staeg", i. e. the specimen on which STAEGER's (1845) record is based.

The aedeagi (fig. 12) of the three Greenland males of this species whose genitalia were examined have rather larger distal sections than those of specimens examined from other areas. Externally however the Greenland specimens agree fully with Icelandic.

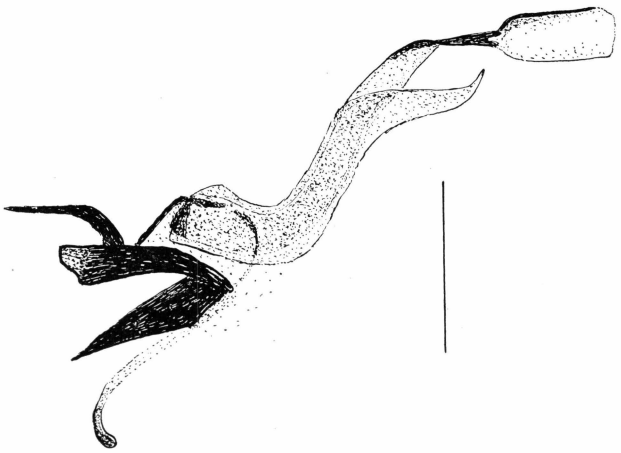


Fig 12. *Phytomyza opacella* HENDEL, aedeagus in lateral view. (Scale 0.1 mm).

### Biology.

Unknown, but it seems probable that the larva is a leaf-miner on Gramineae or perhaps some other monocotyledon.

### Distribution.

Outside Greenland this species is known from Iceland, the Faroes, Central Europe (Italian Tirol) and Northern Scandinavia. The Scandinavian specimens have been distinguished as subspecies *glacialis* GRIF. by GRIFFITHS (1964). In Greenland the species has been taken at various localities on the west coast as far as 70°45′ N. I consider it to be a good example of the European element in the Greenland fauna, which may have reached the island over a land-bridge via Iceland and the Faroes during an interglacial period.

## ***Phytomyza ranunculi*** (SCHRANK).

SW ♂, Tigssaluk, 8.viii.1889.

S 23 ex., Eqaluit, near Julianehåb, 6–21.vii.48: 70 ex., Eqaluitlandet, near Julianehåb, 15–21.vii.48: 24 ex., Qanisartût, near Julianehåb, 20.vi.48 (13 ex.) and 20.vii.48 (11 ex.): 2 ♂♂, 2 ♀♀, Ipiutat, near Julianehåb, 6.ix.1889: ♂, Igaliko Fjord, 29.viii.1889: ♂♀, Frederiksdal, 30.vi.48: 9 ex., Ûnartoq, 6.–11.vii.48.

SE 2 ♀♀, Angmagssalik, 27.vii.33 (leg. JØRGENSEN).

The Greenland specimens of *ranunculi* all belong to the darker colour forms known as form *praecox* MEIGEN and form *flavoscutellata* FALLÉN. The distiphallus of most specimens forms three to four coils

(agreeing with the figure given by NOWAKOWSKI (1962) except that the coils are directed upwards): one specimen is however remarkable in that the distiphallus is irregularly S-shaped without any complete coils. I have previously remarked on the wide range of variation in the distiphallus of this species in my paper on the Icelandic and Faroese Agromyzidae (GRIFFITHS, 1964). The hypophallus is always clearly sclerotised in contrast to the closely related new species described below as *vibeana*. The ratio of costal segments 2 to 4 in the Greenland specimens is 2.2–3.0, significantly higher than in *vibeana*.

### Biology.

The larvae are leaf-miners on *Ranunculus*.

### Distribution.

This species is of holarctic distribution, occurring in Iceland, the Faroes, throughout Europe, North Africa (Atlas mountains), Japan and North America. In Greenland it appears to be of restricted distribution in the South and South East. On the west coast it has not been taken north of Tigssaluk (61°25′ N.). This distribution suggests that it has reached Greenland from Iceland, and is part of the European element in the Greenland fauna.

