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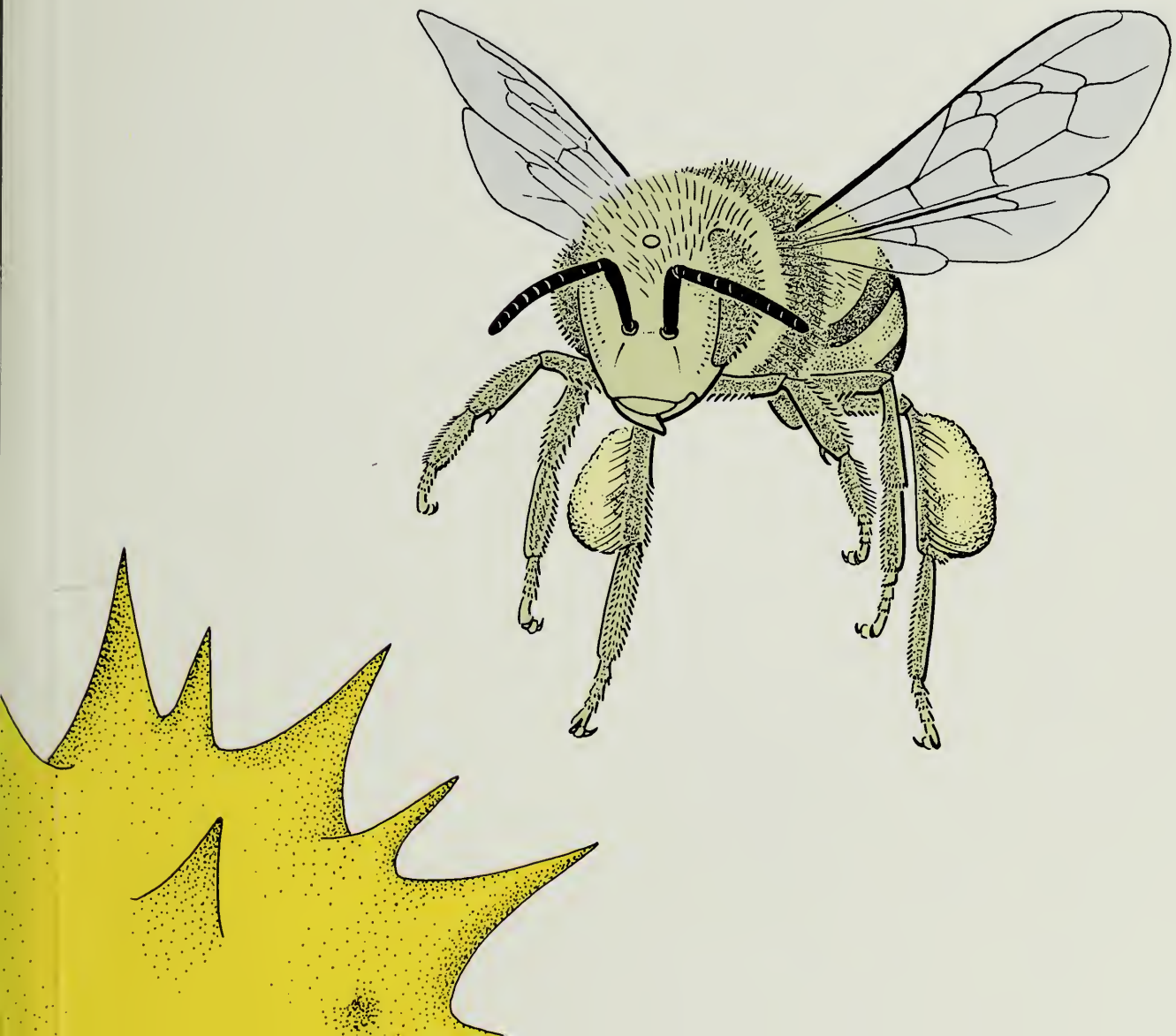
# Pollen grains of Canadian honey plants



# Pollen grains of Canadian honey plants

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A decorated entrance panel, dated 1853, from a bee colony used in Slovenia. It depicts the devil successfully stealing molten honey from an outraged worker who is tending her honey pots. Note that the devil is mocking her by sticking out his tongue as he retreats.

# Contents

# Acknowledgments

The authors wish to thank Drs. B.R. Baum and S.I. Warwick from the Centre for Land and Biological Resources Research, Research Branch, Agriculture Canada, for reviewing the preliminary draft of this manuscript; Mrs. Jane Ramsay for technical assistance with the phenology data; Ms. Frances Smith, Western Region Headquarters, for editing and improving the text; Mr. Carl Halchuk, Western Region Headquarters, and Ms. Judy McCarthy, Central Experimental Farm, for the layout of the photomicrographs; Ms. Norene McDonald, Western Region Headquarters, and Ms. Claire Ménard, Eastern Region Headquarters, for typesetting; Mr. A.F. Yang, Electron Microscopy Unit, Plant Research Centre, for assistance with scanning electron microscopy (SEM); Mrs. A. Jardine for printing many of the SEM photomicrographs; Dr. and Mrs. N.S. Gregory, for providing us with the decorated entrance panel, dated 1853, from a bee colony used in Slovenia; Mr. Jack Grossman, Billybee Honey Products Ltd., for several interesting discussions related to Canadian honey production; Mr. Herb Isaac, West-Man Honey Producers Ltd., for providing us with untreated honey samples extracted at selected periods during the pollination season; and our former directors Mr. G.A. Mulligan and Dr. R. Trottier for long-term support and encouragement.

# Introduction

According to recent tables published by Statistics Canada (1990), the Canadian honey industry exports approximately $12.2 million worth of natural honey per year. Canada imports only approximately $1.3 million worth. This publication demonstrates to Canadian beekeepers, honey packers, and brokers the usefulness of identifying the nectar sources of their honey by pollen grain analysis. It also attempts to provide an authoritative guide by which the nectar sources of Canadian honey can be identified by pollen grain concentration. The identification of the nectar and the plants from which it is derived arms the producer of the product with additional knowledge about honey. It is hoped that awareness of nectar sources will be beneficial to Canada's beekeepers and to our honey industry.

Vascular plant species provide two major rewards to the bees that pollinate them: pollen grains and nectar. Plants reproduce sexually by several methods. Some species are self-pollinated, others are self-incompatible, and still others are cross-pollinated. Species that are cross-pollinated or self-incompatible require the pollen grains to be conveyed, reaching the pistil by insect transfer, wind currents, or (rarely) water.

The pollen grain that the insect receives has a twofold function. The pollen contains nutrients essential for the diet of the insect and, more importantly, of its offspring. The plant, in turn, also benefits because it realizes its reproductive potential through increased pollination and seed set, resulting in a greater number of offspring. Because of the benefits associated with pollination, which has intrinsic value both to insects and to plants, a system has evolved that includes plants, insects, and other animals, incorporating humans and other mammals. The relationship between bees, and other pollinating insects, with the plants that they pollinate is known as mutualistic, meaning that neither the insect nor the plant can survive without the presence of the other. The outcome of this coevolutionary mutualism is the biological success of vascular land plants and their pollinators as evidenced by great species diversity, by the vast geographical areas they occupy, and by the amount of land they cover. In temperate regions, the most important pollinators are probably members of the order Hymenoptera, which includes bees, wasps, and hornets.

Experiments show that bees and their relatives seem to be better than other insects at remembering and locating plant species. They relate to characteristics of plants exhibited by floral architecture, fragrance, and ultraviolet reflectance. Bees apparently prefer plants that are fragrant, contain nectar, and have asymmetrical, rigid blossoms or flowers. Plants pollinated by insects are called entomophilous, meaning that they are adapted for insect pollination. Wind-pollinated plants are anemophilous.

Pollen is the most important food for bees. It provides all the nitrogen needed by younger bees and by nurse bees, which synthesize or manufacture proteins. Young honey bees that receive an inadequate amount of pollen have a shortened lifespan. Pollen digestion is also necessary for producing venom. Young adult bees require pollen in their diet; the amount in the hive has a direct relationship to the quantity of bees per colony. Larger quantities of pollen collected and stored in the hive support a greater number of bees.

In North America the honey bee (*Apis mellifera* Linnaeus), a native of Europe and Africa, is used for producing honey. Species used elsewhere in the world are *Apis cerana* Fabricius, *A. dorsata* Fabricius, and *A. florea* Fabricius. The last two species are difficult to raise in hives. The honey bee also pollinates and improves fertilization, and consequently the yield of numerous crop species in Canada, because many of the crops that require pollination are not native to this continent. Our native pollinators have proved to be inefficient or unsuitable for that purpose.

The wall of each grain of pollen is composed of a compound called sporopollenin. One of the major characteristics of sporopollenin is its ability to resist decomposition. Although sporopollenin can be destroyed through physical means such as abrasion, chemical decomposition is extremely difficult to achieve. The compound is resistant to strong acids such as concentrated sulfuric, nitric, and hydrofluoric acids. Because of its nonbiodegradable surface, the pollen grain has become the subject of study in many seemingly unrelated fields. It links the activities of geologists chemists, soil scientists, palynologists, botanists, climatologists, entomologists, apiculturalists, and allergologists—all of whom use pollen grains in their studies of physical and natural phenonoma.

Pollen grains are used in apiculture to allow the honey producer or scientist to detect the foraging pattern of the honey bee and to help reveal its nectar source. By determining the nectar source, beekeepers may be able to improve hive management, predict honey production, and identify combinations of plant species that produce better or less desirable honey.

In Canada honey bees are used to pollinate fruit, vegetables, and field and fodder crops. Important crops that greatly benefit from honey bee pollination include apples (*Malus*); pears (*Pyrus*); plums and peaches (*Prunus*); hardy kiwi (*Actinidia*); blackberries, raspberries, and boysenberries (*Rubus*); strawberries (*Fragaria*); currants and gooseberries (*Ribes*); cole crops such as broccoli, cabbage, cauliflower, kale, kohlrabi, mustard, rutabaga, and turnip, (*Brassica*); radish (*Raphanus*); canola (*Brassica*); asparagus (*Asparagus*); blueberries (*Vaccinium*); melons and watermelons (*Citrullus*); squash and pumpkins (*Cucurbita*); cucumbers and gherkins (*Cucumis*); tomato (*Lycopersicon esculentum*); carrot (*Daucus carota*); chicory and endive (*Cichorum*); sunflowers (*Helianthus*

*annuus*); flax (*Linum*); broad beans, field beans, and lima beans (*Vicia*); soybeans (*Glycine max*); peas (*Phaseolus*); buckwheat (*Fagopyrum*); alfalfa (*Medicago*); clover (*Trifolium*); birdsfoot trefoil (*Lotus*); sainfoin (*Onobrychis*); crownvetch (*Coronillia*); kidneyvetch (*Anthyllis*); lupine (*Lupinus*); and sweetclover (*Melilotus*).

Melissopalynology is the name given to the study of microscopically determining the types and the amounts of pollen grains found in honey. Many countries outside North America use pollen grain analysis of honey. Their regulations require honey to undergo pollen grain analysis. One of the benefits to producers, packagers, and consumers of honey is that speciality or gourmet lots can be identified, marketed, and sold as a particular type of honey, such as goldenrod, clover, buckwheat, heather, and so on. Honeydew honey, which is a sweet substance secreted on plants by aphids, scales, or fungi and collected by bees, can also easily be determined by microscopic examination. Canadian honey normally contains very small quantities of honeydew elements.

Scientists all over the world use pollen grain analysis as the primary method for characterizing honey for grading purposes. To achieve export markets for honey, samples must be provided to import brokers and government laboratories for analysis. This analysis is combined with chemical criteria and organoleptic sensory tests such as aroma, taste, color and texture, permitting the importers to determine the quality of the honey and its commercial value.

The countries that routinely examine lots of exported or domestic honey are mainly in Europe, the Middle East, and Asia. They include Germany, Poland, France, Belgium, Luxembourg, Great Britain, Romania, Hungary, Japan, India, Egypt, Argentina, Mexico, and New Zealand. Canada and the United States make limited use of pollen grain analysis because pollen grain content is not a part of their honey-grading regulations. When honey from Canada, for example, is exported to Europe, it is subjected to import regulations, which include pollen grain analysis. It is therefore very important to ascertain the type of product shipped.

Some unifloral honey, such as clover honey, must contain a percentage of clover pollen grains of more than 70% to command premium prices. Clover honey is in demand for the following reasons: it is transported, shipped, and stored easily and has a long shelf life without crystallizing; it has a delicate aroma and taste; and it can easily be blended with inferior honey, which takes on its desirable taste and aroma. Inferior honey may be too aromatic, may crystallize quickly, or may have an unappealing color or texture. It may also alter chemically because of improper storage or ferment as a result of yeast contamination.

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## Foraging of honey bees for pollen and nectar

Beekeepers and honey bee or leafcutting bee researchers are interested in determining the plant species that bees visit. Identifying pollen grains with a microscope is the most common method of investigation. Pollen grains can be examined either in the honey, in trapped pollen grain pellets before they are deposed in the hive, or singly on the body of the honey bee.

Some plant species collected by honey bees are of no value for honey because they do not produce nectar. Often these species are extremely valuable for brood rearing. For example, willow, oak, poison ivy, Manitoba maple, and corn produce pollen grains when nectar-producing species may be in short supply. However, a study showed that honey bees prefer collecting corn pollen grains even when red clover is readily available. The availability of pollen grains from nectarless species may therefore have a positive or negative effect on honey production. Collecting pollen grains from species such as corn may be reduced by supplemental feeding with pollen grain pellets at the appropriate time. These pellets can be collected using pollen pellet traps or specially designed vacuum aspirators.

Researchers suggest that the foraging experience of older honey bees may determine the frequency of visits to hives and the distance traveled. Other studies contradict this assumption and show that the age of bees has little effect on individual flight distance and frequency of hive visits. However, distance of the source plant from the hive is important, because alfalfa plants closer to hives are reported to show a greater preponderance of tripped (visited) versus untripped flowers.

Some important cultivated crops such as apples, pears, plums, canola, and clover species have breeding systems that prevent seed or fruit set. Because these intrinsic problems are associated with fruit and seed setting, it is useful to determine the efficiency at which they are pollinated and the relative amount of pollen and nectar that honey bees collect. For example, in *Brassica* (rape, canola, and mustards), where the pollen grains are sticky, studies show that insect or honey bee pollination had a twofold effect: direct cross-pollination by the insect and the loosening and release of pollen grains from the flower by the insect for subsequent cross-pollination by wind. Recent studies conducted in England reveal that substantial amounts

of *Brassica* pollen grains become airborne. Aerobiologists and allergists in Canada claim that people who live in areas with a high level of canola and mustard production become sensitized to their pollen grains.

In selecting the species included in this study we consulted the published works of Canadian laboratories and of palynologists, the publication by Jane Ramsay entitled *Plants for Beekeeping*, and numerous botanical texts. These references appear after each section of the study.

The photomicrographs taken under the scanning electron microscope (SEM) and the light microscope (LM) are arranged in the same sequence as the pollen grain descriptions and are located at the end of this publication.

A glossary of terms and a general bibliography of selected studies are listed at the end of the book. We have attempted to use currently accepted names of plants. A list of floras and the taxonomy followed is presented below.

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## Microscopic analysis of honey

Louveaux et al. (1970) prepared an excellent review of the microscopic methods of melissopalynology for the International Commission for Bee Botany. In this work the microscopic analysis of pollen grains found in honey is described as follows: the geographical origin of the honey and its botanical origin can be determined; amounts of honeydew can be assessed; contaminants such as brood, dust, soot can be observed; yeasts and other airborne biological contaminants such as molds and insect scale can be identified. Counterfeit honey or honey that has been "salted" with desirable pollen grains to misrepresent the honey's botanical content can be discovered, based on plant geographical distributions and the spectra of pollen grains found in the honey.

The frequency of pollen grains is usually estimated by identifying and counting 100 grains. The frequency class of pollen grains can be determined by identifying and counting 300 grains. The percentage count can be accurately calculated by identifying and counting 1200 grains. It is recommended that two preparations of the same honey be examined.

Estimates of pollen grain frequency are expressed as follows:

- 45% of the total sum of grains is termed very frequent;
- 16–45%, frequent;
- 3–15%, rare;
- 3%, sporadic.

The determination of pollen grain frequency is expressed as follows:

- predominant: a species that constitutes 45% of pollen grains;
- secondary dominant: a species that constitutes 16–45% of pollen grains;
- important minor pollen: a species that constitutes 3–15% of pollen grains;
- minor pollen: a species that constitutes less than 3%.

Pollen grains of plant species that do not produce nectar are noted separately and are not included in the results. These species are normally wind-pollinated or nectarless. Honey bees occasionally collect fungal spores, which they deposit in the honey, thus contaminating it.

Because of characteristics intrinsic to the reproductive biology of plants, pollen grains of some species may be overrepresented or underrepresented in the pollen grain sum. In Canada overrepresented species are not normally found. The underrepresented pollen grains of species in Canadian honey normally include linden (*Tilia*), fireweed or willow herb (*Epilobium*), alfalfa (*Medicago sativa*), and blueberry (*Vaccinium*).

## Techniques

Several methods can be used to extract pollen grains from honey samples and prepare them for microscopic analysis. Methods 1 and 2 are simple and require little equipment or preparation time.

Method 3 is used by palynologists around the world to make comparable microscope slides of pollen grains. This acid-based technique digests the cytoplasm of the pollen grain and leaves its acid-resistant wall laminations intact. The pollen grains are passed through various acids and solvents and imbedded in silicone oil mounting media before they are coverslipped on the microscope slide. Because silicone oil has a refractive index similar to that of glass and the coverslips need not be ringed, pollen grains can be rolled around under the microscope objective by sliding the coverslip. This allows the investigator to examine the pollen grain from all available angles and perspectives.

All methods are acceptable for determining the pollen grain content of honey. We and other scientists at Agriculture Canada laboratories use the acetolysis silicone oil technique because we feel that it gives superior pollen grain preparations. It also allows investigators to make use of world-wide palynological literature, where most of the pollen grain descriptions and photomicrographs are of acetolized pollen grains mounted in silicone oil.

## Method 1

- Melt 10 g of unpasteurized, unfiltered honey in 10 cc of hot water.
- Smear the melted honey on a microscope slide using a rubber stopper.
- Cover the slide with a glass coverslip and examine the mount under a 40× objective (approximately 400× magnification), thus determining the identity of the pollen grains.

## Method 2

- Melt 10 g of honey in a large centrifuge tube over hot water (double boiler) or in a warming oven.
- Centrifuge the molten honey for 2 min at 2500 rpm, thus allowing the pollen grains, which are lighter than other components, to remain on the surface meniscus.
- Pipet the grains onto a microscope slide and examine them as in method 1.

## Method 3 (acetolysis – silicone oil technique)

- Melt 10 g of unpasteurized, unfiltered honey in 25 cc of distilled water in a 50-cc centrifuge tube. Centrifuge and decant.
- Add 20 cc of a 9:1 mixture of acetic anhydride-to-concentrated sulfuric acid and acetolyze in a double boiler or water bath by slowly bringing the water to a boil, 100°C. Stir carefully with a clean glass rod. (**This procedure must be done in a fume hood or in a very well ventilated place.**) Centrifuge and decant.
- Add 20 cc of distilled water and mix sample well with a vortex mixer. Centrifuge and decant.
- Add 20 cc of glacial acetic acid and mix sample with a vortex mixer. Centrifuge and decant.
- Add 20 cc of 95% ethyl or methyl alcohol and mix sample with a vortex mixer. Centrifuge and decant.
- Add 20 cc of absolute ethyl or methyl alcohol and mix sample with a vortex mixer. Centrifuge and decant.
- Add 15 cc acetone and mix sample with a vortex mixer. Centrifuge and decant.
- Add 15 cc of thiophene-free benzene and mix sample with a vortex mixer. Centrifuge and decant, leaving a small amount of the acetone or the benzene covering the sample. (**This step may be omitted.**)

- Half-fill porcelain spotplates with 40 000 viscosity silicone oil. Remove some of the material from the top of the centrifuge tube with a pipette and place in the oil, stirring the sample into the oil with a clean toothpick.
- Place a small amount of the oil–pollen grain mixture on a microscope slide and coverslip.
- Examine preparation under the microscope for pollen grains.

Microscope slides of permanent pollen grains to be used for reference are deposited in the Permanent Pollen Grain Collection of the Centre for Land and Biological Resources Research. The pollen grain slides are cross-referenced to vouchered herbarium plant specimens deposited in the Agriculture Canada Herbarium, Ottawa, Ont., which is internationally known under the acronym DAO. Microscope slides of the pollen are prepared by two methods: acetolized pollen grains embedded in silicone oil and unacetolized pollen grains in glycerine jelly. For purposes of scanning electron microscopy, unacetolized pollen grains were examined. The average size of each pollen type was based on the measurements of at least 20 grains mounted in silicone oil. To confirm size and morphological observations the pollen from each species was quickly examined from various locations using glycerine jelly preparations. The measurements were made under 400× or 1250× (oil emersion) magnification under a light microscope. Photographs were taken using PanX film. Pollen grains for the scanning electron microscope were prepared directly from the voucher specimens. Photographs were taken on an Amray 1000 SEM using PlusX film. Phenological flowering times are determined, and ecological data are collected from herbarium specimens in the DAO herbarium at Ottawa from across the geographical range of the species in Canada.

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# Key to pollen grain classes

a. Grains in groups or four ..... (1.) Tetrads (p.15) (Bignoniaceae, Ericaceae, Lauraceae)

a. Grains single (monads) ..... b.

b. Apertures simple, i.e., either pores or colpi (furrows).

c. With pores (pori).