## ***Phytomyza varipes*** MACQUART.

S ♀, Qagssiarssuk, 29.vii.48: ♀, Qanisartût, near Julianehåb, 20.vi.48.

The aedeagus of this species has been figured in GRIFFITHS (1964). It is common in Iceland, where it has been bred from seeds of *Rhinanthus minor* EHRH. Although only two females have been taken in Greenland, the identification can be accepted as virtually certain because of the characteristic long ovipositor of the species. Both are dark specimens with their third antennal segment dark and their femora only obscurely streaked with yellow.

### Distribution.

Outside Greenland this species is known from Iceland, the Faroes, and widely in North and Central Europe, including Great Britain and Scandinavia. It is clearly to be regarded as part of the European element in the Greenland fauna which may have arrived there during an interglacial period by way of a land-bridge via Iceland. The restricted known distribution of the species in the extreme south of Greenland is close to one of LINDROTH's (1957) suggested refuge areas.

### *Phytomyza vibeana* sp. nov.

NW ♂ holotype, ♂ 2 ♀♀ paratypes, Upernavik, 12.vii.51.

CE 8 ♂♂ 8 ♀♀ paratypes, Hekla Havn, viii–1.ix.1891 (5 ♂♂ 8 ♀♀), 17.vi.–2.vii.1892 (3 ♂♂).

Also one paratype ♀ without data (leg. VIBE).

I have retained two paratypes (♂, Hekla Havn and ♀, Upernavik) in my personal collection: one ♀ paratype from Hekla Havn belongs to the Hope Department, Oxford: the remaining material is in the Zoological Museum, Copenhagen.

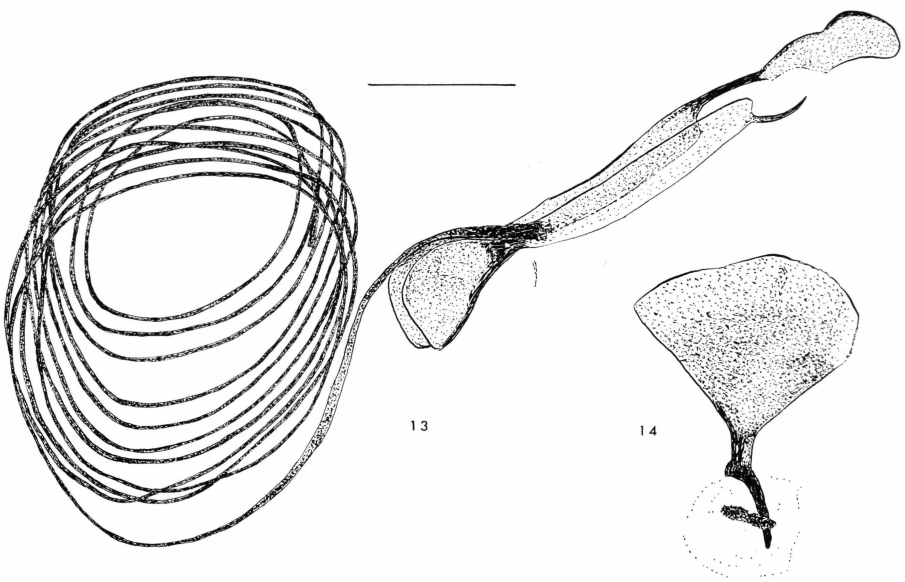
This species is close to *P. ranunculi* (SCHRANK) and is to be compared with it as follows.