1 pore ..... (2.) Monoporate (Gramineae) ..... **(72.)** ***Zea mays***

3 pores ..... (3.) Triporate (p. 16) (Onagraceae, Leguminosae)

4 pores ..... (4.) Tetraporate (Onagraceae) ..... **(134.)** ***Epilobium angustifolium***

More than 4 pores all equatorially arranged ..... ..... (5.) Stephanoporate (Campanulaceae) ..... **(13.)** ***Campanula rapunculoides***

More than 4 pores some but not all equatorially arranged ... ..... (6.) Periporate (p. 17) (Convolvulaceae, Malvaceae, Ranunculaceae, Saxifragaceae)

c. With furrows (colpi).

1 furrow ..... (7.) Monocolpate (p. 17) (Iridaceae, Liliaceae, Magnoliaceae)

3 furrows ..... (8.) Tricolpate (p. 18) (Aceraceae, Boraginaceae, Capparidaceae, Cruciferae, Geraniaceae, Hamamelidaceae, Labiatae, Portulacaceae, Ranunculaceae, Rosaceae, Salicaceae, Scrophulariaceae, Simaroubaceae, Violaceae)

4 furrows ..... (9.) Tetracolpate (p. 23) (Balsaminaceae, Solanaceae)

6 furrows equatorially arranged .. (10.) Hexacolpate (p. 23) (Hydrophyllaceae, Labiatae)

6 or more furrows meridionally arranged ... (11.) Pericolpate (Ranunculaceae) ..... **(144.)** ***Anemone patens***

b. Apertures compound, i.e. pores within furrows.

3 furrows and pores meridionally arranged ..... ..... (11.) Tricolporate (p. 24) (Aceraceae, Caprifoliaceae, Compositae, Cornaceae, Dipsacaceae, Elaeagnaceae, Euphorbiaceae, Gentianaceae, Guttiferae, Hippocastanaceae, Leguminosae, Linaceae, Oleaceae, Oxalidaceae, Phrymaceae, Polygonaceae, Primulaceae, Rhamnaceae, Scrophulariaceae, Solanaceae, Tiliaceae, Umbelliferae, Verbenaceae, Vitaceae)

Greater than 3 furrows with 3 pores equatorially arranged . . . . . (12.) Heterocolpate (Lythraceae) . . . . . **(127.) *Lythrum salicaria***
Greater than 3 furrows and pores equatorially arranged . . . . . (13.) Stephanocolporate (p. 33) (Boraginaceae, Cucurbitaceae)

# Artificial key to pollen grains classes

(See "Glossary" for definition of terms)

1. **TETRADS** (all spherical grains)

1.1 **Areolate** (Figs. SEM[1] 17, 18; LM[2] 23, 24)

a. Grains united in tetrahedral tetrads.

aa. Grains united in rhomboidal tetrads.

b. Grains 25–31 μm in diameter . . . . . **(9.)** ***Catalpa speciosa***

bb. Grains 40–50 μm in diameter . . . . . **(10.)** ***Catalpa ovata***

1.2 **Rugulate** (Figs. SEM 173, 174; LM 261–263)

a. Grains united in rhomboidal tetrads.

aa. Grains united in tetrahedral tetrads.

b. Grains less than 35 μm in diameter . . . . . **(87.)** ***Loiseleuria procumbens***

bb. Grains more than 35 μm in diameter . . . . . **(57.)** ***Arctostaphylos uva-ursi***

1.3 **Psilate** (Figs. SEM 121, 122; LM 185–187)

a. Grains united in rhomboidal tetrads.

aa. Grains united in tetrahedral tetrads.

b. Average diameter less than 30 μm . . . . . **(61.)** ***Ledum groenlandicum***

bb. Average diameter more than 30 μm.

c. Furrow obviously transversing the pore, PAI[3] more than 0.4 . . . . . **(63.)** ***Vaccinium angustifolium***

cc. Furrow not obviously transversing the pore, PAI less than 0.4.

d. Exine less than 2.0 μm thick . . . . . **(64.)** ***Vaccinium arboreum***

dd. Exine more than 2.0 μm thick . . . . . **(62.)** ***Rhododendron canadense***

[1] Scanning electron microscope
[2] Light microscope
[3] Polar area index

1.4 **Verrucate** (Figs. SEM 117, 118; LM 179–181)

a. Grains united in rhomboidal tetrads.

aa. Grains united in tetrahedral tetrads.

b. Grains less than 29.0 μm in diameter . . . . . **(59.)** ***Kalmia angustifolia***

bb. Grains more than 29.0 μm in diameter.

c. Average grain less than 35 μm in diameter.

d. Exine more than 2.0 μm . . . . . **(68.)** ***Vaccinium vitis-idaea***

dd. Exine less than 2.0 μm.

e. PAI less than 0.4 . . . . **(67.)** ***Vaccinium myrtilloides***

ee. PAI more than 0.4 . . . . . **(60.)** ***Kalmia latifolia***

cc. Average grain more than 39 μm in diameter . . . **(58.)** ***Calluna vulgaris*** . . . . **(65.)** ***Vaccinium corymbosum*** . . . . **(66.)** ***Vaccinium macrocarpon***

2. **TRIPORATE**

2.1 **Rugulate** (Figs. SEM 219, 220; LM 330–332)

a. Grains spherical (PEI[4] = 1.0).

aa. Grains not spherical (PEI does not equal 1.0).

b. Grains prolate-like (PEI more than 1.0).

bb. Grains oblate-like (PEI less than 1.0).

c. Grains peroblate to oblate (P.E.I less than 0.75).

cc. Grains suboblate to oblate spheroidal (PEI = 0.75–1.0).

d. Grains suboblate (PEI = 0.75–0.88).

dd. Grains oblate spheroidal (PEI = 0.88–1.0).

e. Average length more than 33 μm with microverrucate particles within the lumina . . . . . **(110.)** ***Phaseolus coccineus***

ee. Average length less than 33 μm without microverrucate particles within the lumina . . . . . **(111.)** ***Phaseolus vulgaris***

[4] Polar equatorial index

2.2 **Psilate** (Figs. SEM 267, 268; LM 401, 402)

a. Grains not spherical (PEI does not equal 1.0).

aa. Grains spherical (subtriangular) (PEI = 1.0).

b. Grains less than 70 µm in diameter . . . . . **(134.)** ***Epilobium angustifolium***

bb. Grains more than 95 µm in diameter . . . . . **(133.)** ***Clarkia*** **sp.**

2.3 **Verrucate** (Figs. SEM 269, 270; LM 403, 404)

a. Grains not spherical (PEI does not equal 1.0).

aa. Grains spherical (subtriangular) (PEI = 1.0).

b. Grains less than 90 µm in diameter.

bb. Grains more than 90 µm in diameter . . . . . **(135.)** ***Oenothera biennis***

3. **PERIPORATE** (all spherical grains)

3.1 **Echinate** (Figs. SEM 259, 260; LM 390–392).

a. Grains less than 95 µm in diameter . . . . . **(130.)** ***Malva moshata***

aa. Grains more than 100 µm in diameter.

b. Exine including spines less than 20 µm . . . . . **(45.)** ***Ipomoea purpurea***

bb. Exine including spines more than 20 µm . . . . . **(129.)** ***Hibiscus trionum***

3.2 **Microechinate** (Figs. SEM 291, 292; LM 435–437).

a. Grains less than 25 µm in diameter with operculate pores with verrucate membranes . . . . . **(146.)** ***Thalictrum occidentale***

3.3 **Verrucate** (Figs. SEM 327, 328; LM 489–491).

a. Grains with psilate ridges between several concave faces, each face having verrucate particles with 1 or 2 pores per face . . . . . **(164–170.)** ***Ribes*** **sp.**

4. **MONOCOLPATE**

4.1 **Psilate** (Figs. SEM 247, 248; LM 373–375).

a. Grains spherical (PEI = 1.0).

aa. Grains not spherical (PEI does not equal 1.0).

b. Grains oblate-like (PEI less than 1.0).

bb. Grains prolate-like (PEI more than 1.0).

c. Grains prolate spheroidal to subprolate (PEI = 1.0–1.33).

cc. Grains prolate to perprolate (PEI more than 1.33).

d. Grains perprolate (PEI more than 2.0).

dd. Grains prolate (PEI = 1.33–2.0).

e. Grains less than 25 μm wide and 45 μm long . . . . . (**124.**) ***Allium cernuum***

ee. Grains more than 35 μm wide and 60 μm long . . . . . (**128.**) ***Liriodendron tulipifera***

4.2 **Reticulate** (Figs. SEM 153, 154; LM 232, 233).

a. Grains perprolate (PEI more than 2.0); width more than 35 μm and length more than 80 μm . . . . . (**77.**) ***Iris versicolor***

## 5. TRICOLPATE

5.1 **Striate** (Figs. SEM 303, 304; LM 453–455).

a. Grains spherical (PEI = 1.0).

aa. Grains not spherical (PEI does not equal 1.0).

b. Grains oblate-like (PEI less than 1.0).

c. Grains peroblate to oblate (PEI less than 0.75).

cc. Grains suboblate to oblate spheroidal (PEI = 0.75–1.0).

d. Grains suboblate (PEI = 0.75–0.88).

dd. Grains oblate spheroidal (PEI = 0.88–1.0).

e. Grains pertectate, less than 21 μm long . . . . . (**6.**) ***Acer tataricum***

ee. Grains tectate.

f. Grains with a coarse sculpturing pattern and an exine more than 2.0 μm thick . . . . . (**155.**) ***Prunus serrulata***

ff. Grains with fine puncta between the striations and an exine less than 2.0 μm thick . . . . . (**153.**) ***Prunus pensylvanica***

bb. Grains prolate-like (PEI more than 1.0).

g. Grains prolate spheroidal to subprolate (PEI = 1.0–1.33).

h. Grains prolate spheroidal (PEI = 1.0–1.14).

i. Grains semitectate less than 41 μm long . . . . . (2.) ***Acer macrophyllum***

ii. Grains tectate.

j. Grains with coarse sculpturing and acute ridges connected at the poles and disconnected between the furrows, less than 22 μm in length . . . . . (151.) ***Fragaria virginiana***

jj. Grains with fine sculpturing.

k. Grains with a regular longitudinal sculpturing pattern . . . . . (159.) ***Pyrus malus***

kk. Grains with an irregular sculpturing pattern.

l. Grains with a swirling sculpturing pattern, PAI less than 0.3 . . . . . (150.) ***Crataegus monogyna***

ll. Grains with an overlapping sculpturing pattern, PAI more than 0.3 . . . . . (152.) ***Prunus domestica***

hh. Grains subprolate (PEI = 1.14–1.33).

m. Grains semitectate.

n. Grains with coarse striations in overlapping swirls . . . . . (5.) ***Acer rubrum***

nn. Grains with simple ridges and scattered perforations in the vallae between the ridges.

o. Exine less than 2.0 μm thick . . . . . (3.) ***Acer platanoides***

oo. Exine more than 2.0 μm thick . . . . . (4.) ***Acer pseudo-platanus***

mm. Grains tectate.

p. Grains with lateral striations.

q. Grains less than 27 μm long . . . . . (156.) ***Pyrus aucuparia***

qq. Grains more than 30 μm long . . . . . (158.) ***Pyrus coronaria***

pp. Grains without lateral striations.

r. Striations in a swirling pattern, grains less than 40 μm long . . . . . (149.) ***Crataegus crus-galli***

rr. Striations longitudinal without a swirling pattern.

s. Puncta present.

t. Grains more than 34 μm long.
tt. Grains less than 34 μm long.
u. Grains with fine striations .... **(161.)** ***Rubus idaeus***
uu. Grains with regular striations ..... **(148.)** ***Amelanchier alnifolia***
ss. Puncta absent; exine more than 1.5 μm thick ..... **(160.)** ***Rosa multiflora***
gg. Grains prolate to perprolate (PEI = more than 1.33).
v. Grains perprolate (PEI more than 2.0).
vv. Grains prolate (PEI = 1.33–2.0), less than 32 μm long with lateral striations between the furrows and puncta present ..... **(157.)** ***Pyrus communis***

5.2 **Foveolate-reticulate** (Figs. SEM 345, 346; LM 516–518)
a. Grains spherical (PEI = 1.0).
aa. Grains not spherical (PEI does not equal 1.0).
b. Grains oblate-like (PEI less than 1.0).
bb. Grains prolate-like (PEI more than 1.0).
c. Grains prolate spheroidal to subprolate (PEI = 1.0–1.33).
d. Grains subprolate (PEI = 1.14–1.3).
dd. Grains prolate spheroidal (PEI = 1.0–1.14), less than 20 μm long ..... **(173.)** ***Linaria vulgaris***
cc. Grains prolate to perprolate (PEI = more than 1.33).
e. Grains perprolate (PEI more than 2.0).
ee. Grains prolate (PEI = 1.33–2.0) less than 20 μm long ..... **(14.)** ***Cleome serrulata***

5.3 **Reticulate** (Figs. SEM 99, 100; LM 151–153)
a. Grains spherical (PEI = 1.0).
aa. Grains not spherical (PEI does not equal 1.0).
b. Grains oblate-like (PEI less than 1.0).
bb. Grains prolate-like (PEI more than 1.0).
c. Grains prolate spheroidal to subprolate (PEI = 1.0–1.33).
d. Grains prolate spheroidal (PEI = 1.0–1.14) with coarse sculpturing, less than 20 μm long ..... **(73.)** ***Hamamelis virginiana***
dd. Grains subprolate (PEI = 1.14–1.33).

e. Sculpturing shallow or irregular.
f. Grains less than 21 μm long . . . . . (**80.**) ***Leonurus cardiaca***
ff. Grains more than 21 μm long.
g. Exine more than 2.5 μm . . . . . (**175.**) ***Ailanthus altissima***
gg. Exine less than 2.5 μm . . . . . (**86.**) ***Stachys palustris***
ee. Sculpturing well-defined covering the entire grain.
h. Grains more than 25 μm long.
i. Exine less than 3.0 μm thick.
ii. Exine more than 3.0 μm thick . . . (**53.**) ***Sinapis alba*** . . . . . (**51.**) ***Diplotaxis tenuifolia***
hh. Grains less than 25 μm long.
j. PEI less than 1.25 . . . . (**49.**) ***Brassica nigra***
jj. PEI more than 1.25.
k. Average width more than 19 μm; average length more than 25 μm . . . . . (**48.**) ***Brassica napus***
kk. Average width less than 19 μm; average length less than 25 μm . . . . . (**52.**) ***Raphanus raphanistrum***
cc. Grains prolate or tear-drop shape.
l. Grains prolate (PEI = 1.33–2.0).
m. Grains less than 15 μm wide and less than 21 μm long . . . . . (**47.**) ***Alyssum saxatile***
mm. Grains more than 15 μm wide and more than 21 μm long.
n. PAI less than 0.2; exine less than 2.0 μm thick . . . . . (**163.**) ***Salix discolor***
nn. PAI more than 0.2; exine more than 2.0 μm thick . . . . . (**50.**) ***Brassica rapa***
ll. Grains tear-drop-shaped, less than 15 μm wide and less than 18 μm long, with fine reticulations . . . . . (**12.**) ***Echium vulgare***

5.4 **Perforate-punctate** (Figs. SEM 161, 162; LM 243–245)
a. Grains subprolate (PEI = 1.14–1.33), less than 19 μm wide and more than 19 μm long; exine more than 2.0 μm thick . . . . . (**81.**) ***Mentha spicata***

5.5 **Microechinate** (Figs. SEM 289, 290; LM 432–434)

a. Grains spherical (PEI = 1.0).

aa. Grains not spherical (PEI does not equal 1.0).

b. Grains prolate-like (PEI more than 1.0).

bb. Grains oblate-like (PEI less than 1.0).

c. Grains peroblate to oblate (PEI = less than 0.50–0.75).

cc. Grains suboblate to oblate spheroidal (PEI = 0.75–1.0).

d. Grains suboblate (PEI = 0.75–0.88).

dd. Grains oblate spheroidal (PEI = 0.88–1.0).

e. Grains less than 23 μm wide and less than 23 μm long, with verrucate furrow membranes . . . . . **(145.)** ***Clematis virginiana***

ee. Grains more than 40 μm wide and more than 38 μm long, with granular furrow membranes . . . . . **(140.)** ***Claytonia virginica***

5.6 **Psilate** (Figs. SEM 373, 374; LM 562–564)

a. Grains spherical (PEI = 1.0).

aa. Grains not spherical (PEI does not equal 1.0).

b. Grains oblate-like (PEI less than 1.0).

bb. Grains prolate-like (PEI more than 1.0).

c. Grains prolate to perprolate (PEI more than 1.33).

cc. Grains prolate spheroidal to subprolate.

d. Grains prolate spheroidal (PEI = 1.0–1.14), less than 31 μm wide and 35 μm long; exine less than 2.0 μm thick . . . . . **(187.)** ***Viola palustris***

dd. Grains subprolate (PEI = 1.14–1.33), less than 21 μm wide and less than 29 μm long . . . . . **(78.)** ***Ajuga reptans***

5.7 **Undefined sculpturing** (Figs. SEM 323, 324; LM 483–485)

a. Grains subprolate (PEI = 1.14–1.33), less than 20 μm wide and less than 23 μm long; exine less than 2.0 μm thick . . . . . **(161.)** ***Rubus odoratus***

5.8 **Microreticulate** (Figs. SEM 347, 348; LM 519–521)

a. Grains prolate spheroidal (PEI = 1.0–1.14), less than 21 μm wide and less than 21 μm long; furrows extending almost to the poles . . . . . **(174.)** ***Penstemon gracilis***

5.9 **Reticulate-piliate** (Figs. SEM 141, 142; LM 215–217)

a. Grains oblate spheroidal (PEI = 0.88–1.0), more than 61 μm wide and less than 61 μm long; intectate . . . . . **(71.)** ***Geranium bicknelli***

5.10 **Perstriate** (Figs. SEM 307, 308; LM 459–461)

a. Grains subprolate (PEI = 1.14–1.33), less than 23 μm long; exine more than 2.0 μm thick . . . . . **(154.)** ***Prunus serotina***

## 6. TETRACOLPATE

6.1 **Reticulate** (Figs. SEM 15, 16; LM 21, 22)

a. Grains spherical (PEI = 1.0).

aa. Grains not spherical (PEI does not equal 1.0).

b. Grains oblate-like (PEI less than 1.0).

bb. Grains prolate-like (PEI more than 1.0).

c. Grains not round-rectangular to rectangular.

cc. Grains round-rectangular to rectangular.

d. Grains less than 30 μm long . . . **(8.)** ***Impatiens glandulifera***

dd. Grains more than 30 μm in length . . . . . **(7.)** ***Impatiens capensis***

6.2 **Psilate** (Figs. SEM 351, 352; LM 525–527)

a. Grains prolate (PEI = 1.33–2.0), less than 25 μm wide and more than 27 μm long . . . . . **(176.)** ***Nicotiana tabacum***

## 7. HEXACOLPATE

7.1 **Reticulate** (Figs. SEM 169, 170; LM 255–257)

a. Grains spherical (PEI = 1.0).

aa. Grains not spherical (PEI does not equal 1.0).

b. Grains oblate-like (PEI less than 1.0).

c. Grains peroblate to oblate (PEI = less than 0.75).

cc. Grains suboblate to oblate spheroidal (PEI = 0.88–1.0).

d. Grains suboblate (PEI = 0.75–0.88).

dd. Grains oblate spheroidal (PEI = 0.88–1.0), more than 32 μm wide and less than 33 μm long, with well-defined reticulum . . . . . **(85.)** ***Salvia officinalis***

bb. Grains prolate-like (PEI more than 1.0).

e. Grains prolate to perprolate (PEI more than 1.33).

ee. Grains prolate spheroidal to subprolate (PEI = 1.0–1.33).

f. Grains prolate spheroidal (PEI = 1.0–1.14), more than 30 μm wide and less than 39 μm long, with a perforate-punctate reticulum . . . . . **(82.)** ***Monarda fistulosa***

ff. Grains subprolate (PEI = 1.14–1.33).

g. Grains more than 35 μm long.

gg. Grains less than 35 μm long.

h. PAI less than 0.25 . . . . . **(83.)** ***Nepeta cataria***

hh. PAI more than 0.40 . . . . **(79.)** ***Dracocephalum parviflorum***

7.2 **Punctate** (Figs. SEM 149, 150; LM 226–228)

a. Grains subprolate (PEI = 1.14–1.33), less than 20 μm wide and more than 20 μm long . . . . . **(75.)** ***Phacelia linearis***

7.3 **Undefined Sculpturing** (Figs. SEM 167, 168; LM 252–254)

a. Grains prolate (PEI = 1.33–2.0), more than 20 μm wide and more than 30 μm long, with extremely shallow reticulum . . . . . **(84.)** ***Prunella vulgaris***

## 8. TRICOLPORATE

8.1 **Psilate** (Figs. SEM 371, 372; LM 559–561)

a. Grains spherical (PEI = 1.0), with short furrows, the grains triangular in polar view . . . . . **(56.)** ***Elaeagnus commutata***

aa. Grains not spherical (PEI not equal to 1.0).

b. Grains oblate-like (PEI less than 1.0).

c. Grains peroblate to oblate (PEI less than 0.75).

cc. Grains suboblate to oblate spheroidal (PEI = 0.88–1.0).

d. Grains suboblate (PEI = 0.75–0.88).

dd. Grains oblate spheroidal (PEI = 0.88–1.0).

e. Grains less than 20 μm long . . . . . **(147.)** ***Rhamnus alnifolia***

ee. Grains more than 20 μm long.

f. Grains with indistinctive sculpturing and smooth polar ends . . . . . (**112.**) ***Robinia pseudoacacia***

ff. Grains with short-furrows and annulate pores . . . . . (**186.**) ***Verbena hastata***

bb. Grains prolate-like (PEI more than 1.0).

g. Grains prolate spheroidal to subprolate (PEI = 1.0–1.33).

h. Grains prolate spheroidal (PEI = 1.0–1.14).

i. Grains less than 25 μm long . . . . . (**96.**) ***Cercis canadensis***

ii. Grains more than 40 μm long . . . . . (**46.**) ***Cornus stolonifera***

h. Grains subprolate (PEI = 1.14–1.33).

j. Grains more than 25 μm long.

jj. Grains less than 25 μm long . . . . . (**95.**) ***Caragana arborescens***

gg. Grains prolate (PEI more than 1.33).

k. Grains perprolate (PEI more than 2.0).

kk. Grains prolate (PEI = 1.33–2.0).

l. Grains more than 25 μm long . . . . . (**25.**) ***Centaurea cyanus***

ll. Grains less than 25 μm long.

m. Grains less than 17 μm long . . . . . (**102.**) ***Lotus corniculatus***

mm. Grains more than 17 μm long.

n. Exine with tectate structure . . . . . (**99.**) ***Hedysarum boreale***

nn. Exine with a semitectate structure . . . . . (**76.**) ***Hypericum perforatum***

8.2 **Punctate-reticulate** (Figs. SEM 207, 208; LM 312–314)

a. Grains subprolate (PEI = 1.14–1.33), 20–29 μm long, with irregular-shaped puncta between the furrows and with smooth polar ends . . . . . (**104.**) ***Medicago lupulina***

8.3 **Psilate-punctate** (Figs. SEM 209, 210; LM 315–317)

a. Grains subprolate (PEI = 1.14–1.33), 30–38 μm long, with an indistinctive sculpturing pattern . . . . . (**105.**) ***Medicago sativa***

8.4 **Rugulate** (Figs. SEM 353, 354; LM 528–530)

a. Grains spherical (PEI = 1.0), with a coarse sculpturing pattern and with furrows extending to the poles . . . . . **(177.)** ***Petunia hybrida***

aa. Grains not spherical (PEI does not equal 1.0).

b. Grains oblate-like (PEI less than 1.0).

bb. Grains prolate-like (PEI more than 1.0).

c. Grains prolate spheroidal to subprolate (PEI = 1.0–1.33), with the furrow extending into the polar area.

d. Grains subprolate (PEI = 1.14–1.33).

dd. Grains prolate spheroidal (PEI = 1.0–1.14) . . . . . **(139.)** ***Polygonum cilinode***

cc. Grains prolate to perprolate (PEI more than 1.33), with small pores within the furrows.

e. Grains prolate (PEI = 1.33–2.0), less than 35 μm long; exine less than 2.0 μm . . . . . **(120.)** ***Vicia sativa***

ee. Grains perprolate (PEI more than 2.0) . . . . . **(184.)** ***Daucus carota*** . . . . . **(182.)** ***Angelica atropurpurea***

8.5 **Rugulate-striate** (Figs. SEM 369, 370; LM 556–558)

a. Grains prolate (PEI = 1.33–2.0), 25–30 μm long, with small pores within the furrows . . . . . **(185.)** ***Pastinaca sativa***

8.6 **Echinolophate** (Figs. SEM 59, 60; LM 86–89)

a. Grains spherical (PEI = 1.0), with large open ridges containing prominent spines on their crests

b. Grain diameter normally more than 40 μm.

c. Exine diameter including spines more than 10 μm . . . . . **(30.)** ***Cichorium intybus*** . . . . . **(29.)** ***Cichorium endiva***

cc. Exine diameter including spines less than 10 μm . . . . . **(44.)** ***Tragpogon dubius***

bb. Overall grain diameter normally less than 40 μm . . . . . **(43.)** ***Taraxacum officinale***

8.7 **Punctate** (Figs. SEM 343, 344; LM 513–515)

a. Grains oblate-spheroidal (PEI = 0.88–1.0), 17–23 μm long . . . . . **(172.)** ***Digitalis purpurea***

8.8 **Piliate-microechinate** (Figs. SEM 251, 252; LM 379–381)

a. Grains subprolate (PEI = 1.14–1.33).

b. Grains normally less than 52 μm long . . . . . **(125.)** ***Linum flavum***

bb. Grains normally more than 52 μm long . . . . . **(126.)** ***Linum perenne***

8.9 **Microreticulate** (Figs. SEM 273, 274; LM 408–410)

a. Grains spherical in shape (PEI = 1.0).

aa. Grains not spherical in shape (PEI not equal to 1.0).

b. Grains oblate-like (PEI less than 1.0).

c. Grains peroblate to oblate (P.E.I. less than 0.75).

cc. Grains suboblate to oblate spheroidal (PEI = 0.75–1.0).

d. Grains suboblate (PEI = 0.75–0.88).

e. Grains more than 24 μm long, without a fine reticulum.

ee. Grains less than 24 μm long, with a fine reticulum . . . . . **(137.)** ***Phryma leptostachya***

dd. Grains oblate spheroidal (PEI = 0.88–1.0).

f. Grains less than 24 μm long.

ff. Grains more than 24 μm long, with a punctate surface . . . . . **(69.)** ***Euphorbia esula***

bb. Grains prolate-like (PEI more than 1.0).

g. Grains prolate spheroidal to subprolate (PEI = 1.0–1.33).

h. Grains prolate spheroidal (PEI = 1.0–1.13).

i. Exine less than 2.0 μm thick . . . . . **(88.)** ***Amorpha fruticosa***

ii. Exine more than 2.0 μm thick.

j. Grains with an indistinctive pattern . . . . . **(188.)** ***Vitis vinifera***

jj. Grains with a fine sculpturing pattern and a granular furrow membrane . . . . . **(143.)** ***Lysimachia thrysiflora***

hh. Grains subprolate (PEI = 1.14–1.33)

k. Grains less than 25 μm long . . . . . **(98.)** ***Cytisus scoparius***

kk. Grains more than 25 µm . . . . . (**123.**) ***Wisteria floribunda***

gg. Grains prolate to perprolate (PEI more than 1.33).

l. Grains perprolate (PEI more than 2.0).

ll. Grains prolate (PEI = 1.33–2.0).

m. Grains less than 25 µm long . . . . . (**142.**) ***Lysimachia terrestris***

mm. Grains more than 35 µm long . . . . . (**91.**) ***Astragalus cicer***

8.10 **Striate** (Figs. SEM 1, 2; LM 1–3)

a. Grains spherical in shape (PEI = 1.0).

aa. Grains not spherical in shape (PEI not equal to 1.0).

b. Grains oblate-like (PEI less than 1.0).

bb. Grains prolate-like (PEI more than 1.0).

c. Grains prolate spheroidal to subprolate (PEI = 1.0–1.33).

d. Grains prolate spheroidal (PEI = 1.0–1.14).

dd. Grains subprolate (PEI = 1.14–1.33), more than 20 µm wide and more than 26 µm long, with smooth furrow margins . . . . . (**1.**) ***Acer circinatum***

cc. Grains prolate to perprolate (PEI more than 1.33).

e. Grains perprolate (PEI more than 2.0).

ee. Grains prolate (PEI = 1.33–2.0), less than 17 µm wide and less than 24 µm long, with tooth-like spines present in the furrows . . . . . (**74.**) ***Aesculus hippocastaneum***

8.11 **Microechinate** (Figs. SEM 109, 110; LM 167–169)

a. Grains spherical (PEI = 1.0), more than 72 µm in diameter, with two sizes of spines . . . . . (**55.**) ***Dipsacus sylvestris***

aa. Grains not spherical (PEI less than 1.0).

b. Grains oblate-like (PEI less than 1.0).

bb. Grains prolate-like (PEI more than 1.0).

c. Grains prolate spheroidal to subprolate (PEI = 1.0–1.33).

d. Grains prolate spheroidal (PEI = 1.0–1.13), with two types of spines (acute and mucronate) . . . . . (**15.**) ***Diervilla lonicera***

dd. Grains subprolate (PEI = 1.14–1.33).

e. Grains less than 40 μm wide and less than 49 μm long . . . . . (**25.**) ***Centaurea montana***

ee. Grains more than 45 μm wide and more than 62 μm long . . . . . (**35.**) ***Echinops sphaerocephalus***

cc. Grains prolate to perprolate (PEI more than 1.33).

f. Grains perprolate (PEI more than 2.0).

ff. Grains prolate (PEI = 1.33–2.0), with pore transversing the furrows, the grains less than 46 μm wide and less than 62 μm long . . . . . (**34.**) ***Echinops exaltatus***

8.12 **Echinate** (Figs. SEM 47, 48; LM 68–70).

a. Grains spherical (PEI = 1.0), 26–30 μm in diameter, with microperforate spines . . . . . (**40.**) ***Liatris cylindracea***

aa. Grains not spherical (PEI less than 1.0).

b. Grains oblate-like (PEI less than 1.0).

c. Grains peroblate to oblate (PEI less than 0.75).

cc. Grains suboblate to oblate spheroidal (PEI = 0.75–1.0).

d. Grains suboblate (PEI 0.75–0.88).

dd. Grains oblate spheroidal (PEI = 0.88–1.0).

e. Less than 21 μm long.

f. No sculpturing pattern on or between the spines; exine more than 4.0 μm thick . . . . . (**24.**) ***Aster novae-angliae***

ff. Microperforate sculpturing pattern on spines; exine less than 4.0 μm thick . . . . . (**42.**) ***Solidago canadensis***

ee. Grain more than 21 μm long.

g. Grain more than 38 μm long.

h. Exine more than 10 μm thick . . . . . (**32.**) ***Cirsium vulgare***

hh. Exine less than 10 μm thick . . . . . (**31.**) ***Cirsium muticum***

gg. Grain normally less than 36 μm long.

i. PAI less than 0.35 . . . . . (**37.**) ***Helianthus annuus***

ii. PAI more than 0.5 . . . (**39.**) ***Helianthus salicifolius***

bb. Grains prolate-like (PEI more than 1.0).

j. Grains prolate to perprolate (PEI more than 1.33).

jj. Grains prolate spheroidal to subprolate (PEI = 1.0–1.33).

k. Grains prolate-spheroidal (PEI = 1.0–1.14).

l. Exine less than 6.5 μm thick, with microperforate spines

m. Length less than 27 μm . . . . . **(36.)** ***Eupatorium perfoliatum***

mm. Length more than 27 μm . . . . . **(33.)** ***Cosmos bipinnatus***

ll. Exine more than 6.5 μm thick, with microperforate spines . . . . . **(38.)** ***Helianthus petiolaris***

kk. Grains subprolate (PEI = 1.14–1.33).

n. Grains less than 35 μm long.

o. Grains more than 28 μm long . . . . . **(27.)** ***Centaurea maculosa***

oo. Grains less than 28 μm long.

p. Exine less than 5.0 μm thick . . . . . **(26.)** ***Centaurea diffusa***

pp. Exine more than 5.0 μm thick . . . . . **(41.)** ***Rudbeckia hirta***

nn. Grains more than 35 μm long.

q. Exine less than 2.5 μm thick . . . . . **(16.)** ***Lonicera involucrata***

qq. Exine more than 2.5 μm thick.

r. Average length more than 46 μm . . . . . **(17.)** ***Lonicera morrowi***

rr. Average length less than 46 μm . . . . . **(18.)** ***Lonicera tatarica***

8.13 **Reticulate** (Figs. SEM 355, 356; LM 531–534)

a. Grains with isopolar symmetry . . . . . **(178-181.)** ***Tilia*** **sp.**

aa. Grains with polar symmetry.

b. Grains spherical (PEI = 1.0).

c. Grains more than 30 μm in diameter.

cc. Grains less than 30 μm in diameter . . . . . **(136.)** ***Oxalis stricta***

bb. Grains not spherical (PEI does not equal 1.0).

c. Grains oblate-like (PEI less than 1.0).

d. Grains peroblate to oblate (PEI less than 0.75).

dd. Grains suboblate to oblate spheroidal (PEI = 0.75–1.0).

e. Grains suboblate (PEI = 0.75–0.88).

f. Exine more than 4.0 μm thick.

ff. Exine less than 4.0 μm thick . . . . . **(122.)** ***Vigna sinensis***

ee. Grains oblate spheroidal (PEI = 0.88–1.0).

g. Exine less than 4.0 μm thick.

gg. Exine more than 4.0 μm thick . . . . . **(70.)** ***Gentianella crinata***

cc. Grains prolate-like (PEI more than 1.0).

h. Grains prolate spheroidal to subprolate (PEI = 1.0–1.33).

i. Grains prolate spheroidal (PEI = 1.0–1.14).

j. Grains more than 32 μm long . . . . . **(131.)** ***Ligustrum japonicum***

jj. Grains less than 32 μm long.

k. Exine more than 3.5 μm thick.

l. Grains less than 25 μm long . . . . . **(21.)** ***Viburnum opulus***

ll. Grains more than 25 μm long . . . . **(132.)** ***Ligustrum vulgare***

kk. Exine less than 3.5 μm thick.

m. Grains less than 21 μm long . . . . . **(171.)** ***Antirrhinum majus***

mm. Grains more than 21 μm long.

n. Exine less than 2.0 μm thick . . . . . **(103.)** ***Lupinus argenteus***

nn. Exine more than 2.0 μm thick . . . . . **(23.)** ***Viburnum prunifolium***

ii. Grains subprolate (PEI = 1.14–1.33).

o. Grains more than 30 μm long.

p. Reticulate pattern encompassing the entire grain . . . . . **(114.)** ***Trifolium pratense***

pp. Grains with reticulate pattern and smooth polar ends . . . . . **(100.)** ***Lathyrus tuberosus***

oo. Grains less than 30 μm long.

q. Grains less than 17 μm long . . . . . **(94.)** ***Baptisia tinctoria***

qq. Grains more than 17 μm long.

r. Exine more than 2.0 μm thick . . . . . **(22.)** ***Viburnum plicatum***

rr. Exine less than 2.0 μm thick.

s. PAI more than 0.32.

t. Exine less than 1.8 μm thick.

tt. Exine more than 1.8 μm thick.

u. Grains less than 23 μm long . . . . . **(19.)** ***Sambucus canadensis***

uu. Grains more than 23 μm long . . . . . **(141.)** ***Lysimachia punctata***

ss. PAI less than 0.32.

v. Grain with an irregular reticulate pattern . . . . . **(113.)** ***Trifolium hybridum***

vv. Grain with a reticulate pattern encompassing the entire grain.

w. Grains less than 20 μm long . . . . . **(94.)** ***Baptisia australis***

ww. Grains more than 20 μm long.

x. Average length of grains less than 23 μm . . . . . **(101.)** ***Lespedeza bicolor***

xx. Average length of grains more than 23 μm . . . . . **(92.)** ***Astragalus striatus***

hh. Grains prolate to perprolate.

y. Grains prolate (PEI = 1.33–2.0).

z. Grains more than 30 μm long.

aaa. Grains with a foveate-reticulate pattern.

bbb. Grains less than 39 μm long . . . . . **(109.)** ***Onobrychis viciaefolia***

bbbb. Grains more than 39 μm long . . . . . **(138.)** ***Fagopyrum esculentum***

aaaa. Grains with a shallow, indistinct, or disjointed reticulum and with smooth polar ends.

ccc. Grains with a shallow reticulum and with smooth polar ends.

ddd. Average length of grains less than 34 μm . . . . . **(116.)** ***Vicia angustifolia***

dddd. Average length of grains more than 34 μm . . . . . **(117.)** ***Vicia americana***

cccc. Grains with indistinctive or disjointed reticulum and smooth polar ends.

eee. Grains with indistinctive reticulation and smooth polar ends . . . . . **(118.)** ***Vicia cracca***

eeee. Grains with disjointed reticulations and smooth polar ends . . . . . **(119.)** ***Vicia faba***

zz. Grains less than 30 μm long.

fff. Exine more than 1.7 μm thick.

ggg. Grains less than 23 μm long, with a microreticulate sculpturing pattern . . . . . **(90.)** ***Astragalus alpinus***

gggg. Grains more than 23 μm long, with an indistinctive sculpturing pattern . . . . . **(115.)** ***Trifolium repens***

ffff. Exine less than 1.7 μm thick.

hhh. Grains more than 24 μm long, with a foveolate-reticulate sculpturing pattern . . . . . **(108.)** ***Melilotus officinalis***

hhhh. Grains less than 24 μm long, with a foveolate-reticulate sculpturing pattern.

iii. Grains with PAI more than 0.35 . . . . . **(107.)** ***Melilotus indica***

iiii. Grains with PAI less than 0.35 . . . . . **(106.)** ***Melilotus alba***

yy. Grains perprolate (PEI more than 2.0).

jjj. Grains more than 34 μm long, with reticulate sculpturing between the furrows and smooth polar ends . . . . . **(121.)** ***Vicia villosa***

8.14 **Undefined sculpturing** (Figs. SEM 365, 366; LM 550–552)

a. Grains perprolate (PEI more than 2.0), with small pores within the furrows . . . . . **(183.)** ***Carum carvi***

8.15 **Retipiliate** (Figs. SEM 39, 40; LM 56–58)

a. Grains prolate spheroidal (PEI = 1.0–1.14), less than 25 μm long . . . . . **(20.)** ***Viburnum lentago***

8.16 **Verrucate** (Figs. SEM 177, 178; LM 267–269)

a. Grains prolate spheroidal (PEI = 1.0–1.14), less than 36 μm long . . . . . **(89.)** ***Anthyllis vulneraria***

8.17 **Microrugulate** (Figs. SEM 193, 194; LM 291–293)

a. Grains prolate spheroidal (PEI = 1.0–1.14), less than 24 μm long, with the sculpturing pattern encompassing the entire grain . . . . . **(97.)** ***Coronilla varia***

## 9. STEPHANOCOLPORATE

9.1 **Punctate** (Figs. SEM 107, 108; LM 163–166)

a. Grains oblate spheroidal (PEI = 0.88–1.0), more than 50 μm wide and less than 50 μm long; exine more than 3.5 μm thick . . . . . **(54.)** ***Echinocystis lobata***

9.2 **Microgemmate** (Figs. SEM 21, 22; LM 27, 28)

a. Grains prolate spheroidal (PEI = 1.0–1.14), less than 25 μm wide and more than 20 μm long . . . . . **(11.) *Borago officinalis***

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# Descriptions of pollen grains and related data

## ACERACEAE (maple family)

1. ***Acer circinatum*** Pursh

vine maple, mountain maple
érable circiné, érable à feuilles rondes

SEM Figs. 1, 2; LM Figs. 1–3

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.2; PAI 0.16; size 20.9–25.7 μm wide × 26.6–32.3 μm long; average size 24.1 × 28.9 μm; sculpturing striate; ektexine and endexine of equal thickness, with wall about 2.5 μm thick; structure semitectate. SEM shows many elongated divided simple ridges with scattered perforations in the vallae between the ridges.

Distribution: Southern British Columbia.

Flowering period: Late April–May.

Ecological notes: On rocky slopes, burnt-over areas, rich low woodlands, and at the edges of mixed woodlands. Native.

2. ***Acer macrophyllum*** Pursh

bigleaf maple, broadleaf maple, Oregon maple, British Columbia maple
érable à grandes feuilles

SEM Figs. 3, 4; LM Figs. 4–6

Description: Grains tricolpate, prolate spheroidal in equatorial view; PEI 1.13; PAI 0.19; size 30.4–34.2 μm wide × 32.3–40.0 μm long; average size 32.12 μm wide × 36.22 μm long; sculpturing coarse, striate; ektexine and endexine about 2.0 μm thick; structure semitectate.

Distribution: Vancouver Island, southwestern British Columbia.

Flowering period: Late March to mid May.

Ecological notes: Common on dry slopes overlooking riverbanks, on open bluffs, in open woods, and along shorelines. Native.

3. ***Acer platanoides*** L.

Norway maple
érable de Norvège, érable platanoïde, érable platane

SEM Figs. 5, 6; LM Figs. 7–9

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.16; PAI 0.20; size 22.8–28.5 μm wide × 27.6–33.3 μm long; average size 26.1 μm wide × 30.4 μm long; sculpturing striate; ektexine and endexine about 1.5 μm thick; structure semitectate. SEM shows many elongated divided simple ridges, with scattered perforations in the vallae between the ridges.

Distribution: Newfoundland, Nova Scotia, Prince Edward Island, New Brunswick, Quebec, Ontario, and British Columbia.

Flowering period: Late April to mid May.

Ecological notes: Widely planted as an ornamental tree in towns, villages, and rural areas. Occasionally escaping to high areas or well-drained sandy sites. Introduced; a native of Europe.

4. ***Acer pseudo-platanus*** L.

sycamore maple
érable-sycomore

SEM Figs. 7, 8; LM Figs. 10–12

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.21; PAI 0.34; size 24.7–32.3 μm wide × 28.5–41.8 μm long; average size 27.9 μm wide × 33.7 μm long; sculpturing striate; ektexine and endexine about 2.3 μm thick; structure semitectate. SEM shows many elongated, divided simple ridges, with minute scattered perforations in the vallae between the ridges.

Distribution: Nova Scotia, Ontario, and British Columbia.

Flowering period: June in Nova Scotia, 2–3 weeks behind the flowering of sugar and red maples. Mid May in Ontario and British Columbia.

Ecological notes: Abundant; established along roadsides and planted as an ornamental species around towns and villages. Introduced; a native of Europe.

5. ***Acer rubrum*** L.

red maple, soft maple, scarlet maple, water maple
érable rouge, plaine rouge, plaine

SEM Figs. 9, 10; LM Figs. 13–15.

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.18; PAI 0.25; size 22.8–28.5 μm wide × 24.7–34.2 μm long; average size

26.4 μm wide × 31.1 μm long; sculpturing coarse striate; ektexine and endexine about 1.5 μm thick; structure semitectate. SEM shows striations in overlapping swirls.

Distribution: Newfoundland, Nova Scotia, Prince Edward Island, Quebec, and Ontario.

Flowering period: Late April in Quebec and Ontario to late May in regions further east.

Ecological notes: The species is usually abundant throughout its optimum range. It occurs in extremely variable sites such as wet woods, sandy soils, gravel shorelines, riversides, the edges of mixed deciduous–coniferous woodlands, granite slopes with oaks, sandy soils around the Great Lakes, grassy fields, and primary stands or secondary regrowth. Native.

6. ***Acer tataricum*** L.