#### External Morphology.

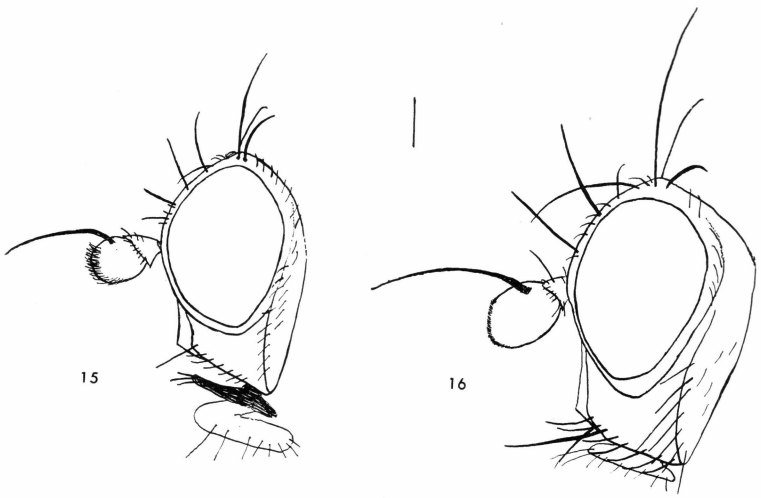
3rd antennal segment a little larger (fig. 16) than in *ranunculi*. Small first upper orbital bristle generally present. Acrostichals few, generally only two pairs present. Costal segment 2 is 1.6–2.0 times as long as segment 4. Wing-length: 2.3–2.7 mm.

#### Colour.

Frons, face and jowls varying from yellow-brown to almost black: in most specimens the centre of the frons and lunule are brown, the orbits ash-grey and the ocellar triangle more or less shining black. All three antennal segments always black.




Figs. 13–14. *Phytomyza vibeana* sp. nov. holotype: 13, aedeagus in lateral view; 14, ejaculatory bulb. (Scale 0.1 mm).




Figs. 15–16. Head in lateral view of: 15, *Cerodontha* (*Dizygomyza*) *thulensis* sp. nov., ♀ paratype; 16, *Phytomyza vibeana* sp. nov., ♀ paratype, Upernavik. (Scale 0.1 mm).

Mesonotum and scutellum entirely dull black. Pleura entirely dull black except that the upper and hind margins of the mesopleuron are narrowly yellow. Legs dark, except for the yellow tips of the femora. Squamae brown with a brown or black fringe.

Abdomen brown or black.

♂ **genitalia** (figs. 13–14).

Hypophallus virtually eliminated. Distiphallus extraordinarily long, forming about ten coils. Ejaculatory bulb as fig. 14.

This species is readily distinguishable from *P. ranunculi* (SCHRANK) by its much darker coloration and distinctive aedeagus. The distiphallus of *ranunculi* is variable, but I have not seen any specimen in which it forms more than six coils: also the hypophallus is always clearly sclerotised in that species. Other significant differences are found in the smaller costal ratio and larger third antennal segment of *vibeana*.

## Distribution.

Dr. J. T. NOWAKOWSKI has kindly let me examine a female which may belong to this species bred by him from mines on *Ranunculus alpestris*, Poland, Tatry, Wąwóz Kraków, larva 24.vii.61, puparium 30.vii., emerged 10.ii.62. This agrees in coloration and costal ratio with the Greenland specimens, but it seems advisable to wait until a male is obtained before accepting the occurrence of *vibeana* in central Europe.

HERING (1957) also refers to mines on *Ranunculus glacialis* L. occurring in the high mountains of central Europe which he suspects are caused by a species other than *ranunculi*, and it would be interesting if the identity of their producer could be confirmed.

The two known Greenland localities of this species are both well within the Arctic Circle and far north of the known stations of *P. ranunculi* (SCHRANK) there.

## KEY FOR IDENTIFICATION

The number of Agromyzidae found in Greenland is small and there is little difficulty in providing a key based largely on external characters. Only for the males of the two *Cerodontha* (*Dizygomyza*) spp. have I given no external distinctions: this is because the only male of *C.* (*D.*) *thulensis* (the holotype) has a shrunken head, which makes comparison unreliable. But in spite of the straightforward appearance of this key, I would advise future workers always to check the male genitalia of their material on a sample basis, particularly when new localities are worked.