Tartary maple
érable de tartarie

SEM Figs. 11, 12; LM Figs. 16–18

Description: Grains tricolpate, oblate spheroidal in equatorial view; PEI 0.89; PAI 0.17; size 20.9–22.8 μm wide × 17.1–20.9 μm long; average size 21.9 μm wide × 19.5 μm long; sculpturing fine, striate; ektexine and endexine 2.2 μm; exine 0.75 μm; structure pertectate. SEM shows many elongated divided simple ridges, with minute scattered perforations in the vallae between the ridges.

Distribution: Southern Ontario, and Quebec.

Flowering period: Late May to early June.

Ecological notes: Widely cultivated as an ornamental shrub or small tree throughout cities, towns, and in the countryside. Occasionally occurring as an escape in outlying areas near habitations. Introduced; a native of Eurasia.

## **BALSAMINACEAE** (touch-me-not family)

7. ***Impatiens capensis*** Meerb.

spotted jewelweed, balsam, cape touch-me-not, touch-me-not, spotted touch-me-not, spotted snapweed, snapweed, lady's-earrings, jewelweed
impatiente biflore, impatiente du cap, chou sauvage

SEM Figs. 13, 14; LM Figs. 19, 20

Description: Grains tetracolpate; prolate-rectangular to round-rectangular in equatorial view; PEI 1.4; PAI 0.50; size 20.9–24.7 μm wide × 30.4–34.2 μm long; average size 23.38 μm wide × 32.69 μm long; sculpturing coarsely reticulate; ektexine and endexine about 1.5 μm thick; structure intectate. SEM shows minute granular particles within the reticulum.

Distribution: Mackenzie District, N.W.T.; Newfoundland; Nova Scotia, west to British Columbia.

Flowering period: From early to mid July to mid September.

Ecological notes: Often in wet and springy places, brooksides, or acidic to subacidic swamps. Native.

8. ***Impatiens glandulifera*** Royle
policeman's helmet

SEM Figs. 15, 16; LM Figs. 21, 22

Description: Grains tetracolpate; prolate-rectangular to round-rectangular in equatorial view; PEI 1.37; PAI 0.55; size 19.0–21.9 μm wide × 26.6–29.5 μm long; average size 20.5 μm wide × 28.0 μm long; sculpturing reticulate; ektexine and endexine about 1.5 μm thick; structure intectate. SEM shows minute granular particles within the reticulum.

Distribution: Nova Scotia, New Brunswick, Quebec, Ontario, and British Columbia.

Flowering period: Late July to late September.

Ecological notes: Occasionally cultivated, becoming established in wet woods, roadside thickets, and waste or springy places. Introduced; a native of Himalayan region of Asia.

## **BIGNONIACEAE** (bignonia family)

9. ***Catalpa ovata*** G. Don
Chinese catawbatree

SEM Figs. 17, 18; LM Figs. 23, 24

Description: Grains rhomboidal-decussate tetrad, spherical; diameter 40.0–49.4 μm; average size 44.88 μm; sculpturing aerolate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows a aerolate sculpturing pattern.

Distribution: Southern Quebec and southern Ontario.

Flowering period: Mid July to early August.

Ecological notes: A cultivated species rarely escaping. Introduced; a native of east Asia.

10. ***Catalpa speciosa*** Warder ex Engelm.
catawbatree, cigartree

SEM Figs. 19, 20; LM Figs. 25, 26

Description: Grains rhomboidal-decussate tetrad, spherical; diameter 25.7–30.4 μm; average size 27.4 μm; sculpturing aerolate; ektexine and endexine about 3.8 μm thick; structure tectate. SEM shows a aerolate sculpturing pattern.

Distribution: Rare in southwestern Ontario.

Flowering period: Late June to early to mid August.

Ecological notes: A cultivated species that rarely escapes cultivation. Native in eastern North America.

## **BORAGINACEAE** (borage family)

11. ***Borago officinalis*** L.
borage, common borage
bourrache officinale

SEM Figs. 21, 22; LM Figs. 27, 28

Description: Grains stephanocolporate, prolate spheroidal in equatorial view; PEI 1.05; PAI 0.18; size 19.0–24.7 μm wide × 20.9–26.6 μm long; average size 22.4 μm wide × 23.4 μm long; sculpturing microgemmate; ektexine and endexine about 3.0 μm thick; structure tectate. SEM clearly shows a microgemmate sculpturing pattern.

Distribution: Nova Scotia, west to British Columbia.

Flowering period: Mid July to frost.

Ecological notes: A cultivated species that has spread to waste places and along roadsides. Introduced; a native of the Mediterranean region of Europe.

12. ***Echium vulgare*** L.

blueweed, blue devil, viper's bugloss, blue-thistle
vipérine vulgaire, bouquet bleu, herbe aux vipères, langue d'oie, herbe bleue, herbe piquante, vipérine commune

SEM Figs. 23, 24; LM Figs. 29–31

Description: Grains tricolpate, teardrop-shaped in equatorial view; PEI 1.41; PAI 0.22; size 10.5–13.3 μm wide × 15.2–17.1 μm long; average size 11.9 μm wide × 16.7 μm long; sculpturing fine, reticulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows small perforations on the surface.

Distribution: Newfoundland, west to British Columbia.

Flowering period: Mid June to mid September.

Ecological notes: A common weed in dry fields, waste places, meadows, and along roadsides; common except in the Prairie Provinces, where it is sporadically weedy. Introduced; a native of Europe.

## CAMPANULACEAE (bluebell family)

13. ***Campanula rapunculoides*** L.

creeping bellflower, bellflower, bluebell, garden bluebell
campanule fausse raiponce, campanule raiponce, campanule, clochettes, raiponce, raiponcette

SEM Figs. 25, 26; LM Figs. 32, 33

Description: Grains stephanoporate, spheroidal; diameter 38.0–41.8 μm; average size 39.66 μm; sculpturing rugulate; ektexine and endexine about 2.3–2.6 μm thick; structure tectate. SEM shows a microrugulate sculpturing pattern between the microechinate spines.

Distribution: Newfoundland, west to Manitoba, Alberta, and British Columbia.

Flowering period: July to late September.

Ecological notes: On roadsides, in lawns, thickets, and waste places. Native.

## CAPPARIDACEAE (caper family)

14. ***Cleome serrulata*** Pursh

pink beeplant, beeplant, stinking-clover, spiderflower, Rocky Mountain beeplant, bee spiderflower
cléome denté, cléome à feuilles dentelées

SEM Figs. 27, 28; LM Figs. 34–36

Description: Grains tricolpate; prolate in equatorial view; PEI 1.37; PAI 0.16; size 11.4–13.3 μm wide × 15.2–18.1 μm long; average size 11.8 μm wide × 16.2 μm long; sculpturing reticulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a foveolate sculpturing pattern.

Distribution: Quebec, west to British Columbia.

Flowering period: Mid June to mid September.

Ecological notes: On damp sandy soils, prairie, in waste places, and along roadsides; particularly common in the Prairie Provinces. Native.

## CAPRIFOLIACEAE (honeysuckle family)

15. ***Diervilla lonicera*** Mill.

honeysuckle-bush, bush-honeysuckle, honeysuckle diervilla, life-of-man
dièreville chèvrefeuille, diervillée du Canada, herbe bleue, chèvrefeuille d'Acadie

SEM Figs. 29, 30; LM Figs. 37–40

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.11; PAI 0.53; size 37.1–41.8 μm wide × 40.0–47.5 μm long; average size 39.48 μm wide × 43.63 μm long; sculpturing microechinate; ektexine and endexine 1.5 μm thick; structure tectate. SEM shows the microechinate spines to be acute or mucronate.

Distribution: Newfoundland, Nova Scotia, west to Saskatchewan.

Flowering period: Mid June to late July.

Ecological notes: In dry woods, clearings, and rocky places. Native.

16. ***Lonicera involucrata*** (Rich.) Banks

twinberry honeysuckle, black twinberry, fly honeysuckle, black honeysuckle, bracted honeysuckle, bearberry honeysuckle
chèvrefeuille involucré

SEM Figs. 31, 32; LM Figs. 41–44

Description: Grains tricolporate; subprolate in equatorial view; PEI 1.15; PAI 0.82; size 38.0–49.4 μm wide × 47.5–55.1 μm long; average size 43.9 μm wide × 50.5 μm long; sculpturing echinate; ektexine and endexine about 2.0 μm thick; structure tectate.

Distribution: Mackenzie District, N.W.T.; Yukon Territory; Quebec, west to British Columbia.

Flowering period: May to early July.

Ecological notes: In moist woods, along streambanks, and in swampy locations. Native.

17. ***Lonicera morrowi*** Gray
Morrow honeysuckle
chèvrefeuille de Morrow

SEM Figs. 33, 34; LM Figs. 45–48

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.15; PAI 0.75; size 37.1–42.8 μm wide × 41.8–51.3 μm long; average size 40.3 μm wide × 46.5 μm long; sculpturing echinate; ektexine and endexine about 3.0 μm thick; structure tectate. SEM shows spines to be of varying sizes.

Distribution: Quebec, Ontario, and Saskatchewan.

Flowering period: May to end of June.

Ecological notes: Cultivated, occasionally escaping to thickets, along roadsides, and near old dwellings. Introduced; a native of Asia.

18. ***Lonicera tatarica*** L.
Tartarian honeysuckle, honeysuckle, twin sisters
chèvrefeuille de Tartarie, chèvrefeuille

SEM Figs. 35, 36; LM Figs. 49–52

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.17; PAI 0.73; size 36.1–40.9 μm wide × 41.8–47.5 μm long; average size 39.0 μm wide × 45.6 μm long; sculpturing echinate; ektexine and endexine about 2.6–3.0 μm thick; structure tectate. SEM shows spines to be of varying sizes.

Distribution: New Brunswick, west to Alberta.

Flowering period: May to early July.

Ecological notes: A cultivated species, escaping to thickets, to borders of woods, and along shores. Introduced; a native in Eurasia.

19. ***Sambucus canadensis*** L.

Canada elderberry, elderberry, Canadian elder, American elder, sweet elder
sureau blanc, sureau du Canada, sirop blanc

SEM Figs. 37, 38; LM Figs. 53–55

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.16; PAI 0.34; size 16.9–19.0 μm wide × 19.0–21.9 μm long; average size 17.8 μm wide × 20.7 μm long; sculpturing reticulate; ektexine and endexine about 1.9 μm thick; structure tectate.

Distribution: Nova Scotia, New Brunswick, Quebec, and Ontario.

Flowering period: Late June to late July.

Ecological notes: In moist woods, fields, and along roadsides, a reported weed of silviculture. Native.

20. ***Viburnum lentago*** L.

nannyberry, sweet viburnum, sheepberry, wild-raisin
viorne lentago, alisier, bourdaine, viorne à manchettes

SEM Figs. 39, 40; LM Figs. 56–58

Description: Grains tricolporate, prolate spheroidal, almost spherical in equatorial view; PEI 1.02; PAI 0.31; size 20.9–23.8 μm wide × 20.9–24.7 μm long; average size 22.2 μm wide × 22.6 μm long; sculpturing retipiliate; ektexine and endexine about 3.4 μm thick; structure semitectate. SEM shows the surface of the reticulum to have small spines.

Distribution: Quebec. west to Saskatchewan.

Flowering period: Late May to mid July.

Ecological notes: In woods and along roadsides and streambanks. Native.

21. ***Viburnum opulus*** L.

European cranberry bush, Guelder-rose, snowball
obier, tose de Gueldre

SEM Figs. 41, 42; LM Figs. 59–61

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.11; PAI 0.29; size 19.0–20.0 μm wide × 20.9–22.8 μm long; average size 19.4 μm wide × 21.5 μm long; sculpturing reticulate; ektexine and endexine about 4.0 μm thick; structure tectate. SEM shows granular particles within the reticulum.

Distribution: Nova Scotia, and Ontario.

Flowering period: June to mid July.

Ecological notes: A cultivated species that occasionally escapes to moist woods. Introduced; a native of Eurasia.

22. ***Viburnum plicatum*** Thunb.
Japanese snowball

SEM Figs. 43, 44; LM Figs. 62–64

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.14; PAI 0.44; size 17.1–20.9 μm wide × 19.0–24.7 μm long; average size 18.8 μm wide × 21.5 μm long; sculpturing reticulate; ektexine and endexine about 3.0 μm thick; structure tectate. SEM shows granular particles within the reticulum.

Distribution: Cultivated in southern Ontario, Quebec, the Maritime Provinces, and British Columbia.

Flowering period: Late May to June.

Ecological notes: A cultivated species occasionally escaping. Introduced; a native of Eastern Asia.

23. ***Viburnum prunifolium*** L.
black-haw, sweet-haw, stagbush, nannyberry
viorne à feuilles de prunier

SEM Figs. 45, 46; LM Figs. 65–67

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.09; PAI 0.36; size 20.0–22.8 μm wide × 21.9–25.7 μm long; average size 21.8 μm wide × 23.7 μm long; sculpturing coarse reticulate; ektexine and endexine about 2.6 μm thick; structure tectate. SEM shows the surface of the reticulum to have small spines.

Distribution: May occur in eastern Canada.

Flowering period: Late May to June.

Ecological notes: In thickets, along shores, and at the borders of woods. Native.

## COMPOSITAE (composite family)

24. ***Aster novae-angliae*** L.

New England aster, Michaelmas daisy
aster de la Nouvelle-Angleterre, aster d'automne

SEM Figs. 47, 48; LM Figs. 68–70

Description: Grains tricolporate, oblate spheroidal in equatorial view; PEI 0.89; PAI 0.39; size 19.0–24.7 μm wide × 18.1–20.9 μm long; average size 21.9 μm wide × 19.49 μm long; sculpturing echinate; ektexine and endexine 4.5 μm thick; structure tectate. SEM shows no sculpturing pattern on or between the spines.

Distribution: Nova Scotia, New Brunswick, Quebec, Ontario, and Manitoba.

Flowering period: August to mid October.

Ecological notes: In damp localities, meadows, and along shores. Native.

25. ***Centaurea cyanus*** L.

cornflower, bachelor's-button, bluebottle
centaurée bleuet, bleuet, barbeau

SEM Figs. 49, 50; LM Figs. 71–73

Description: Grains tricolporate, prolate in equatorial view; PEI 1.36; PAI 0.51; size 20.0–20.9 μm wide × 25.7–30.4 μm long; average size 20.72 μm wide × 28.14 μm long; sculpturing psilate; ektexine and endexine 4.5 μm thick; structure tectate. SEM shows submicroechinate processes.

Distribution: Newfoundland, west to Manitoba, Alberta, and British Columbia.

Flowering period: July to August.

Ecological notes: An occasional escape, persisting in grainfields and along roadsides. Introduced; a native of Eurasia.

26. ***Centaurea diffusa*** Lam.

diffuse knapweed, diffuse star-thistle
centaurée diffuse

SEM Figs. 51, 52; LM Figs. 74–76

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.17; PAI 0.21; size 18.1–21.9 μm wide × 20.9–24.7 μm long; average size 19.21 μm wide × 22.43 μm long; sculpturing echinate; ektexine and endexine 4.5 μm thick; structure tectate. SEM shows granular furrow membranes.

Distribution: Gaspé, Quebec; Alberta and British Columbia.

Flowering period: June to July in western Canada; July to August in Quebec.

Ecological notes: Found along roadsides and railway tracks. Introduced; a native of Eurasia.

27. ***Centaurea maculosa*** Lam.

spotted knapweed
centaurée maculée, centaurée tachetée

SEM Figs. 53, 54; LM Figs. 77–79

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.18; PAI 0.21; size 23.8–26.6 μm wide × 28.5–30.4 μm long; average size 25.0 μm wide × 29.6 μm long; sculpturing echinate; ektexine and endexine 5.3 μm thick; structure tectate. SEM shows broadly based spines.

Distribution: Nova Scotia, New Brunswick, Quebec, Ontario, and British Columbia.

Flowering period: July to August.

Ecological notes: In fields, waste places, and along roadsides. Introduced; a native of Eurasia.

28. ***Centaurea montana*** L.

mountain star-thistle, mountain-bluet
centaurée des montagnes

SEM Figs. 55, 56; LM Figs. 80–82

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.28; PAI 0.26; size 33.3–40.0 μm wide × 45.6–48.5 μm long; average size

36.79 μm wide × 47.23 μm long; sculpturing microechinate; ektexine and endexine 5.6–6.0 μm thick; structure tectate. SEM shows submicroechinate processes.

Distribution: Newfoundland, New Brunswick, Quebec, Ontario, and British Columbia.

Flowering period: June to July.

Ecological notes: A cultivated species occasionally escaping. Introduced; a native of Europe.

29. ***Cichorium endiva*** L.

endive
chicorée endive

SEM Figs. 57, 58; LM Figs. 83–85

Description: Grains echinolophate tricolporate, spheroidal in equatorial view; PAI 0.17; diameter 38.0–42.8 μm; average size 40.34 μm; sculpturing echinate; ektexine and endexine 10.5–10.9 μm thick; structure tectate. SEM shows a microperforate ridged echinate tectum with interporal lacunae.

Distribution: Southwestern Ontario and southern interior British Columbia.

Flowering period: September.

Ecological notes: A common cultivated species. Introduced; a native of the Mediterranean region.

30. ***Cichorium intybus*** L.

chicory, blue sailors, common chicory, succory, wild chicory
chicorée sauvage, chicorée, barbe de capucin, chicorée à café, chicorée amère, chicorée bleue, chicorée commune, chicorée cultivée, chicorée frisée, chicorée ordinaire, endive, endive sauvage

SEM Figs. 59, 60; LM Figs. 86–89

Description: Grains echinolophate tricolporate, spheroidal in equatorial view; PAI 0.19; diameter 36.1–44.7 μm; average size 40.23 μm; sculpturing echinate; ektexine and endexine about 10.5–10.9 μm thick; structure tectate. SEM shows microperforate ridged echinate tectum with interporal lacunae.

Distribution: Labrador, west to British Columbia.

Flowering period: July to early September.

Ecological notes: Common in fields, parklands, and along roadsides. Introduced; a native of Eurasia.

31. ***Cirsium muticum*** Michx.

swamp thistle, dunce-nettle, horsetops
chardon mutique, cirse mutique

SEM Figs. 61, 62; LM Figs. 90–93

Description: Grains tricolporate, oblate spheroidal in equatorial view; PEI 0.91; PAI 0.53; size 43.7–49.4 μm wide × 40.0–45.6 μm long; average size 46.8 μm wide × 42.7 μm long; sculpturing echinate; ektexine and endexine 8.3 μm thick; structure tectate. SEM shows tricolporate nature and spines.

Distribution: Newfoundland, west to Saskatchewan.

Flowering period: From mid July to September.

Ecological notes: In moist habitats, such as along riverbanks, and in swamps, meadows, and thickets. Native.

32. ***Cirsium vulgare*** (Savi) Tenore

bull thistle, spear thistle, common thistle
chardon vulgaire, piqueux chardon, gros chardon, pet d'âne, piqueux, chardon, chardon anglais, chardon lancéolé, cirse vulgaire, cirse, cirse lancéolé, piquants pépiques

SEM Figs. 63, 64; LM Figs. 94, 95

Description: Grains tricolporate, oblate spheroidal in equatorial view; PEI 0.95; size 40.0–42.8 μm wide × 38.0–41.8 μm long; average size 41.7 μm wide × 39.4 μm long; sculpturing echinate; ektexine and endexine 11.8 μm; structure tectate. SEM shows large broad-based spines.

Distribution: Newfoundland, west to British Columbia.

Flowering period: July to September.

Ecological notes: In waste places, clearings, pastures, fields, and along roadsides. Introduced; a native of Eurasia.

33. ***Cosmos bipinnatus*** Cav.

cosmos
cosmos bipinné

SEM Figs. 65, 66; LM Figs. 96–98

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.02; PAI 0.13; size 26.6–30.4 μm wide × 28.5–29.5 μm long; average size 28.4 μm wide × 28.9 μm long; sculpturing echinate; ektexine and endexine about 6.0 μm thick; structure tectate. SEM shows tricolporate nature and microperforated spines.

Distribution: Cultivated throughout most of southern Canada.

Flowering period: Mid July to frost.

Ecological notes: A cultivated species rarely escaping in Canada. Introduced; a native of Mexico.

34. ***Echinops exaltatus*** Schrad.
Russian globe thistle
échinope de Russie

SEM Figs. 67, 68; LM Figs. 99–102

Description: Grains tricolporate, prolate in equatorial view; PEI 1.35; PAI 0.47; size 40.0–49.4 μm wide × 57.0–66.5 μm long; average size 45.8 μm wide × 61.7 μm long; sculpturing microechinate; ektexine and endexine about 7.6 μm thick; structure tectate. SEM shows pores traversing the furrows and a smooth surface with microechinate sculpturing.

Distribution: Southwestern Quebec, Ontario, and southwestern British Columbia.

Flowering period: Mid July to early September.

Ecological notes: Garden ornamental occasionally escaping. Introduced; a native of southern and central Europe.

35. ***Echinops sphaerocephalus*** L.
globe thistle
boulette commune

SEM Figs. 69, 70; LM Figs. 103–106

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.31; PAI 0.43; size 47.5–51.3 μm wide × 62.7–69.4 μm long; average size 49.5 μm wide × 65.0 μm long; sculpturing microechinate; ektexine and endexine about 8.6–9.5 μm thick; structure tectate. SEM shows pores traversing the furrows and a smooth surface with a microechinate sculpturing pattern.

Distribution: Quebec, Ontario, Manitoba, and British Columbia.

Flowering period: Mid July to late August.

Ecological notes: A cultivated species occasionally escaping to waste heaps in fields and waste places, common in the area of Goderich, Ont. Introduced; a native of Eurasia.

36. ***Eupatorium perfoliatum*** L.

boneset, thoroughwort
eupatoire perfoliée, herbe à souder

SEM Figs. 71, 72; LM Figs. 107–109

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.09; PAI 0.18; size 19.0–24.7 μm wide × 20.9–26.6 μm long; average size 21.7 μm wide × 23.7 μm long; sculpturing echinate; ektexine and endexine about 6.0 μm thick; structure tectate. SEM shows deep furrows and microperforated spines.

Distribution: Nova Scotia, west to southern Manitoba.

Flowering period: July to October.

Ecological notes: In low woods or thickets, swales, prairies, and along wet shores. Native.

37. ***Helianthus annuus*** L.

sunflower, common sunflower, common annual sunflower
hélianthe annuel, grand soleil, tourne-soleil

SEM Figs. 73, 74; LM Figs. 110–112

Description: Grains tricolporate, oblate spheroidal in equatorial view; PEI 0.92; PAI 0.32; size 32.3–38.0 μm wide × 30.4–36.1 μm long; average size 35.0 μm wide × 32.1 μm long; sculpturing echinate; ektexine and endexine about 7.1 μm thick; structure tectate. SEM shows shallow furrows extending to the polar area and microperforated spines.

Distribution: Nova Scotia to British Columbia.

Flowering period: Late June to early September.

Ecological notes: Widely cultivated throughout southern Canada, particularly in Ontario and the Prairie Provinces, for its seed and oil. Escaping to heavier soils and along roadsides. Native.

38. ***Helianthus petiolaris*** Nutt.

prairie sunflower, annual sunflower
hélianthe des prairies

SEM Figs. 75, 76; LM Figs. 113–115

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.04; PAI 0.23; size 25.7–30.4 μm wide × 27.6–32.3 μm long; average size 28.8 μm wide × 30.0 μm long; sculpturing echinate; ektexine and endexine about 8.3 μm thick; structure tectate. SEM shows microperforated spines.

Distribution: Ontario to British Columbia.

Flowering period: July to September.

Ecological notes: In sandy areas and along roadsides. Introduced in Ontario and British Columbia; a native of the Prairie Provinces.

39. ***Helianthus salicifolius*** A. Dietr.

willow-leaved sunflower

SEM Figs. 77, 78; LM Figs. 116–118

Description: Grains tricolporate, oblate spheroidal in equatorial view; PEI 0.93; PAI 0.60; size 28.5–34.2 μm wide × 27.6–32.3 μm long; average size 31.9 μm wide × 29.6 μm long; sculpturing echinate; ektexine and endexine about 8.0 μm thick; structure tectate. SEM shows clearly defined annulate pores with shallow furrows.

Distribution: Southern Manitoba, west to southern Alberta.

Flowering period: September to October.

Ecological notes: On calcareous soils, in prairie glades, and on plains. Native.

40. ***Liatris cylindracea*** Michx.

blazingstar

SEM Figs. 79, 80; LM Figs. 119–121

Description: Grains tricolporate, spherical in equatorial view; PAI 0.33; diameter 26.6–29.5 μm; average size 27.8 μm; sculpturing echinate; ektexine and endexine about 6.0 μm thick; structure tectate. SEM shows few microperforated spines.

Distribution: Southern Ontario.

Flowering period: July to September.

Ecological notes: In dry open places and on sandy soils. Native.

41. ***Rudbeckia hirta*** L.

black-eyed Susan, brown-eyed Susan, yellow daisy
rudbeckie hérissée, rudbeckie tardive, marguerite jaune, marguerite orangée, moutarde orange, rudbeckie, rudbékie bicolore, rudbeckie hirsute, obéliscaire

SEM Figs. 81, 82; LM Figs. 122–124

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.15; PAI 0.23; size 19.0–21.9 μm wide × 22.8–24.7 μm long; average size 20.6 μm wide × 23.8 μm long; sculpturing echinate; ektexine and endexine about 6.0 μm thick; structure tectate. SEM shows clearly defined nonannulate pores and microperforate spines.

Distribution: Newfoundland, west to British Columbia.

Flowering period: July to early September.

Ecological notes: In open woods, thickets, barrens, fields, and on the open prairie. Introduced; a native of central and eastern United States.

42. ***Solidago canadensis*** L.

Canada goldenrod, common goldenrod
verge d'or du Canada, verge d'or, verge d'or commune, gerbe d'or, bouquets jaunes, solidage du Canada

SEM Figs. 83, 84; LM Figs. 125–127

Description: Grains tricolporate, oblate-spheroidal in equatorial view; PEI 0.93; PAI 0.30; size 17.1–19.0 μm wide × 15.2–18.1 μm long; average size 18.5 μm wide × 17.2 μm long; sculpturing echinate; ektexine and endexine about 3.0 μm thick; structure tectate. SEM shows clearly defined furrows and microperforate spines.

Distribution: Mackenzie District, N.W.T.; Yukon Territory; Newfoundland, west to British Columbia.

Flowering period: Mid July to August.

Ecological notes: In pastures, forest nurseries, prairie areas, perennial gardens, and along roadsides. Native.

43. ***Taraxacum officinale*** Weber

dandelion, common dandelion, facelock
pissenlit, pissenlit officinal, dandelion officinal, dent-de-lion commune, florion d'or, pissenlit dent-de-lion, dent-de-lion

SEM Figs. 85, 86; LM Figs. 128–131

Description: Grains echinolophate-tricolporate, spheroidal in equatorial view; PAI 0.16, diameter 30.4–38.0 μm; average size 33.8 μm; sculpturing echinate; ektexine and endexine about 6.9–7.1 μm thick; structure tectate. SEM shows a ridged echinate tectum with interporal lacunae.

Distribution: Labrador, Newfoundland, west to British Columbia.

Flowering period: Early May to September.

Ecological notes: A common weed of lawns, grasslands, open grounds, waste places, and along roadsides. Introduced; a native of Europe.

44. ***Tragopogon dubius*** Scop.

goat's-beard, yellow goat's-beard
salsifis majeur

SEM Figs. 87, 88; LM Figs. 132–135

Description: Grains echinolophate-tricolporate, spheroidal in equatorial view; PAI 0.19; diameter 37.1–40.0 μm; average size 38.5 μm; sculpturing echinate; ektexine and endexine about 7.9–8.3 μm thick; structure tectate. SEM shows a ridged echinate tectum with interporal lacunae.

Distribution: Mackenzie District, N.W.T.; Quebec, west to British Columbia.

Flowering period: June to September.

Ecological notes: Along roadsides and in waste places. Introduced; a native of Eurasia.

## **CONVOLVULACEAE** (morning-glory family)

45. ***Ipomoea purpurea*** (L.) Roth

common morning-glory
ipomée pourpre

SEM Figs. 89, 90; LM Figs. 136, 137

Description: Grains periporate, spheroidal in shape; diameter 120.0–144.0 μm; average diameter 134.0 μm; sculpturing echinate; ektexine and

endexine about 16.6 μm thick, including echinae; structure tectate. SEM shows mucronate spines and a reticulum with serrated edges. The operculum consists of a spiny plug.

Distribution: Quebec, and Ontario.

Flowering period: August to mid September.

Ecological notes: A cultivated species that has spread into fields, waste places, and along roadsides. Introduced; a native of tropical North and South America.

## CORNACEAE (dogwood family)

46. ***Cornus stolonifera*** Michx.

red-osier dogwood, dogwood, kinnikinnick
cornouiller stolonifère, hart rouge, osier rouge, poison

SEM Figs. 91, 92; LM Figs. 138–141

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.11; PAI 0.22; size 38.0–45.6 μm wide × 41.8–51.3 μm long; average size 41.0 μm wide × 45.4 μm long; sculpturing psilate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM shows a microechinate sculpturing pattern.

Distribution: Mackenzie District, N.W.T.; Yukon Territory; Labrador and Newfoundland, west to British Columbia.

Flowering period: Late May–early July.

Ecological notes: A cultivated species spread to thickets and along shorelines. Native.

## CRUCIFERAE (mustard family)

47. ***Alyssum saxatile*** L.

golden-cress, basket-of-gold, rock madwort, goldentuft
corbeille d'or

SEM Figs. 93, 94; LM Figs. 142–144

Description: Grains tricolpate, prolate in equatorial view; PEI 1.47; PAI 0.40; size 12.4–14.3 μm wide × 18.1–20.9 μm long; average size 13.2 μm wide × 19.5 μm long; sculpturing reticulate; ektexine and endexine about

2.3 μm thick; structure tectate. SEM shows well-defined reticulate sculpturing pattern spread evenly over the entire pollen grain.

Distribution: Throughout southern Canada.

Flowering period: May to mid June.

Ecological notes: A commonly cultivated species rarely escaping. Introduced; a native of Eurasia.

48. ***Brassica napus*** L.

rape, canola
colza

SEM Figs. 95, 96; LM Figs. 145–147

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.32; PAI 0.29; size 18.1–20.9 μm wide × 24.7–27.6 μm long; average size 19.2 μm wide × 25.4 μm long; sculpturing reticulate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows well-defined reticulate sculpturing pattern spread evenly over the entire pollen grain.

Distribution: Cultivated throughout southern Canada.

Flowering period: June to August.

Ecological notes: A commonly cultivated species. Introduced; a native of Eurasia.

49. ***Brassica nigra*** (L.) Koch

black mustard
moutarde noire, moutarde, moutarde sauvage, petit bouquet jaune, sénevé, sénevé noir

SEM Figs. 97, 98; LM Figs. 148–150

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.21; PAI 0.27; size 15.2–19.0 μm wide × 18.1–24.7 μm long; average size 18.0 μm wide × 21.9 μm long; sculpturing reticulate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows a well-defined reticulate sculpturing pattern spread evenly over the entire pollen grain.

Distribution: Newfoundland, west to Ontario and British Columbia.

Flowering period: Late June to October.

Ecological notes: Formerly cultivated, spreading to waste places and cultivated fields. Introduced; a native of Eurasia and North Africa.

50. ***Brassica rapa*** L.

bird rape, bird's rape, field mustard, wild turnip
moutarde des oiseaux, navette, chou champêtre, chou-rave, rave, moutarde d'Allemagne, moutarde des champs, moutarde sauvage, navet sauvage, navette d'Allemange, navette des oiseaux, navette d'été, navette fourragère, navette oléagineuse, navette sauvage, sénevé à feuilles lisses

SEM Figs. 99, 100; LM Figs. 151–153

Description: Grains tricolpate, prolate in equatorial view; PEI 1.36; PAI 0.24; size 17.1–19.0 μm wide × 22.8–29.5 μm long; average size 18.7 μm wide × 25.4 μm long; sculpturing reticulate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows a well-defined reticulate sculpturing pattern spread evenly over the entire pollen grain.

Distribution: Mackenzie District, N.W.T.; Yukon Territory; Newfoundland, west to British Columbia.

Flowering period: June to August.

Ecological notes: A cultivated species spread to waste places; a weed of cultivated fields. Introduced; a native of Eurasia.

51. ***Diplotaxis tenuifolia*** (L.) DC.

wall-rocket, narrow-leaved wall-rocket
diplotaxis à feuilles ténues

SEM Figs. 101, 102; LM Figs. 154–156

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.20; PAI 0.24; size 20.9–25.7 μm wide × 26.6–30.4 μm long; average size 23.4 μm wide × 28.2 μm long; sculpturing reticulate; ektexine and endexine about 3.8 μm thick; structure tectate. SEM shows well-defined reticulate sculpturing pattern spread evenly over the entire pollen grain.

Distribution: Nova Scotia, New Brunswick, Quebec, Ontario, and British Columbia.

Flowering period: Mid June to frost.

Ecological notes: A common weed of roadsides and waste places. Introduced; a native of Europe.

52. ***Raphanus raphanistrum*** L.

wild radish, jointed charlock, jointed radish, jointed wild radish
radis sauvage, rave sauvage, ravenelle, moutarde, moutarde des champs, radis-rouge

SEM Figs. 103, 104; LM Figs. 157–159

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.27; PAI 0.26; size 16.9–19.0 μm wide × 22.8–23.8 μm long; average size 18.2 μm wide × 23.1 μm long; sculpturing reticulate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows a well-defined reticulate sculpturing pattern spread evenly over the entire pollen grain.

Distribution: Newfoundland, west to British Columbia.

Flowering period: Mid June to July, in British Columbia beginning to flower in late May.

Ecological notes: A weed of grainfields and waste places, common in the Maritime Provinces and Quebec. Introduced; a native of Eurasia.

53. ***Sinapis alba*** L.

white mustard, charlock, rough mustard
moutarde blanche, moutarde rude, moutarde anglaise, moutarde, moutarde cultivée, petit bouquet jaune, sénevé

SEM Figs. 105, 106; LM Figs. 160–162

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.2; PAI 0.23; size 21.9–24.7 μm wide × 26.6–30.4 μm long; average size 23.1 μm wide × 27.7 μm long; sculpturing reticulate; ektexine and endexine about 3.8 μm thick; structure tectate. SEM shows a well-defined reticulate sculpturing pattern spread evenly over the entire pollen grain.

Distribution: Nova Scotia, west to British Columbia.

Flowering period: Late June to October.

Ecological notes: A cultivated species that has become established as a weed of fields and waste places. Introduced; a native of Eurasia.

## CUCURBITACEAE (gourd family)

54. ***Echinocystis lobata*** (Michx.) T. & G.

wild cucumber, balsam-apple, prickly cucumber
concombre grimpant, échinocystis lobé, échinocyste lobé, concombre sauvage, concombres grimpants, concombre rameur

SEM Figs. 107, 108; LM Figs. 163–166

Description: Grain stephanocolporate, oblate spheroidal in equatorial view; PEI 0.89; PAI 0.17; size 51.3–57.0 μm wide × 46.6–49.4 μm long; average size 54.9 μm wide × 48.7 μm long; sculpturing punctate; ektexine and endexine about 3.8 μm thick; structure tectate. SEM shows a punctated surface.

Distribution: Nova Scotia, west to British Columbia.

Flowering period: Mid July to August.

Ecological notes: In thickets, moist woods, along fencerows, and in rich soils near streams. Native.

## DIPSACACEAE (teasel family)

55. ***Dipsacus sylvestris*** Hudson

teasel, card teasel, wild teasel
cardère des bois, cardère sylvestre, cardère, cabaret des oiseaux, chardon des forêts

SEM Figs. 109, 110; LM Figs. 167–169

Description: Grains tricolporate, spherical in equatorial view; PAI 0.63; diameter 72.2–84.7 μm; average size 77.5 μm; sculpturing microechinate; ektexine and endexine about 4.9–5.3 μm thick; structure tectate. SEM shows two sizes of microechinate spines: the larger are widely dispersed and the smaller are close together.

Distribution: Quebec, Ontario, and British Columbia.

Flowering period: July to August.

Ecological notes: In old fields, pastures, and along roadsides, weedy in asparagus. Introduced; a native of Eurasia.

## ELAEAGNACEAE (oleaster family)

56. ***Elaeagnus commutata*** Bernh.

silverberry, wolf-willow
chalef argenté, chalef changeant, bois d'argent, chalef

SEM Figs. 111, 112; LM Figs. 170–172

Description: Grains tricolporate, spherical in equatorial view; PAI 0.61; diameter 32.3–41.8 μm; average size 37.1 μm; sculpturing psilate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows grains triangular with short furrows.

Distribution: Keewatin and Mackenzie Districts, N.W.T.; Yukon Territory; Newfoundland; Nova Scotia, west to British Columbia.

Flowering period: Late May to June.

Ecological notes: On dry calcareous slopes and along river banks. Native.

## ERICACEAE (heath family)

57. ***Arctostaphylos uva-ursi*** (L.) Spreng.

bearberry, common bearberry, kinnikinnick, mealberry, hog-cranberry
raisin d'ours, arctostaphyle raisin d'ours, arctostaphyle, bousserole, sac à commis

SEM Figs. 113, 114; LM Figs. 173–175

Description: Grains tetrahedral tetrad, tricolporate, spherical in equatorial view; PAI 0.24; diameter 38.0–41.8 μm; average size 39.8 μm; sculpturing rugulate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM in polar and equatorial views shows the tricolporate nature of the individual grain.

Distribution: Keewatin and Mackenzie Districts, N.W.T.; Yukon Territory; Newfoundland, west to British Columbia.

Flowering period: Early May to mid June.

Ecological notes: On open rocky and sandy soils. Native.

58. ***Calluna vulgaris*** (L.) Hull.

heather, Scotch heather, ling
bruyère commune

SEM Figs. 115, 116; LM Figs. 176–178

Description: Grains tetrahedral tetrad, tricolporate, spherical in equatorial view; PAI 0.31; diameter 39.0–45.6 μm; average size 41.5 μm; sculpturing verrucate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM in polar and equatorial views shows the tricolporate nature of the individual grain.

Distribution: Rare in eastern Newfoundland and scattered throughout Nova Scotia.

Flowering period: Mid July to November.

Ecological notes: Locally occurring on peaty or damp sandy soils. Introduced; a native of Europe, now naturalized.

59. ***Kalmia angustifolia*** L.

sheep-laurel, dwarf-laurel, pig-laurel, wicky, lambkill
kalmia à feuilles étroites, crevard de moutons, laurier, poison de brebis, bois-chaud, herbe à commis, herbe forte, kalmia, kalmia à feuilles étoilées, pétrole, sacacoumi, tuemoutons

SEM Figs. 117, 118; LM Figs. 179–181

Description: Grains tetrahedral tetrad, tricolporate, spherical in equatorial view; PAI 0.43; diameter 22.8–28.5 μm; average size 26.2 μm; sculpturing verrucate; ektexine and endexine about 1.5–1.9 μm thick; structure tectate. SEM in polar and equatorial views shows the tricolporate nature of the individual grain.

Distribution: Newfoundland, west to Ontario.

Flowering period: Late June to late July.

Ecological notes: Common on dry or wet sterile soils, barrens, and in old pastures. Native.

60. ***Kalmia latifolia*** L.

calicobush, mountain-laurel, spoonwood, ivybush
kalmie à larges feuilles

SEM Figs. 119, 120; LM Figs. 182–184

Description: Grains tetrahedral tetrad, tricolporate, spherical in equatorial view; PAI 0.50; diameter 29.5–33.3 μm; average size 31.8 μm; sculpturing verrucate; ektexine and endexine about 1.5–1.9 μm thick; structure tectate.

SEM in polar and equatorial views shows the tricolporate nature of the individual grain.

Distribution: New Brunswick, Quebec, and Ontario.

Flowering period: Late May to late July.

Ecological notes: In dry or moist woods and clearings, on sandy or rocky acidic soils. Native.

61. ***Ledum groenlandicum*** Oeder
common Labrador-tea, Labrador-tea
lédon du Groenland, thé du Labrador, thé velouté, bois de savane

SEM Figs. 121, 122; LM Figs. 185–187

Description: Grains tetrahedral tetrad, tricolporate, spherical in equatorial view; PAI 0.26; diameter 26.6–30.4 μm; average size 28.4 μm; sculpturing psilate, with verrucate particles between the furrows; ektexine and endexine about 1.5 μm thick; structure tectate. Unacetolized material contains viscine threads. SEM in polar and equatorial views shows the tricolporate nature of the individual grain.

Distribution: Keewatin and Mackenzie Districts, N.W.T.; Yukon Territory; Newfoundland, west to British Columbia.

Flowering period: Late May to mid July.

Ecological notes: In peaty soils, particularly in bogs and along wet shores. Native.

62. ***Rhododendron canadense*** (L.) B.S.P.
Canadian rhododendron, rhodora
rhododendron du Canada, rhodora du Canada, rhodora

SEM Figs. 123, 124; LM Figs. 188–190

Description: Grains tetrahedral tetrad, tricolporate, spherical in equatorial view; PAI 0.30; diameter 36.1–41.8 μm; average size 37.3 μm; sculpturing psilate; ektexine and endexine about 3.0 μm thick; structure tectate. Unacetolized material contains viscine threads. SEM in polar and equatorial views shows the tricolporate nature of the individual grain.

Distribution: Newfoundland, west to Ontario.

Flowering period: Mid May to June.

Ecological notes: In bogs and damp thickets, on acid barrens, rocky summits, and slopes. Native.

63. ***Vaccinium angustifolium*** Ait.

lowbush blueberry, blueberry, low sweet blueberry, late sweet blueberry, sweethurts

airelle à feuilles étroites, bleuets, airelle de Pennsylvanie, bleuet nain, bleuets de savane

SEM Figs. 125, 126; LM Figs. 191–193

Description: Grains tetrahedral tetrad, tricolporate, spherical in equatorial view; PAI 0.42; diameter 30.4–40.0 μm; average size 34.0 μm; sculpturing psilate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM in polar and equatorial views shows the tricolporate nature of the individual grain and a furrow within the pore.

Distribution: Keewatin District, N.W.T.; Newfoundland, west to Saskatchewan.

Flowering period: May to early June.

Ecological notes: A cultivated species growing on dry open rocky or sandy soils, found locally in bogs; normally common. Native.

64. ***Vaccinium arboreum*** Marsh.

farkleberry, sparkleberry, tree whortleberry, winter whortleberry

SEM Figs. 127, 128; LM Figs. 194–196

Description: Grains tetrahedral tetrad, tricolporate, spherical in equatorial view; PAI 0.34; diameter 32.3–41.8 μm; average size 35.0 μm; sculpturing psilate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM in polar and equatorial views shows the tricolporate nature of the individual grain.

Distribution: Not known in Canada, although it has been recommended as a potentially good honey plant for cultivation here.

Flowering period: June.

Ecological notes: In dry sandy or rocky woods, thickets, and clearings. Native.

65. ***Vaccinium corymbosum*** L.

highbush blueberry, high blueberry
airelle en corymbe, bleuet en corymbes

SEM Figs. 129, 130; LM Figs. 197–199

Description: Grains tetrahedral tetrad, tricolporate, spherical in equatorial view; PAI 0.36; diameter 39.0–45.6 μm; average size 41.6 μm; sculpturing verrucate; ektexine and endexine about 1.5–1.9 μm thick; structure tectate. SEM in polar and equatorial views shows the tricolporate nature of the individual grain.

Distribution: Southwestern Nova Scotia, New Brunswick, Quebec, and Ontario.