1. – Lower cross-vein present ..... 2
   – Lower cross-vein absent. Costa to $r_{4+5}$ ... *Phytomyza* FALLÉN ..... 5
2. – Costa to $r_{4+5}$. Both cross-veins close to the wing-base, the lower lying only a little beyond the upper. Palpi broadened. Eyes conspicuously haired. ***Napomyza parvicella*** (COQUILLET)
   – Costa to $m_{1+2}$ ..... 3
3. – Orbital setulae conspicuous, proclinate. Wing-tip at apex of $m_{1+2}$. Eye oval-shaped in lateral view, distinctly hairy. Colour variable: in many specimens the frons, lower half of third antennal segment and scutellum are marked with yellow ..... ***Phytoliriomyza arctica*** (LUNDBECK)
   – Orbital setulae very few, more or less erect. Largely black species with conspicuously enlarged antennae at least in the male. Wing-tip between $r_{4+5}$ and $m_{1+2}$ ..... *Cerodontha* subgenus *Dizygomyza* ..... 4
4. – Male aedeagus as figs. 1–2. Female with somewhat enlarged third antennal segment, approaching that of the male ..... ***C. (D.) lindrothi*** GRIFFITHS
   – Male aedeagus as figs. 3–4. Female with small rounded third antennal segment (fig. 15) ..... ***C. (D.) thulensis*** sp. nov.
5. – Rear upper orbital bristle very weak or absent: only one lower orbital. (*ranunculi* group) 6
   – Both upper orbitals of about equal length ..... 7
6. – Scutellum, sides of mesonotum, pleura, frons and first two antennal segments yellow. Costal segments 2 to 4 in a ratio of 2.2–3.0. Hypophallus clearly sclerotised; distiphallus variable, but not forming more than about 5 coils ..... ***P. ranunculi*** (SCHRANK)
   – Thorax and scutellum almost completely dark. First two antennal segments dark. Costal segments 2 to 4 in a ratio of 1.6–2.0. Hypophallus virtually unsclerotised; distiphallus (fig. 13) enormously long, forming about 10 coils. ***P. vibeana*** sp. nov.

7. – Frons yellow. Femora marked with yellow. Acrostichals 2–3 rowed. ♀ ovipositor very elongate, as long as the rest of the abdomen. Distiphallus small and remote from the paraphalli (figured in GRIFFITHS, 1964) .....
***P. varipes*** MACQUART
– Frons dark at least centrally. Femora dark except at their tips. Ovipositor not so elongate ..... 8
8. – Acrostichals 2-rowed. Aedeagus as figs. 9–10. Ejaculatory bulb as fig. 11.
***P. fuscula*** ZETTERSTEDT
– Acrostichals in about 4 rows. Aedeagus as fig. 12. Ejaculatory bulb minute.
***P. opacella opacella*** HENDEL

## ZOOGEOGRAPHY

The fauna and flora of Greenland has long been known to contain a mixture of palaearctic and nearctic elements. BÖCHER, HOLMEN and JAKOBSEN (1959) state that of 485 native higher plants, 257 are circumpolar or amphiatlantic (i. e. found both in Europe and North America), 114 western (found in North America but not in Europe), 82 eastern (found in Europe but not North America) and 35 endemic (of which 15 however belong to the genus *Hieracium* and are closely related to European species). LINDROTH's (1957) figures for the terrestrial Greenland fauna—50 % Holarctic, 23 % Palaearctic and 27 % Nearctic—are very similar. The palaearctic species in the flora are most numerous in the South, Southeast and Southwest, where the climate is oceanic. It is now generally accepted by botanists that much of the flora has survived at least one period of glaciation on nunataks and coastal refuges, though opinions differ on the number, if any, of perglacial survivors. The majority of the likely refuge areas are in the South and Southwest.

LINDROTH (1957) has shown that many European Coleoptera and other ground-living insects, for which overseas dispersal is almost inconceivable, must have reached Greenland by a land-bridge from Europe through Iceland and the Faroes, presumably during an interglacial period (LINDROTH, 1931 and 1957). Although the date of this land-bridge appears not yet to have been established on geological grounds, its existence appears to be an inevitable supposition to explain the existing composition of the flora and fauna of Greenland, Iceland and the Faroes. In my recent paper on the Agromyzid fauna of Iceland and the Faroes (GRIFFITHS, 1964), I concluded that no other explanation was possible for the Agromyzid fauna of these islands.