Flowering period: Mid May to early June.

Ecological notes: Commonly found in wets soils such as swamps and bogs, occasionally in dry upland areas. Native.

66. ***Vaccinium macrocarpon*** Ait.

large cranberry, American cranberry, cranberry
airelle à gros fruits, gros atocas, graines, pommes de pré, grande canneberge, canneberge à gros fruits

SEM Figs. 131, 132; LM Figs. 200–202

Description: Grains tetrahedral tetrad, tricolporate, spherical in equatorial view; PAI 0.34; diameter 38.0–41.8 μm; average size 39.8 μm; sculpturing verrucate; ektexine and endexine about 1.5–1.9 μm; structure tectate. SEM in polar and equatorial views shows the tricolporate nature of the individual grain.

Distribution: Newfoundland, Nova Scotia, west to Ontario and British Columbia.

Flowering period: July.

Ecological notes: A cultivated species found in bogs, swamps, and along wet shores. Native in Northeastern America, adventive in British Columbia.

67. ***Vaccinium myrtilloides*** Michx.

velvet-leaved blueberry, blueberry, Canada blueberry, sourtop blueberry
airelle du Canada, airelle fausse-Myrtille, bleuets, bleuet du Canada

SEM Figs. 133, 134; LM Figs. 203–205

Description: Grains tetrahedral tetrad, tricolporate, spherical in equatorial view; PAI 0.35; diameter 30.4–34.2 μm; average size 32.7 μm; sculpturing verrucate; ektexine and endexine about 1.5 μm; structure tectate. SEM in polar and equatorial views shows the tricolporate nature of the individual grain.

Distribution: Mackenzie District, N.W.T.; Nova Scotia, west to British Columbia. Reported in Labrador and Newfoundland.

Flowering period: June to early July.

Ecological notes: In moist woods, swamps, and clearings. Native.

68. ***Vaccinium vitis-idaea*** L.

foxberry, bog cranberry, cowberry, mountain cranberry, rock cranberry, lingen, lingberry, partridgeberry, redberries, red whortleberry
airelle vigne-d'Ida, airelle ponctuée, bleuet vigne d'Ida, graines rouges, pommes de terre, pommes, berris

SEM Figs. 135, 136; LM Figs. 206–208

Description: Grains tetrahedral tetrad, tricolporate, spherical in equatorial view; PAI 0.30; diameter 32.3–40.0 μm; average size 34.6 μm; sculpturing verrucate; ektexine and endexine about 2.3 μm; structure tectate. SEM in polar and equatorial views shows the tricolporate nature of the individual grain.

Distribution: Found throughout Canada.

Flowering period: June to mid July.

Ecological notes: In bogs and on dry rocky soils. Native.

## EUPHORBIACEAE (spurge family)

69. ***Euphorbia esula*** L.

leafy spurge, wolf's-milk
euphorbe ésule, euphorbe feuillue, embranchée

SEM Figs. 137, 138; LM Figs. 209–211

Description: Grains tricolporate, oblate spheroidal in equatorial view; PEI 0.89; PAI 0.43; size 28.5–36.1 μm wide × 24.7–30.4 μm long; average size 32.9 μm wide × 29.2 μm long; sculpturing microreticulate; ektexine and endexine about 3.4 μm thick; structure tectate. SEM shows a punctate surface.

Distribution: Nova Scotia, Prince Edward Island, and Ontario, west to British Columbia.

Flowering period: May to September.

Ecological notes: A serious weed on sandy banks, in cultivated fields, pastures, rangeland, old fields, and along roadsides. Introduced; a native of Eurasia.

## GENTIANACEAE (gentian family)

70. ***Gentianella crinata*** (Froel.) G. Don

fringed gentian
gentiane frangée

SEM Figs. 139, 140; LM Figs. 212–214

Description: Grains tricolporate, oblate spheroidal in equatorial view; PEI 0.95; PAI 0.40; size 39.0–43.7 μm wide × 38.0–41.8 μm long; average size 42.9 μm wide × 40.6 μm long; sculpturing coarse, reticulate; ektexine and endexine about 4.5 μm thick; structure tectate. SEM shows circular and irregular lumina.

Distribution: Mackenzie District, N.W.T.; Quebec, west to British Columbia.

Flowering period: Late August to October.

Ecological notes: In meadows, wet thickets, low woods, and along brooksides. Native.

## GERANIACEAE (geranium family)

71. ***Geranium bicknelli*** Britt.

Bicknell's geranium, Bicknell's crane's-bill
géranium de Bicknell

SEM Figs. 141, 142; LM Figs. 215–217

Description: Grains tricolpate, oblate spheroidal in equatorial view; PEI 0.92; PAI 0.43; size 62.7–66.5 μm wide × 57.0–60.8 μm long; average size 63.8 μm wide × 58.8 μm long; sculpturing reticulate-pilate; ektexine and endexine about 3.8 μm thick; structure intectate. SEM shows two types of pila: one is wide and clavate, the other, rod-shaped.

Distribution: Mackenzie District, N.W.T.; Yukon Territory; Newfoundland; Nova Scotia, west to British Columbia.

Flowering period: July to August.

Ecological notes: In open woods, clearings, fields, and on disturbed soils. Native.

## GRAMINEAE (grass family)

72. ***Zea mays*** L.

corn, maize
maize, blé d'indie

SEM Figs. 143, 144; LM Figs. 218, 219

Description: Grains spherical in equatorial view, monoporate, the pore having an annulus and operculum; diameter 66.5–77.9 μm; average size 72.3 μm; sculpturing psilate; ektexine and endexine about 2.0 μm thick; structure intectate. SEM shows a microgranulate sculpturing pattern.

Distribution: Cultivated throughout southern Canada.

Flowering period: July to August.

Ecological notes: An important cultivated species, volunteering in many crops, casual on garden refuse and dumps but not persistent. Introduced; a native of Mexico and south-central America.

## HAMAMELIDACEAE (witch-hazel family)

73. ***Hamamelis virginiana*** L.

common witch-hazel, witch-hazel
hamamélis de Virginie, café du diable

SEM Figs. 145, 146; LM Figs. 220–222

Description: Grains tricolpate, prolate-spheroidal in equatorial view; PEI 1.1; PAI 0.40; size 15.2–18.1 μm wide × 16.9–19.0 μm long; average size 16.9 μm wide × 18.6 μm long; sculpturing coarsely reticulate; ektexine and endexine about 1.9 μm thick; structure tectate.

Distribution: New Brunswick, Nova Scotia, Quebec, and Ontario.

Flowering period: Late September to early October.

Ecological notes: On the edges of woodlands. Native.

## HIPPOCASTANACEAE (buckeye family)

74. ***Aesculus hippocastanum*** L.

horse-chestnut
marronnier d'Inde, marronnier, marronnier commun

SEM Figs. 147, 148; LM Figs. 223–225

Description: Grains tricolporate, prolate in equatorial view; PEI 1.5; PAI 0.26; furrows with spines; size 13.3–16.9 μm wide × 20.9–23.8 μm long; average size 14.7 μm wide × 22.5 μm long; sculpturing fine, striate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows that the spines run the full length of the furrow.

Distribution: Southwestern Quebec and southwestern Ontario.

Flowering period: Mid May to mid June.

Ecological notes: A commonly cultivated ornamental tree. Introduced; a native of southeastern Europe and adjacent Asia.

## HYDROPHYLLACEAE (waterleaf family)

75. ***Phacelia linearis*** Holz.

linear-leaved scorpionweed

SEM Figs. 149, 150; LM Figs. 226–228

Description: Grains hexacolpate, subprolate in equatorial view; PEI 1.17; PAI 0.20; size 17.1–19.0 μm wide × 20.9–23.8 μm long; average size 18.5 μm wide × 21.8 μm long; sculpturing punctate; ektexine and endexine about 0.5 μm thick; structure tectate.

Distribution: Alberta and British Columbia.

Flowering period: Late April to frost.

Ecological notes: On prairie and dry light soils and hillsides. Native.

## GUTTIFERAE (St. John's-wort family)

76. ***Hypericum perforatum*** L.

St. John's wort, common St. John's-wort, Klamath weed, goatweed
millepertuis perforé, millepertuis commun, chasse-diable, faux-lin, herbe aux cent trous, herbe Saint-Jacques, herbe Saint-Jean, lin sauvage, millepertuis, milletrous, truchereau, pertuisane

SEM Figs. 151, 152; LM Figs. 229–231

Description: Grains tricolporate, prolate in equatorial view; PEI 1.44; PAI 0.29; size 13.3–16.9 μm wide × 19.0–22.8 μm long; average size 14.3 μm wide × 20.6 μm long; sculpturing psilate; ektexine and endexine about 1.1 μm thick; structure semitectate. SEM shows a punctate surface.

Distribution: Newfoundland, west to Ontario and British Columbia.

Flowering period: Late June to mid August.

Ecological notes: In dry pastures, neglected fields, and along roadsides. Introduced; a native of Eurasia.

## IRIDACEAE (iris family)

77. ***Iris versicolor*** L.

blue flag, poison flag, larger blue flag, blue iris, wild iris, flag, boats, wild blue flag
iris versicolore, caljeux

SEM Figs. 153, 154; LM Figs. 232, 233

Description: Grains monocolpate, perprolate in equatorial view; PEI 2.04; PAI 0.29; size 39.0–45.0 μm wide × 84.0–93.0 μm long; average size 42.9 μm wide × 87.6 μm long; sculpturing reticulate; ektexine and endexine about 2.9 μm thick; structure tectate. SEM shows a regular reticulate sculpturing pattern.

Distribution: Keewatin District, N.W.T.; Newfoundland, west to Manitoba.

Flowering period: May to early August.

Ecological notes: In meadows, marshes, and along turfy shores. Native.

## LABIATAE (mint family)

78. ***Ajuga reptans*** L.

ajuga, carpet bugleweed, bugle
bugle rampante, herbe de Saint-Laurent, petit consoude

SEM Figs. 155, 156; LM Figs. 234–236

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.30; PAI 0.19; size 17.1–20.9 μm wide × 23.8–28.5 μm long; average size 19.7 μm wide × 25.6 μm long; sculpturing psilate; ektexine and endexine about 1.5–1.9 μm thick; structure tectate. SEM shows an indistinctive rugulate sculpturing pattern.

Distribution: Newfoundland, Quebec, and Ontario.

Flowering period: Early May to June.

Ecological notes: Along roadsides and in fields. Introduced; a native of Eurasia.

79. ***Dracocephalum parviflorum*** Nutt.

American dragonhead, dragonhead, small-flowered dragonhead
dracocéphale d'Amérique, dracocéphale parviflore, dracocéphale à petite fleur

SEM Figs. 157, 158; LM Figs. 237–239

Description: Grains hexacolpate, subprolate in equatorial view; PEI 1.25; PAI 0.43; size 22.8–26.6 μm wide × 28.5–34.2 μm long; average size 24.4 μm wide × 30.4 μm long; sculpturing fine, reticulate; ektexine and endexine about 1.5–1.9 μm thick; structure tectate. SEM shows a perforate-punctate sculpturing pattern.

Distribution: Mackenzie District, N.W.T.; Yukon Territory; Newfoundland; Quebec, west to British Columbia.

Flowering period: June to early August.

Ecological notes: On rocky or calcareous soils or in recent clearings. Often weedy in cultivated clovers. Native.

80. ***Leonurus cardiaca*** L.

motherwort, common motherwort
agripaume cardiaque, herbe piquante cardaire

SEM Figs. 159, 160; LM Figs. 240–242

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.17; PAI 0.36; size 15.2–17.1 μm wide × 19.0–20.9 μm long; average size 16.8 μm wide × 19.7 μm long; sculpturing reticulate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM shows an extremely shallow reticulum.

Distribution: Nova Scotia, west to Saskatchewan and British Columbia.

Flowering period: July to September.

Ecological notes: In waste places and along roadsides. Introduced; a native of Eurasia.

81. ***Mentha spicata*** L.

spear mint
menthe à épis, menthe romaine, menthe, menthe verte, baume, baume vert

SEM Figs. 161, 162; LM Figs. 243–245

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.15; PAI 0.30; size 16.9–19.0 μm wide × 19.0–20.9 μm long; average size 17.5 μm wide × 20.1 μm long; sculpturing reticulate; ektexine and endexine about 2.3 μm thick; strucuture tectate. SEM shows a perforate-punctate sculpturing pattern.

Distribution: Nova Scotia, west to British Columbia.

Flowering period: July to August.

Ecological notes: A cultivated mint species, commonly escaping throughout its range. Introduced; a native of Eurasia.

82. ***Monarda fistulosa*** L.

wild bergamot, horse mint
monarde fistuleuse

SEM Figs. 163, 164; LM Figs. 246–248

Description: Grains hexacolpate, prolate spheroidal in equatorial view; PEI 1.07; PAI 0.32; size 30.4–36.1 μm wide × 30.4–38.0 μm long; average size 32.8 μm wide × 35.2 μm long; sculpturing reticulate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows a perforate-punctate sculpturing pattern.

Distribution: Quebec, Ontario, Manitoba, Alberta, and British Columbia.

Flowering period: July to September.

Ecological notes: In dry thickets, clearings, on prairie, and at the borders of woods. Native.

83. ***Nepeta cataria*** L.

catnip, catmint, common catnip
herbe à chats, népéta cataire, cataire, népète chataire, chataire, chataire commune, cataire commune, herbe-des-chats, mente à chats, menthe de chat, népéte, népéta chataire

SEM Figs. 165, 166; LM Figs. 249–251

Description: Grains hexacolpate, subprolate in equatorial view; PEI 1.15; PAI 0.20; size 24.7–27.6 μm wide × 27.6–32.3 μm long; average size 26.1 μm wide × 30.0 μm long; sculpturing reticulate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM shows a perforate-punctate sculpturing pattern.

Distribution: Newfoundland, Nova Scotia, west to British Columbia.

Flowering period: July to September.

Ecological notes: Formerly cultivated for its medicinal qualities, has now escaped to waste places, fencerows, and along roadsides. Introduced; a native of Eurasia.

84. ***Prunella vulgaris*** L.

heal-all, carpenterweed, selfheal
prunelle vulgaire, brunelle, herbe au charpentier, prunelle commune, brunelle commune, brunelle vulgaire, primevère commune, prunelle, prunellier commun

SEM Figs. 167, 168; LM Figs. 252–254

Description: Grains hexacolpate, prolate in equatorial view; PEI 1.34; PAI 0.62; size 24.7–28.5 μm wide × 32.3–38.0 μm long; average size 26.0 μm wide × 34.7 μm long; sculpturing not clearly defined; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows an extremely shallow reticulum.

Distribution: Newfoundland, west to British Columbia.

Flowering period: July to September.

Ecological notes: In open woods, thickets, waste places, along roadsides, and on grasslands. Introduced; a native of Eurasia.

85. ***Salvia officinalis*** L.

sage, common sage, garden sage
sauge officinale

SEM Figs. 169, 170; LM Figs. 255–257

Description: Grains hexacoplate, oblate spheroidal in equatorial view; PEI 0.93; PAI 0.12; size 32.3–35.2 μm wide × 30.4–32.3 μm long; average size 33.8 μm wide × 31.5 μm long; sculpturing reticulate; ektexine and endexine about 2.6 μm thick; structure tectate. SEM shows a clearly defined reticulum.

Distribution: Cultivated throughout southern Canada.

Flowering period: June to July.

Ecological notes: Cultivated, utilized as a source of culinary sage. Introduced; a native of the Mediterranean region.

86. ***Stachys palustris*** L.

marsh hedge-nettle, woundwort, marsh woundwort
épiaire des marais, crapaudine, épiaire des bois, épiaire poilue, stachyde des marais

SEM Figs. 171, 172; LM Figs. 258–260

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.31; PAI 0.20; size 19.0–22.8 μm wide × 22.8–30.4 μm long; average size 20.5 μm wide × 27.0 μm long; sculpturing fine, reticulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows an extremely shallow reticulum.

Distribution: Mackenzie District, N.W.T.; Yukon Territory; Newfoundland; Nova Scotia, west to British Columbia.

Flowering period: Late June to mid August.

Ecological notes: In waste places, meadows, ditches, old fields, wet prairie areas, and along wet roadsides and on beaches. Native and introduced; a native of Eurasia.

## **LAURACEAE** (laurel family)

87. ***Loiseleuria procumbens*** (L.) Desv.

alpine azalea
azalée couchée

SEM Figs. 173, 174; LM Figs. 261–263

Description: Grains tetrahedral tetrad, tricolporate, spherical in equatorial view; PAI 0.30; diameter 26.6–32.3 μm; average size 29.0 μm; sculpturing rugulate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM in polar and equatorial views shows the tricolporate nature of the individual grain.

Distribution: Franklin, Keewatin, and Mackenzie Districts, N.W.T.; Yukon Territory; Newfoundland and Labrador; Nova Scotia; Quebec; Manitoba, west to British Columbia.

Flowering period: June to August.

Ecological notes: In alpine and peaty or rocky exposed areas. Native.

## LEGUMINOSAE (pulse family)

88. ***Amorpha fruticosa*** L.
false indigo, bastard indigo, indigo-bush
faux-indigo

SEM Figs. 175, 176; LM Figs. 264–266

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.1; PAI 0.26; size 16.9–17.1 μm wide × 18.1–20.0 μm long; average size 17.0 μm wide × 18.7 μm long; sculpturing microreticulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a microreticulate sculpturing pattern encompassing the entire pollen grain.

Distribution: Quebec, Manitoba, and Saskatchewan.

Flowering period: Late June to early July.

Ecological notes: In moist woodlands and along riverbanks. Native.

89. ***Anthyllis vulneraria*** L.
lady's-fingers, kidney-vetch
trèfle jaune des sables

SEM Figs. 177, 178; LM Figs. 267–269

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.12; PAI 0.65; size 28.5–32.3 μm wide × 32.3–35.2 μm long; average size 30.0 μm wide × 33.5 μm long; sculpturing verrucate; ektexine and endexine about 1.5–2.3 μm thick; structure tectate. SEM shows a verrucate sculpturing pattern.

Distribution: New Brunswick, Quebec, and Ontario.

Flowering period: Late May to July.

Ecological Notes: Occurs locally in clover fields and on waste ground. Introduced; a native of Europe.

90. ***Astragalus alpinus*** L.
alpine milk-vetch

SEM Figs. 179, 180; LM Figs. 270–272

Description: Grains tricolporate, prolate in equatorial view; PEI 1.37; PAI 0.40; size 13.3–17.1 μm wide × 19.0–20.9 μm long; average size 14.7 μm wide × 20.3 μm long; sculpturing reticulate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM shows a microreticulate sculpturing pattern encompassing the entire pollen grain.

Distribution: Franklin District, N.W.T.; Yukon Territory; Newfoundland and Labrador; Quebec, west to British Columbia.

Flowering period: June to August.

Ecological notes: On gravelly riverbanks and lakeshores. Native.

91. ***Astragalus cicer*** L.
cicer milk-vetch, mountain chick-pea
chiche de montagne, astragale pois chiche

SEM Figs. 181, 182; LM Figs. 273–275

Description: Grains tricolporate, prolate in equatorial view; PEI 1.55; PAI 0.44; size 24.7–26.6 μm wide × 37.1–40.9 μm long; average size 25.3 μm wide × 39.2 μm long; sculpturing microreticulate; ektexine and endexine about 1.13–1.5 μm thick; structure tectate. SEM shows a microreticulate sculpturing pattern between the furrows and a smooth polar end.

Distribution: Southern Manitoba, west to southwestern Alberta.

Flowering period: Mid June to July.

Ecological notes: A cultivated species grown as a forage, rare as a weed. Introduced; a native of Europe.

92. ***Astragalus striatus*** Nutt.

ascending purple milk-vetch
astragale rayé

SEM Figs. 183, 184; LM Figs. 276–278

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.21; PAI 0.27; size 17.1–20.9 μm wide × 20.0–24.7 μm long; average size 19.5 μm wide × 23.7 μm long; sculpturing reticulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a microreticulate sculpturing pattern encompassing the entire pollen grain.

Distribution: Mackenzie District, N.W.T.; Yukon Territory; Ontario, west to British Columbia.

Flowering period: Late May to July.

Ecological notes: On dry prairies, plains, and ridges. Native.

93. ***Baptisia australis*** (L.) R. Br.

blue false indigo, plains false indigo, wild blue indigo
baptisie australe, podalyre de la Caroline

SEM Figs. 185, 186; LM Figs. 279–281

Description: Grains tricolporate, prolate-spheroidal to subprolate in equatorial view; PEI 1.14; PAI 0.28; size 15.2–16.9 μm wide × 17.1– 19.0 μm long; average size 15.2 μm wide × 18.1 μm long; sculpturing reticulate; ektexine and endexine about 1.5–1.9 μm thick; structure tectate. SEM shows microreticulate pattern encompassing the entire pollen grain.

Distribution: North central United States, possibly cultivated by beekeepers in many parts of Canada.

Flowering period: May to June.

Ecological notes: A cultivated species spreading to gravelly soils of rich woods and prairies. Introduced; a native of the north-central United States.

94. ***Baptisia tinctoria*** R. Br.

wild indigo, yellow indigo, rattleweed, horseflyweed
baptisie des teinturiers

SEM Figs. 187, 188; LM Figs. 282–284

Descriptions: Grains tricolporate, subprolate in equatorial view; PEI 1.22; PAI 0.36; size 11.4–13.3 μm wide × 14.3–16.9 μm long; average size 12.4 μm

wide × 15.1 μm long; sculpturing reticulate; ektexine and endexine about 1.13–1.5 thick; structure tectate. SEM shows a microreticulate sculpturing pattern encompassing the entire pollen grain.

Distribution: Southwestern Ontario.

Flowering period: Late June to July.

Ecological notes: In dry open woods and clearings. Native.