The arrival of North American insects in Greenland is considered to have occurred by two main routes: aerial introduction from Labrador and Baffin Island, and by a higharctic route from Ellesmere Island to North and Northwest Greenland. LINDROTH (1957) concluded that the first route has been effective almost exclusively for winged insects, and that the comparatively narrow strait between Baffin Island and Greenland has constituted the most effective barrier to the dispersal of soil-

bound animals in the entire northern circumpolar area. But the higharctic route has clearly been effective in allowing many mammals and plants to reach Greenland. Its importance for insects must also be expected to be considerable, but appears to have been little investigated for most groups.

A higharctic route through Spitzbergen to Northeast Greenland appears to be established for a few plants, but it seems very doubtful on present information whether any insects have arrived from that direction.

The known Agromyzid fauna of Greenland consists of nine species. This is a small number by comparison with thirteen species in Iceland (GRIFFITHS, 1964), thirteen in the Faroes (GRIFFITHS, 1964) and nineteen in Torne Lappmark in Northern Scandinavia (RYDÉN, 1954). The breakdown of the Greenland species according to their known distributions is as follows:

| | |
|---|---|
| 2 Holarctic | – *Phytoliriomyza arctica* (LUNDBECK) |
| | *Phytomyza ranunculi* (SCHRANK) |
| 3 Palaearctic | – *Phytomyza fuscula* ZETT. |
| | – *opacella* HD. |
| | – *varipes* MACQ. |
| 1 Nearctic | – *Napomyza parvicella* (COQ.) |
| 1 Iceland only | – *Cerodontha* (*Dizygomyza*) *lindrothi* GRIF. |
| 2 not known outside Greenland | – *Cerodontha* (*Dizygomyza*) *thulensis* sp. nov. |
| | *Phytomyza vibeana* sp. nov. |

But this statement of known distributions is not as it stands an assessment of the probable origin of the species in Greenland. A holarctic species may have reached Greenland either from Europe or from North America or from both. Of the two holarctic Agromyzid species, *Phytoliriomyza arctica* (LUNDBECK) must be considered to have reached Greenland from North America, as it is absent from Iceland and the Faroes, which are considered to be remnants of a former land-bridge with Europe. On the other hand *Phytomyza ranunculi* (SCHRANK) occurs in Iceland and the Faroes and its restricted distribution in the South and Southeast of Greenland suggests that it must have reached there from Iceland.

Turning to the palaearctic species, *Phytomyza opacella* HD. and *P. varipes* MACQ. present no problems, being both European species occurring on Iceland and the Faroes but not known in North America. The latter species is known in Greenland only from two specimens taken near Julianehåb in the extreme south, one of the likely refuge areas during the last period of glaciation. However *Phytomyza fuscula* ZETT., which is found throughout Greenland, is absent from Iceland and the Faroes. HENDEL (1931–6) recorded it from Kamtschatka, and the absence of records from North America can hardly be considered signi-

ficant when there have been no extensive studies made of the fauna of arctic Canada. Until further information is available I am therefore assuming that this species is holarctic and has reached Greenland from North America.

The new species *Cerodontha* (*Dizygomyza*) *thulensis*, like *Napomyza parvicella* (COQ.), will probably belong to the fauna of the dry higharctic

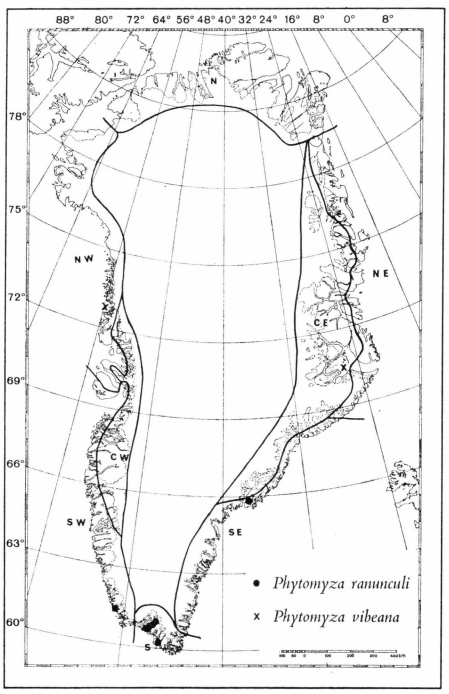



Fig. 17.

region which reaches across the Canadian arctic through Ellesmere Island to Northern Greenland.