95. ***Caragana arborescens*** Lam.

caragana, common caragana, peatree, Siberian peashrub, Siberian pea caragana arborescent, caragana, arbre aux pois

SEM Figs. 189, 190; LM Figs. 285–287

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.29; PAI 0.35; size 15.2–19.0 μm wide × 20.9–24.7 μm long; average size 17.3 μm wide × 22.2 μm long; sculpturing psilate; ektexine and endexine about 0.75–1.13 μm thick; structure tectate. SEM shows an extremely shallow microreticulate sculpturing pattern.

Distribution: Quebec, west to British Columbia.

Flowering period: Mid May to early June.

Ecological notes: A cultivated species used ornamentally as a hedge and windbreak throughout western Canada. Introduced; a native of Asia.

96. ***Cercis canadensis*** L.

redbud, Judas-tree
bouton rouge, arbre de Judée

SEM Figs. 191, 192; LM Figs. 288–290

Description: Grains tricolporate, prolate-spheroidal in equatorial view; PEI 1.09; PAI 0.28; size 18.1–20.9 μm wide × 20.0–22.8 μm long; average size 19.7 μm wide × 21.5 μm long; sculpturing psilate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a very fine microreticulate sculpturing pattern encompassing the entire pollen grain, with occasional puncta present.

Distribution: Southwestern Ontario.

Flowering period: April to early May.

Ecological notes: A cultivated species, rarely escaping to rich woods and ravines. Native.

97. ***Coronilla varia*** L.

crown-vetch, common crown-vetch, axseed
faucille

SEM Figs. 193, 194; LM Figs. 291–293

Description: Grains tricolporate, prolate-spheroidal in equatorial view; PEI 1.08; PAI 0.26; size 19.0–20.9 μm wide × 20.9–22.8 μm long; average size 20.1 μm wide × 21.8 μm long; sculpturing microrugulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a microrugulate sculpturing pattern encompassing the entire pollen grain.

Distribution: Quebec, Ontario, and Manitoba.

Flowering period: June to September.

Ecological notes: Originally a cultivated species, escaping along roadsides, around old dwellings, and in waste places. Planted throughout parts of Ontario as a roadside groundcover to prevent soil erosion. Introduced; a native of Europe, now naturalized in many areas.

98. ***Cytisus scoparius*** (L.) Link

Scotch broom
genêt à balais

SEM Figs. 195, 196; LM Figs. 294–296

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.15; PAI 0.28; size 18.1–20.0 μm wide × 20.9–22.8 μm long; average size 19.0 μm wide × 21.9 μm long; sculpturing microreticulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a microreticulate sculpturing pattern encompassing the entire pollen grain.

Distribution: Nova Scotia, Prince Edward Island, and British Columbia.

Flowering period: Mid May.

Ecological notes: A garden plant escaping to sandy roadsides, barrens, and open woods. Introduced; a native of Europe, now a naturalized pest in British Columbia and Nova Scotia.

99. ***Hedysarum boreale*** Nutt.

northern hedysarum

SEM Figs. 197, 198; LM Figs. 297–299

Description: Grains tricolporate, prolate in equatorial view; PEI 1.70; PAI 0.31; size 9.5–11.4 μm wide × 17.1–19.0 μm long; average size 10.8 μm wide × 18.4 μm long; sculpturing psilate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a microreticulate sculpturing pattern encompassing the entire pollen grain and distinctive verrucate furrow membranes.

Distribution: Franklin and Mackenzie Districts, N.W.T.; Yukon Territory; Quebec, west to British Columbia. Reported in Newfoundland.

Flowering period: Late May to July.

Ecological notes: On slopes of ravines and coulees in the prairies, occasionally in parkland. Native.

100. ***Lathyrus tuberosus*** L.

tuberous vetchling, ground nut pea, earth nut pea
gesse tubéreuse

SEM Figs. 199, 200; LM Figs. 300–302

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.28; PAI 0.42; size 26.6–34.2 μm wide × 34.2–38.0 μm long; average size 28.3 μm wide × 36.1 μm long; smooth polar ends; sculpturing reticulate with ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows an indistinctive sculpturing pattern between the furrows, with smooth polar ends.

Distribution: Southwestern Quebec, southern Ontario, and southern Manitoba.

Flowering period: June to August.

Ecological notes: In fields, meadows, and along roadsides. Introduced; a native of Eurasia.

101. ***Lespedeza bicolor*** Turcz.

shrub bush-clover

SEM Figs. 201, 202; LM Figs. 303–305

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.24; PAI 0.25; size 15.2–19.0 μm wide × 20.0–23.8 μm long; average size 17.7 μm wide × 22.0 μm long; sculpturing reticulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a microreticulate sculpturing pattern encompassing the entire pollen grain.

Distribution: Southwestern Ontario.

Flowering period: July to August.

Ecological notes: A cultivated shrub. Introduced; a native of Japan.

102. ***Lotus corniculatus*** L.
bird's-foot trefoil
lotier corniculé, patte d'oiseau

SEM Figs. 203, 204; LM Figs. 306–308

Description: Grains tricolporate, prolate in equatorial view; PEI 1.44; PAI 0.36; size 9.5–11.4 μm wide × 14.3–16.9 μm long; average size 10.6 μm wide × 15.3 μm long; sculpturing psilate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM shows a microrugulate sculpturing pattern encompassing the entire pollen grain.

Distribution: Newfoundland, west to British Columbia.

Flowering period: July to August.

Ecological notes: Planted as a fodder crop and to prevent roadside soil erosion, now escaping to fields, meadows, waste places, and along roadsides. Introduced; a native of Europe.

103. ***Lupinus argenteus*** Pursh
silvery lupine
lupin argenté

SEM Figs. 205, 206; LM Figs. 309–311

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.11; PAI 0.23; size 22.8–25.7 μm wide × 24.7–28.5 μm long; average size 24.3 μm wide × 26.8 μm long; sculpturing reticulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a foveolate-reticulate sculpturing pattern encompassing the entire pollen grain.

Distribution: Manitoba, west to British Columbia.

Flowering period: July to August.

Ecological notes: Along prairie slopes and ridges, in coniferous woodlands. Native.

104. ***Medicago lupulina*** L.

black medick, hop medick, nonesuch, hop-clover
lupuline, luzerne lupuline, minette, bujoline, lupin noir, lupine, luzerne houblonnée, mignonnette, trèfle jaune, trèfle noir, triolet

SEM Figs. 207, 208; LM Figs. 312–314

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.20; PAI 0.36; size 18.1–20.9 μm wide × 20.9–28.5 μm long; average size 19.1 μm wide × 23.0 μm long; sculpturing punctate-reticulate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM shows irregular-shaped puncta between the furrows and smooth polar ends.

Distribution: Mackenzie District, N.W.T.; Newfoundland, west to British Columbia.

Flowering period: June to September.

Ecological notes: A common weed of roadsides and waste places. Introduced; a native of Europe.

105. ***Medicago sativa*** L.

alfalfa, lucerne
luzerne, luzerne cultivée, lentine

SEM Figs. 209, 210; LM Figs. 315–317

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.29; PAI 0.35; size 24.7–28.5 μm wide × 30.4–37.1 μm long; average size 25.9 μm wide × 33.4 μm long; sculpturing psilate-punctate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows no distinctive sculpturing pattern.

Distribution: Mackenzie District, N.W.T.; Newfoundland, west to British Columbia.

Flowering period: May to September.

Ecological notes: A species extensively cultivated for hay and forage, escaped and now found along roadsides, in old fields, and in waste places. Introduced; a native of central and western Asia, it has now become naturalized.

106. ***Melilotus alba*** Desr.

white sweet-clover, white melilot
mélilot blanc, trèfle d'odeur, luzerne bâtarde, mélilot, mélilot à fleurs

blanches, mélilot de Sibérie, trèfle Bokhara, trèfle d'odeur blanc, trèfle de Boukharie, vieux garçons

SEM Figs. 211, 212; LM Figs. 318–320

Description: Grains tricolporate, prolate in equatorial view; PEI 1.35; PAI 0.32; size 15.2–17.1 μm wide × 20.9–22.8 μm long; average size 16.5 μm wide × 22.1 μm long; sculpturing reticulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a rugulate sculpturing pattern between the furrows and a foveolate-reticulate sculpturing pattern towards the smooth polar ends.

Distribution: Mackenzie District, N.W.T.; Yukon Territory; Newfoundland, west to British Columbia.

Flowering period: Mid July to late August.

Ecological notes: Along roadsides and in waste places. Introduced; a native of Eurasia.

107. ***Melilotus indica*** (L.) All.

small-flowered sweet-clover, annual yellow sweet-clover, sour clover
mélilot à petites fleurs

SEM Figs. 213, 214; LM Figs. 321–323

Description: Grains tricolporate, prolate in equatorial view; PEI 1.34; PAI 0.37; size 15.2–17.1 μm wide × 19.0–23.8 μm long; average size 16.1 μm wide × 21.6 μm long; sculpturing reticulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a rugulate sculpturing pattern between the furrows and a foveolate-reticulate sculpturing pattern at the polar ends.

Distribution: Nova Scotia, Manitoba, and British Columbia.

Flowering period: June to September.

Ecological notes: Along roadsides, in grasslands, and in waste places, spreading its range. Introduced; a native of Eurasia and the Mediterranean region.

108. ***Melilotus officinalis*** (L.) Pall.

yellow sweet-clover, yellow melilot
mélilot jaune, mélilot officinal, trèfle d'odeur jaune, mélilot, mélilot des champs, mélilot diffus, lotier, trèfle d'odeur jaune, trèfle de cheval, trèfle des mouches, trèfle d'odeur, vieux garçons

SEM Figs. 215, 216; LM Figs. 324–326

Description: Grains tricolporate, prolate in equatorial view; PEI 1.47; PAI 0.23; size 16.9–19.0 μm wide × 24.7–26.6 μm long; average size 17.5 μm wide × 25.8 μm long; sculpturing reticulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a rugulate sculpturing pattern between the furrows and a foveolate-reticulate sculpturing pattern at the polar ends.

Distribution: Mackenzie District, N.W.T.; Newfoundland, west to British Columbia.

Flowering period: June to September.

Ecological notes: Introduced as a forage crop, a common weed in waste or cultivated ground and along roadsides. Introduced; a native of Eurasia and the Mediterranean region.

109. ***Onobrychis viciaefolia*** Scop.
sainfoin, common sainfoin, holy-clover
sainfoin

SEM Figs. 217, 218; LM Figs. 327–329

Description: Grains tricolporate, prolate in equatorial view; PEI 1.95; PAI 0.25; size 17.1–19.0 μm wide × 33.3–38.0 μm long; average size 17.8 μm wide × 34.8 μm long; sculpturing reticulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a foveolate-reticulate sculpturing pattern encompassing the entire pollen grain.

Distribution: Quebec, west to British Columbia.

Flowering period: June to August.

Ecological notes: Cultivated for forage, now escaped throughout its range. Introduced; a native of southern Europe.

110. ***Phaseolus coccineus*** L.
scarlet runner bean, multiflora bean
haricot d'Espagne

SEM Figs. 219, 220; LM Figs. 330–332

Description: Grains triporate, oblate spheroidal in equatorial view; PEI 0.91; size 34.2–39.0 μm wide × 32.3–36.1 μm long; average size 37.2 μm wide × 33.8 μm long; sculpturing rugulate; ektexine and endexine

about 1.5 μm thick; structure tectate. SEM shows a very shallow reticulum with smooth ridges and microverrucate particles within the lumina.

Distribution: Widely cultivated in eastern Canada and British Columbia.

Flowering period: July to August.

Ecological notes: Cultivated for its ornamental properties, now reported as occasionally spontaneous on garbage dumps. Introduced; a native in tropical America.

111. ***Phaseolus vulgaris*** L.

common bean, kidney bean, string bean
haricot, vraie fève, fève, fève à beurre

SEM Figs. 221, 222; LM Figs. 333–335

Description: Grains triporate, suboblate to oblate spheroidal in equatorial view; PEI 0.88; size 34.2–40.0 μm wide × 30.4–34.2 μm long; average size 36.5 μm wide × 32.1 μm long; sculpturing fine, rugulate; ektexine and endexine about 1.5–1.9 μm thick; structure tectate. SEM shows a rugulate sculpturing pattern.

Distribution: Cultivated throughout southern Canada.

Flowering period: Late June to Mid August, depending on planting date.

Ecological notes: Cultivated extensively for its edible seeds and pods. Introduced; a native of tropical America.

112. ***Robinia pseudo-acacia*** L.

black locust, yellow locust, common locust, false acacia
acacia blanc, robinier faux-acacia, faux-acacia

SEM Figs. 223, 224; LM Figs. 336–338

Description: Grains tricolporate, oblate spheroidal in equatorial view; PEI 0.94; PAI 0.32; size 26.6–28.5 μm wide × 22.8–26.6 μm long; average size 27.6 μm wide × 25.9 μm long; sculpturing psilate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM shows an indistinctive sculpturing pattern between the furrows and a smooth polar end.

Distribution: Nova Scotia, Prince Edward Island, Quebec, Ontario, and British Columbia.

Flowering period: June. A cultivated variety flowers from early June to September.

Ecological notes: A cultivated ornamental tree, occasionally escaping to woods and thickets. Introduced; a native of the eastern United States.

113. ***Trifolium hybridum*** L.

alsike clover, alsike
trèfle alsike, trèfle hybride

SEM Figs. 225, 226; LM Figs. 339–341

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.31; PAI 0.30; size 15.2–19.0 μm wide × 19.0–28.5 μm long; average size 17.5 μm wide × 22.8 μm long; sculpturing reticulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows an irregular reticulate sculpturing pattern.

Distribution: Mackenzie District, N.W.T.; Yukon Territory; Newfoundland, west to British Columbia.

Flowering period: June to July.

Ecological notes: A cultivated fodder plant that has spread to roadsides, clearings, and fields. Introduced; a native of Europe.

114. ***Trifolium pratense*** L.

red clover, honeysuckle clover
trèfle rouge, trèfle des prés

SEM Figs. 227, 228; LM Figs. 342–344

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.29; PAI 0.37; size 25.7–30.4 μm wide × 34.2–38.0 μm long; average size 28.2 μm wide × 36.2 μm long; sculpturing reticulate; ektexine and endexine about 1.5–1.9 μm thick; structure tectate. SEM shows a reticulate sculpturing pattern encompassing the entire pollen grain, with granular particles within the lumina.

Distribution: Yukon Territory; Labrador, west to British Columbia.

Flowering period: June to August.

Ecological notes: A species cultivated for forage, spread to roadsides, clearings, and turf. Introduced; a native of Europe.

115. ***Trifolium repens*** L.

white clover, dutch clover, wild white clover, white trefoil, creeping white clover
trèfle blanc, trèfle rampant

SEM Figs. 229, 230; LM Figs. 345–347

Description: Grains tricolporate, prolate in equatorial view; PEI 1.41; PAI 0.39; size 16.9–19.0 μm wide × 23.8–26.6 μm long; average size 17.6 μm wide × 24.8 μm long; sculpturing reticulate, with smooth polar ends; ektexine and endexine about 1.9 μm thick; structure tectate. SEM shows an indistinctive sculpturing pattern between the furrows and a smooth polar end.

Distribution: Mackenzie District, N.W.T.; Yukon Territory; Newfoundland, west to British Columbia.

Flowering period: June to September.

Ecological notes: A cultivated species, escaping and becoming naturalized along roadsides, in pastures, woods, grasslands, and lawns. Introduced; a native of Eurasia.

116. ***Vicia angustifolia*** Reichard

narrow-leaved vetch, common vetch, wild vetch
vesce à feuilles étroites, vesce sauvage, pois sauvage

SEM Figs. 231, 232; LM Figs. 348–350

Description: Grains tricolporate, prolate in equatorial view; PEI 1.70; PAI 0.47; size 18.1–20.0 μm wide × 30.4–33.3 μm long; average size 19.1 μm wide × 32.4 μm long; sculpturing reticulate; ektexine and endexine about 1.9–2.3 μm thick; structure tectate. SEM shows a shallow reticulum composed of wide ridges with a smooth polar end.

Distribution: Newfoundland, west to Manitoba and British Columbia.

Flowering period: June to October.

Ecological notes: In fields, waste places, and along roadsides. Introduced; a native of Eurasia.

117. ***Vicia americana*** Muhl.

American vetch, wild vetch, peavine, buffalo-pea
vesce d'Amérique

SEM Figs. 233, 234; LM Figs. 351–353

Description: Grains tricolporate, prolate in equatorial view; PEI 1.68; PAI 0.47; size 20.0–21.9 μm wide × 30.4–38.0 μm long; average size 20.9 μm wide × 35.1 μm long; sculpturing reticulate; ektexine and endexine about 1.5–1.9 μm thick; structure tectate. SEM shows a shallow reticulum composed of wide ridges with a smooth polar end.

Distribution: Mackenzie District, N.W.T.; Quebec, west to British Columbia.

Flowering period: May to July.

Ecological notes: In grasslands, thickets, meadows, open woods, and parkland areas, on damp or gravelly shores, prairie, and dry soils. Native.

118. ***Vicia cracca*** L.

tufted vetch, bird vetch, Canada-pea, cow vetch, purple tufted vetch, wild vetch

vesce jargeau, jargeau, petits oiseaux, vesce multiflore, vesce en épi, vesce à fleur en épi, vesce à fleurs nombreuses, vesce cracca, vesce sauvage, vesce, vesceron, pois sauvage

SEM Figs. 235, 236; LM Figs. 354–356

Description: Grains tricolporate, prolate in equatorial view; PEI 1.78; PAI 0.36; size 19.0–23.8 μm wide × 34.2–40.0 μm long; average size 21.0 μm wide × 37.5 μm long; sculpturing reticulate; ektexine and endexine about 1.9–2.3 μm thick; structure tectate. SEM shows an indistinctive sculpturing pattern between the furrows and smooth polar ends.

Distribution: Keewatin District, N.W.T.; Yukon Territory; Labrador and Newfoundland; Nova Scotia; Quebec; and Ontario.

Flowering period: May to August.

Ecological notes: Common along roadsides and in waste places. Introduced; a native of Eurasia.

119. ***Vicia faba*** L.

broad bean, faba bean, horse bean, Windsor bean

fève des marais, goulgane

SEM Figs. 237, 238; LM Figs. 357–359

Description: Grains tricolporate, prolate in equatorial view; PEI 1.82; PAI 0.36; size 19.0–22.8 μm wide × 36.1–40.9 μm long; average size 20.9 μm wide × 38.1 μm long; sculpturing reticulate; ektexine and

endexine about 1.5–1.9 μm thick; structure tectate. SEM shows a disjointed reticulate sculpturing pattern between the distinctive furrow edges and smooth polar ends.

Distribution: Quebec, Ontario, Saskatchewan, and Alberta.

Flowering period: July to August.

Ecological notes: Occasionally cultivated in North America, rarely reported as an escape. Introduced; a native of North Africa and southwest Asia.

120. ***Vicia sativa*** L.

common vetch, spring vetch, cultivated vetch
vesce cultivée, vesce commune

SEM Figs. 239, 240; LM Figs. 360–362

Description: Grains tricolporate, prolate in equatorial view; PEI 1.49; PAI 0.36; size 19.0–21.9 μm wide × 28.5–32.3 μm long; average size 20.8 μm wide × 31.0 μm long; sculpturing rugulate; ektexine and endexine about 1.5–1.9 μm thick; structure tectate. SEM shows an indistinctive sculpturing pattern between the furrows and smooth polar ends.

Distribution: Newfoundland, west to Ontario and British Columbia.

Flowering period: June to August.

Ecological notes: A cultivated species occasionally spreading to roadsides and waste places. Introduced; a native of Eurasia and southern Europe.

121. ***Vicia villosa*** Roth

hairy vetch, winter vetch, woolly vetch, fodder vetch
vesce velue, vesce de Russie

SEM Figs. 241, 242; LM Figs. 363–365

Description: Grains tricolporate, perprolate in equatorial view; PEI 2.02; PAI 0.46; size 17.1–19.0 μm wide × 34.2–38.0 μm long; average size 17.8 μm wide × 35.9 μm long; sculpturing reticulate, with smooth polar ends; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a reticulate sculpturing pattern between the furrows, verrucate particles in the lumina, and smooth polar ends.

Distribution: Nova Scotia, Quebec, Ontario, Manitoba, and British Columbia.

Flowering period: June to September.

Ecological notes: A cultivated species spreading along roadsides and in fields. Introduced; a native of Europe.

122. ***Vigna sinensis*** Savi
cow pea, black-eyed pea
dolique, pois à vache

SEM Figs. 243, 244; LM Figs. 366–369

Description: Grains tricolporate, suboblate in equatorial view; PEI 0.82; PAI 0.62; size 48.5–57.0 μm wide × 36.1–47.5 μm long; average size 52.0 μm wide × 42.5 μm long; sculpturing reticulate; ektexine and endexine about 3.0–3.4 μm thick; structure tectate. SEM shows the reticulum to be disconnected in polar view and connected between the apertures.

Distribution: Southern Ontario.

Flowering period: June.

Ecological notes: A cultivated species. Introduced; a native of Asia.

123. ***Wisteria floribunda*** (Willd.) DC.
Japanese wisteria
glycine du Japon

SEM Figs. 245, 246; LM Figs. 370–372

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.14; PAI 0.41; size 21.9–25.7 μm wide × 26.6–28.5 μm long; average size 23.9 μm wide × 27.1 μm long; sculpturing microreticulate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM shows a uniform microreticulate sculpturing pattern encompassing the entire pollen grain.

Distribution: Southern Ontario and southern British Columbia.

Flowering period: Late May to early June.

Ecological notes: A species cultivated for its ornamental properties, occasionally escaping. Introduced; a native in Japan.

## **LILIACEAE** (lily family)

124. ***Allium cernuum*** Roth
nodding onion
ail penché

SEM Figs. 247, 248; LM Figs. 373–375

Description: Grains monocolpate, prolate in equatorial view; PEI 1.89; size 16.9–20.9 μm wide × 32.3–41.8 μm long; average size 18.8 μm wide × 35.4 μm long; sculpturing psilate; ektexine and endexine about 1.5 μm thick; structure intectate. SEM shows a smooth surface.