It is not possible to judge the origin of the two remaining species— *Cerondontha* (*Dizygomyza*) *lindrothi* GRIF. and *Phytomyza vibeana* sp. nov.— until more information on the fauna of Canada is available. The former species is found in Iceland (GRIFFITHS, 1964), but does not occur in Europe. The latter species is not yet confirmed outside its two localities in Northwest and Continental East Greenland, but specimens which may belong to it have been bred from the Tatry mountains in southern Poland. Even if this latter locality is confirmed, the direction of the species' arrival in Greenland will still remain an open question until the fauna of Arctic Canada is investigated.

The following table summarises my assessment of the origin of the Greenland Agromyzid fauna:

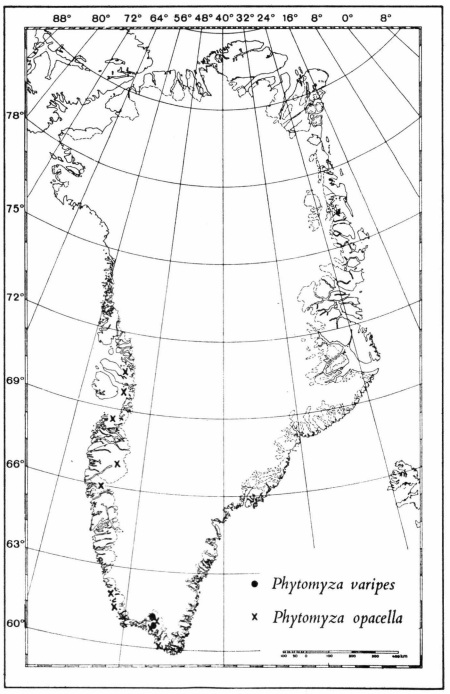



Fig. 18.

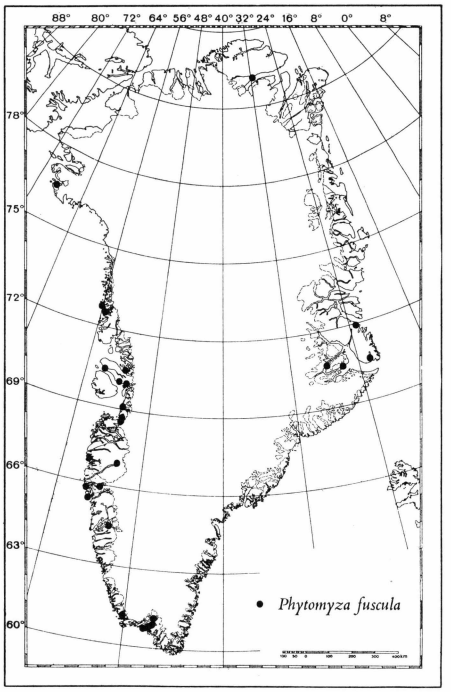



Fig. 19.

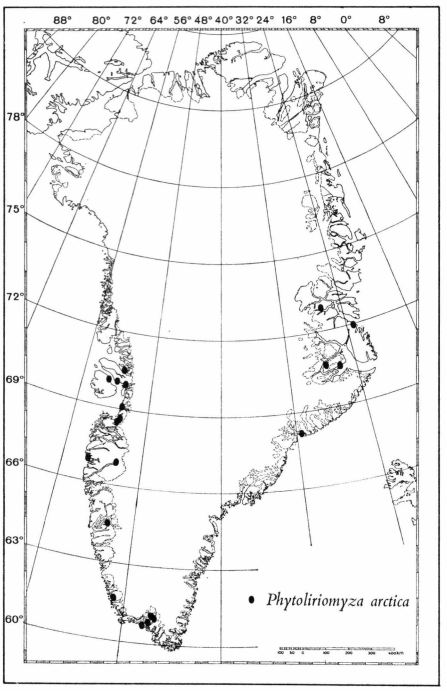



Fig. 20.

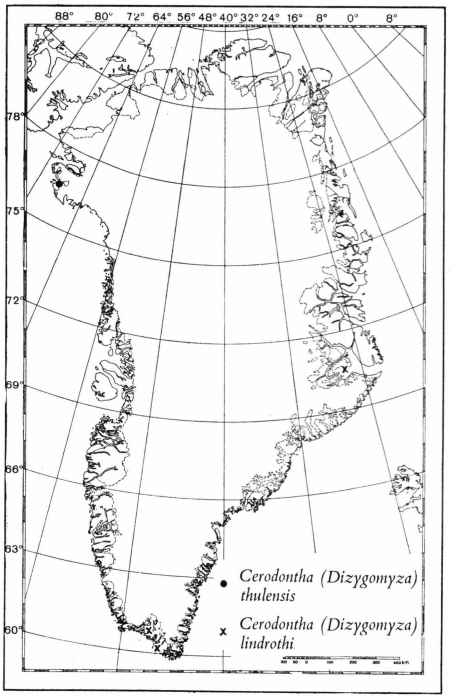



Fig. 21.

| | |
|---|---|
| 1. European element (arrived by land-bridge through Iceland) | – *Phytomyza opacella* HD. |
| | – *ranunculi* (SCHRANK) |
| | – *varipes* MACQ. |
| 2. Nearctic element | |
| (a) Higharctic species, which have reached Northwest Greenland from Ellesmere Island | – *Cerodontha* (*Dizygomyza*) *thulensis* sp. nov. |
| | *Napomyza parvicella* (COQ.) |
| (b) Species widely distributed in Greenland, whose means of arrival is not established | – *Phytoliriomyza arctica* (LDB.) |
| | *Phytomyza fuscula* ZETT. |
| 3. Distribution inadequately known | – *Cerodontha* (*Dizygomyza*) *lindrothi* GRIF. |
| | *Phytomyza vibeana* sp. nov. |

As was to be expected the land-bridge route from Europe through Iceland and the higharctic route from Ellesmere Island seem to have been important for the introduction of Agromyzidae into Greenland. It is interesting to note that there is no clear demonstration that aerial introduction over the Davis Strait has occurred, because both species of the Nearctic faunal element which occur in Southern Greenland are very widely distributed and may also have arrived by the higharctic route. *Phytomyza fuscula* ZETT. occurs today in the farthest North, while *Phytoliriomyza arctica* (LDB.) extends sufficiently far North for it to be conceivable that it used the higharctic route at a period when the climate was slightly warmer than today.

It will be noticed that introduction by human agency has been excluded from consideration in the above account. This is because none of the species are known to be associated with cultivated plants except *Phytomyza fuscula* ZETT., which attacks cereal grasses in Europe. The universal distribution of this species in Greenland from Peary Land to the extreme South must, however, rule out the possibility of it being a recent introduction. The commonest anthropochorous species, *Phytomyza atricornis* MEIGEN, is significantly absent from Greenland, although it is ubiquitous elsewhere in the Northern Hemisphere.

# CONCLUSION

This account of the Agromyzidae of Greenland has been somewhat handicapped by two important gaps in the information. First, there is no direct information on the host-plant association of the species in Greenland. If available, this would have served to put the species in their ecological context much more precisely than has here been possible, and would have acted as a cross-check on speculations on the origin of the species. Secondly, the Agromyzid fauna of the Canadian Arctic and Labrador is still largely unknown, which has made it very difficult to assess the size and significance of the Nearctic element in the Greenland Agromyzid fauna. Probably some of my conclusions will need to be modified when these gaps can be remedied.

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