Distribution: Southwestern Ontario, Saskatchewan, Alberta, and British Columbia.

Flowering period: July to August.

Ecological notes: In dry woods, prairies, on rocky or wooded slopes, and along ledges. Native.

## **LINACEAE** (flax family)

125. ***Linum flavum*** L.
yellow flax, golden flax
lin jaune

SEM Figs. 249, 250; LM Figs. 376–378

Description: Grains tricolporate, prolate spheroidal to subprolate in equatorial view; PEI 1.14; PAI 0.37; size 38.0–45.6 μm wide × 40.0–51.3 μm long; average size 40.6 μm wide × 46.1 μm long; sculpturing pilate; ektexine and endexine about 3.4–3.8 μm thick; structure semitectate. SEM shows clavate and pilate rods of different sizes and large open furrows.

Distribution: Ontario.

Flowering period: June to mid August.

Ecological notes: A cultivated species, rarely becoming established. Introduced; a native of Europe.

126. ***Linum perenne*** L.
perennial flax
lin vivace

SEM Figs. 251, 252; LM Figs. 379–381

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.21; PAI 0.28; size 40.9–51.3 μm wide × 51.3–57.0 μm long; average size 45.3 μm wide × 54.9 μm long; pilate with microechinate processes; ektexine and endexine about 3.8 μm thick; structure semitectate. SEM

shows large sculpturing elements with microechinate processes surrounded by microechinate processes.

Distribution: Keewatin and Mackenzie Districts, N.W.T.; Quebec, west to British Columbia.

Flowering period: June to September.

Ecological notes: In dry prairies, plains, and on rocky calcareous banks. Introduced; a native in Eurasia.

## LYTHRACEAE (loosestrife family)

127. ***Lythrum salicaria*** L.

purple loosestrife, spiked loosestrife
salicaire, lythrum salicaire, salicaire commune, salicaire pourpre, bouquets rouges, bouquet violet, caroncule de dindon, coton rouge, décadent verticillé, lysimaque rouge, roupie, tête de femmes, roupie de coq d'Inde

SEM Figs. 253, 254; LM Figs. 382–384

Description: Grains dimorphic, heterocolpate (having 6 furrows with 3 equally distributed pores); PEI 0.93; PAI 0.32; oblate spheroidal in equatorial view; larger grains 26.6–30.4 μm wide × 23.8–28.5 μm long; average size 28.9 μm wide × 26.9 μm long; smaller grains 17.1–19.0 μm wide × 16.9–19.0 μm long; average size 18.7 μm wide × 17.6 μm long; sculpturing striate; ektexine and endexine about 1.5–1.9 μm thick; structure tectate. SEM shows 6 furrows and 3 pores with granular particles.

Distribution: Newfoundland, Nova Scotia, west to Manitoba, Alberta, and British Columbia.

Flowering period: June to September.

Ecological notes: A common and rapidly spreading weed that is threatening to destroy valuable wetland areas; however, it is a copious producer of pollen and nectar and therefore an important honey plant. Introduced; a native of Eurasia.

## MAGNOLIACEAE (magnolia family)

128. ***Liriodendron tulipifera*** L.

tuliptree, tulip-poplar, yellow-poplar, whitewood
bois jaune, tulipier de Virginie

SEM Figs. 255, 256; LM Figs. 385, 386

Description: Grains monocolpate, prolate to ellipsoidal in equatorial view; PEI 1.76; size 38.0–45.6 μm wide × 62.7–77.9 μm long; average size 40.9 μm wide × 71.7 μm long; sculpturing psilate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a verrucate sculpturing pattern.

Distribution: Southern Ontario.

Flowering period: Early to mid June.

Ecological notes: A cultivated ornamental species, in rich woods. Also native.

## **MALVACEAE** (mallow family)

129. ***Hibiscus trionum*** L.

flower-of-an hour, trilbate ketmia, modesty
ketmie trilobée, fleur d'une heure, œil de faisan, ketmie trifide

SEM Figs. 257, 258; LM Figs. 387–389

Description: Grains periporate, spherical in equatorial view; diameter 117.0–132.0 μm; average size 122.4 μm; sculpturing echinate; ektexine and endexine about 22.5 μm thick, including echinae; structure tectate. SEM shows pores equally distributed between the spines.

Distribution: Nova Scotia, west to Saskatchewan.

Flowering period: July to September.

Ecological notes: A common weed of cultivated and waste ground. Introduced; a native of Eurasia.

130. ***Malva moschata*** L.

musk mallow
mauve musquée, amours

SEM Figs. 259, 260; LM Figs. 390–392

Description: Grains periporate, spherical in equatorial view; diameter 78.0–93.0 μm; average size 86.5 μm; sculpturing echinate; ektexine and endexine about 15.8 μm thick; structure tectate. SEM shows large and small spines and indistinctive pores.

Distribution: Newfoundland, Nova Scotia, west to Manitoba and British Columbia.

Flowering period: July to September.

Ecological notes: In old gardens, fields, and along roadsides. Introduced; a native of Europe.

## OLEACEAE (olive family)

131. ***Ligustrum japonicum*** Thunb.

Japanese privet
troène du Japon

SEM Figs. 261, 262; LM Figs. 393–395

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.11; PAI 0.24; size 30.4–36.1 μm wide × 34.2–40.0 μm long; average size 33.2 μm wide × 37.0 μm long; sculpturing reticulate; ektexine and endexine about 4.1 μm thick; structure tectate. SEM shows a reticulum supported by bacculate rods.

Distribution: Nova Scotia, west to Manitoba and British Columbia.

Flowering period: June.

Ecological notes: A species commonly cultivated as a hedge. Introduced; a native of Japan and Korea.

132. ***Ligustrum vulgare*** L.

privet, common privet
raisin des chiens

SEM Figs. 263, 264; LM Figs. 396–398

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.05; PAI 0.28; size 25.7–28.5 μm wide × 27.6–30.4 μm long; average size 27.3 μm wide × 28.8 μm long; sculpturing reticulate; ektexine and endexine about 3.8–4.1 μm thick; structure tectate. SEM shows a shallow reticulation.

Distribution: Southern Ontario and British Columbia.

Flowering period: June to July.

Ecological notes: A cultivated species. Introduced; a native of Eurasia naturalized in southwestern Ontario.

## ONAGRACEAE (evening-primrose family)

133. ***Clarkia*** species

SEM Figs. 265, 266; LM Figs. 399, 400

Description: Grains triporate, subtriangular in equatorial view; diameter 99.0–120.0 μm; average size 110.7 μm; sculpturing psilate, with viscine threads; ektexine and endexine about 3.4 μm thick; structure tectate.

Distribution: British Columbia.

Flowering period: May to August.

Ecological notes: Cultivated and native species, found in dry open areas.

134. ***Epilobium angustifolium*** L.

fireweed, great willowherb, wickup, pinktops, French willowherb, spiked willowherb, rosebay, flowering-willow, large willowherb

épilobie à feuilles étroites, bouquets rouges, herbe à feu, asperge, lilas de montagne, osier fleuri, asperge des bois

SEM Figs. 267, 268; LM Figs. 401, 402

Description: Grains triporate and tetraporate, subtriangular in equatorial view; equatorial diameter 59.9–66.5 μm; average size 63.0 μm; sculpturing psilate, with viscine threads; ektexine and endexine about 2.3–2.6 μm thick; structure tectate. SEM shows a verrucate sculpturing pattern.

Distribution: Found throughout Canada.

Flowering period: July to August.

Ecological notes: In a variety of habitats, including recent burns, clearings, and damp ravines. Native.

135. ***Oenothera biennis*** L.

yellow evening-primrose, candlestick, common evening-primrose, evening-primrose

onagre bisannuelle, herbes aux ânes, mâche rouge, énothère, énottière, œnothère bisannuelle, onagre, onagraire bisannuelle, onagre commune, onagre de Victorin

SEM Figs. 269, 270; LM Figs. 403, 404

Description: Grains triporate, subtriangular in equatorial view; equatorial diameter 90.0–105.0 μm; average size 93.6 μm; sculpturing verrucate, with viscine threads; ektexine and endexine about 3.0 μm thick; structure tectate.

Distribution: Newfoundland, west to British Columbia.

Flowering period: June to September.

Ecological notes: On dry open soils, in fields, waste places, and along roadsides. Native.

## OXALIDACEAE (wood-sorrel family)

136. ***Oxalis stricta*** L .

European wood-sorrel, upright yellow oxalis
oxalide d'Europe, pain d'oiseau, surate, surette d'Europe

SEM Figs. 271, 272; LM Figs. 405–407

Description: Grains tricolporate, spherical in equatorial view; PAI 0.49; diameter 26.6–30.4 μm; average size 29.1 μm; sculpturing reticulate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows an open reticulum between the furrows and a closed reticulum at the poles.

Distribution: Newfoundland, Nova Scotia, west to Saskatchewan and British Columbia.

Flowering period: May to September.

Ecological notes: A common weed of fields, cultivated ground, and roadsides. Native.

## PHRYMACEAE (lopseed family)

137. ***Phryma leptostachya*** L.

lopseed
phryma à épis grêles

SEM Figs. 273, 274; LM Figs. 408–410

Description: Grains tricolporate, suboblate in equatorial view; PEI 0.85; PAI 0.22; size 24.7–28.5 μm wide × 20.9–22.8 μm long; average size 26.0 μm wide × 22.1 μm long; sculpturing microreticulate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows an irregular reticulum.

Distribution: New Brunswick west to Manitoba.

Flowering period: July to September.

Ecological notes: In rich woods, thickets, and along roadsides. Introduced; a native of east Asia.

## POLYGONACEAE (buckwheat family)

138. ***Fagopyrum esculentum*** Moench

buckwheat

renouée sarrasin, sarrasin, blé noir, sarrasin commun

SEM Figs. 275, 276; LM Figs. 411–413

Description: Grains tricolporate, prolate in equatorial view; PEI 1.37; PAI 0.28; size 28.5–36.1 μm wide × 39.0–49.4 μm long; average size 32.6 μm wide × 44.5 μm long; sculpturing reticulate; ektexine and endexine about 4.5 μm thick; structure tectate. SEM shows a foveolate reticulum.

Distribution: Newfoundland, west to British Columbia.

Flowering period: July to August.

Ecological notes: A commonly cultivated species, occasionally escaping to fields, waste places, and along roadsides. Introduced; a native of Asia.

139. ***Polygonum cilinode*** Michx.

fringed wild buckwheat, bindweed, fringed bindweed, black-fringed knotweed

renouée à nœuds ciliés, renouée noire frangée, renouée liseron, chevrier, faux-liseron, liseron noir, sarrasin sauvage, vrillée bâtarde, vrillée sauvage, vrillée

SEM Figs. 277, 278; LM Figs. 414–416

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.10; PAI 0.18; size 19.0–23.8 μm wide × 20.9–23.8 μm long; average size 20.9 μm wide × 22.9 μm long; sculpturing rugulate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM shows furrows extending well into the polar area.

Distribution: Newfoundland, Nova Scotia, west to Saskatchewan.

Flowering period: July to August.

Ecological notes: In dry woods, thickets, and on rocky slopes. Native.

## PORTULACACEAE (purslane family)

140. ***Claytonia virginica*** L.

Virginia spring beauty, spring beauty
claytonie de Virginie

SEM Figs. 279, 280; LM Figs. 417–419

Description: Grains tricolpate, oblate spheroidal in equatorial view; PEI 0.92; PAI 0.20; size 43.7–47.5 μm wide × 38.0–45.6 μm long; average size 46.0 μm wide × 42.1 μm long; sculpturing microechinate; ektexine and endexine about 4.1 μm thick; structure tectate. SEM shows a clearly defined furrow margin, a granular furrow membrane, and a punctate surface.

Distribution: Quebec and Ontario.

Flowering period: April to May.

Ecological notes: In rich woods, fields, thickets, and clearings. Native.

## PRIMULACEAE (primrose family)

141. ***Lysimachia punctata*** L.

garden-loosestrife, dotted-loosestrife, goldencup
lysimaque, lysimaque ponctuée

SEM Figs. 281, 282; LM Figs. 420–422

Description: Grains tricolporate, subprolate in equatorial view; PEI 1.25; PAI 0.37; size 19.0–22.8 μm wide × 23.8–27.6 μm long; average size 20.3 μm wide × 25.4 μm long; sculpturing reticulate; ektexine and endexine about 1.9–2.3 μm thick; structure tectate. SEM shows unsculptured furrow margins.

Distribution: Newfoundland, Nova Scotia, Prince Edward Island, Quebec, Ontario, and British Columbia.

Flowering period: June to September.

Ecological notes: Along roadsides and in waste places. Introduced; a native of Eurasia.

142. ***Lysimachia terrestris*** B.S.P.

swamp-loosestrife, swampcandles, yellow-loosestrife, terrestrial-loosestrife
lysimaque terrestre, lysimaque bulbifère, lysimaque effilée

SEM Figs. 283, 284; LM Figs. 423–425

Description: Grains tricolporate, prolate in equatorial view; PEI 1.34; PAI 0.31; size 15.2–18.1 μm wide × 20.0–23.8 μm long; average size 17.0 μm wide × 22.7 μm long; sculpturing microreticulate; ektexine and endexine about 3.0 μm thick; structure tectate. SEM shows a fine reticulum.

Distribution: Newfoundland, west to Manitoba and British Columbia.

Flowering period: June to August.

Ecological notes: In open swamps and on wet soils. Native.

143. ***Lysimachia thrysiflora*** L.

yellow-loosestrife, tufted loose-strife, water loose-strife
lysimaque thyrisflore, corneille en bouquet, lysimaque à fleurs en thyrse, naumburgia à fleurs en thyrse

SEM Figs. 285, 286; LM Figs. 426–428

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.13; PAI 0.33; size 17.1–24.7 μm wide × 18.1–26.6 μm long; average size 18.4 μm wide × 20.8 μm long; sculpturing microreticulate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows a fine reticulum and a granular furrow membrane.

Distribution: Mackenzie District, N.W.T.; Nova Scotia, west to British Columbia.

Flowering period: Mid June to July.

Ecological notes: In cold swamps, shaded ditches, springy marshes, and bogs. Native.

## **RANUNCULACEAE** (crowfoot family)

144. ***Anemone patens*** L.

prairie crocus, crocus, pasqueflower, prairiesmoke, prairie anemone, Easterflower, wild crocus, sandflower, lion's-beard, hartshorn plant, American pulsatilla, hartshorn-plant
anémone des prairies, crocus

SEM Figs. 287, 288; LM Figs. 429–431

Description: Grains pericolpate, oblate spheroidal in equatorial view; PEI 0.92; PAI 0.14; size 36.1–40.0 μm wide × 33.3–37.1 μm long; average size 37.9 μm wide × 35.1 μm long; sculpturing psilate; ektexine and

endexine about 2.6–3.0 μm thick; structure tectate. SEM shows a microechinate sculpturing pattern.

Distribution: Mackenzie District, N.W.T.; Yukon Territory; Manitoba, west to British Columbia.

Flowering period: Late April to May.

Ecological notes: On prairies, barrens, and exposed slopes. Native.

145. ***Clematis virginiana*** L.

virgin's-bower, devil's-darningneedle, Virginia virgin's-bower, white clematis
clématite de Virginie, herbe aux gueux

SEM Figs. 289, 290; LM Figs. 432–434

Description: Grains tricolpate, oblate spheroidal in equatorial view; PEI 0.95; PAI 0.17; size 20.9–22.8 μm wide × 19.0–22.8 μm long; average size 22.3 μm wide × 21.2 μm long; sculpturing microechinate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows a microechinate sculpturing pattern with a verrucate furrow membrane.

Distribution: Nova Scotia, west to Manitoba.

Flowering period: July to September.

Ecological notes: On moist soils, low grounds, in thickets, along fencerows, and at the borders of woods. Native.

146. ***Thalictrum occidentale*** Gray

western meadow-rue

SEM Figs. 291, 292; LM Figs. 435–437

Description: Grains periporate, spherical in equatorial view; diameter 17.1–20.9 μm; average size 18.5 μm; sculpturing microechinate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM shows operculate pores with a verrucate membrane.

Distribution: Saskatchewan, Alberta, and British Columbia.

Flowering period: May to July.

Ecological notes: In shady moist places, woodlands, and coulees. Native.

## RHAMNACEAE (buckthorn family)

147. ***Rhamnus alnifolia*** L'Her

alder-leaved buckthorn, buckthorn, dwarf alder, swamp buckthorn
nerprun à feuilles d'aulne

SEM Figs. 293, 294; LM Figs. 438–440

Description: Grains tricolporate, oblate spheroidal in equatorial view; PEI 0.95; PAI 0.23; size 19.0–20.9 μm wide × 17.1–20.0 μm long; average size 19.4 μm wide × 18.4 μm long; sculpturing psilate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a microrugulate sculpturing pattern.

Distribution: Newfoundland, west to British Columbia.

Flowering period: June to July.

Ecological notes: In moist woodlands, swamps, and meadows. Native.

## ROSACEAE (rose family)

148. ***Amelanchier alnifolia*** Nutt.

saskatoon, saskatoonberry, sugarplum, serviceberry, juneberry, shadbush, northern serviceberry
amélanchier à feuilles d'aune, poire, bois de flèche, amélanchier, poirier, petites poires

SEM Figs. 295, 296; LM Figs. 441–443

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.19; PAI 0.24; size 17.1–20.9 μm wide × 20.0–24.7 μm long; average size 18.9 μm wide × 22.5 μm long; sculpturing striate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows puncta in the striate spaces.

Distribution: Keewatin and Mackenzie Districts, N.W.T.; Yukon Territory; Quebec, west to British Columbia.

Flowering period: May to June.

Ecological notes: In coulees, bluffs, thickets, open woodlands, and along the borders of streams. Native.

149. ***Crataegus crus-galli*** L.

cockspur hawthorn, cockspur thorn
ergot-de-coq, aubépine de coq

SEM Figs. 297, 298; LM Figs. 444–446

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.15; PAI 0.22; size 30.4–36.1 μm wide × 34.2–40.0 μm long; average size 32.4 μm wide × 37.2 μm long; sculpturing striate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a swirling striate sculpturing pattern.

Distribution: Quebec and Ontario.

Flowering period: Mid June.

Ecological notes: Abandoned or poorly managed agricultural land. Native.

150. ***Crataegus monogyna*** Jacq.

English hawthorne, May thorn, common hawthorne, one-seeded hawthorn
aubépine monogyne, aubépine

SEM Figs. 299, 300; LM Figs. 447–449

Description: Grains tricolpate, prolate spheroidal in equatorial view; PEI 1.09; PAI 0.24; size 25.7–34.2 μm wide × 28.5–38.0 μm long; average size 31.0 μm wide × 33.6 μm long; sculpturing fine, striate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a swirling striate sculpturing pattern.

Distribution: Nova Scotia, west to Ontario and British Columbia.

Flowering period: May to June.

Ecological notes: A cultivated species that has spread along roadsides and at the borders of woods. Introduced; a native of Eurasia and the Mediterranean region.

151. ***Fragaria virginiana*** Duchesne

strawberry, Virginia strawberry, wild strawberry
fraisier des champs, fraisier de Virginie

SEM Figs. 301, 302; LM Figs. 450–452

Description: Grains tricolpate, prolate spheroidal in equatorial view; PEI 1.08; PAI 0.29; size 18.1–20.9 μm wide × 19.0–21.9 μm long; average size 19.4 μm wide × 21.0 μm long; sculpturing coarse, striate; ektexine and endexine about 1.13–1.5 μm thick; structure tectate. SEM shows coarse, striate sculpturing with acute ridges. The ridges are connected at the poles and disconnected between the furrows.

Distribution: Keewatin and Mackenzie Districts, N.W.T.; Newfoundland, west to British Columbia.

Flowering period: May to July.

Ecological notes: In fields and at the borders of woods. Native.

152. ***Prunus domestica*** L.

garden plum, damson plum, bullace plum, bullace, dawson
prunier de l'Islet, prunier domestique, prunier

SEM Figs. 303, 304; LM Figs. 453–455

Description: Grains tricolpate, prolate spheroidal in equatorial view; PEI 1.11; PAI 0.31; size 29.5–34.2 μm wide × 32.3–36.1 μm long; average size 31.8 μm wide × 35.3 μm long; sculpturing striate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows fine puncta within the overlapping striations.

Distribution: Nova Scotia, Quebec, and Ontario.

Flowering period: May.

Ecological notes: A commonly cultivated species; an introduced native of Europe.

153. ***Prunus pensylvanica*** L.

pin cherry, bird cherry, red cherry, fire cherry, wild red cherry
petit merisier, cerisier de Pennsylvanie, cerisier d'été, arbre à petites merises, merisier

SEM Figs. 305, 306; LM Figs. 456–458

Description: Grains tricolpate, oblate spheroidal in equatorial view; PEI 0.95; PAI 0.27; size 17.1–29.5 μm wide × 20.9–28.5 μm long; average size 25.0 μm wide × 23.8 μm long; sculpturing striate; ektexine and endexine about 1.13–1.5 μm thick; structure tectate. SEM shows fine puncta within the striations.

Distribution: Mackenzie District, N.W.T.; Newfoundland, west to British Columbia.

Flowering period: Mid May to June.

Ecological notes: In woods, thickets, clearings, and recent burns. Native.

154. ***Prunus serotina*** Ehrb.

black cherry, rum cherry, timber cherry, wild cherry
cerisier tardif, cerisier d'automne, cerisier noir, cerises d'automne

SEM Figs. 307, 308; LM Figs. 459–461

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.15; PAI 0.38; size 18.1–20.9 μm wide × 20.9–22.8 μm long; average size 18.9 μm wide × 21.8 μm long; sculpturing perstriate; ektexine and endexine about 2.3 μm thick; structure semitectate. SEM clearly shows a striate-reticulate sculpturing pattern.

Distribution: Nova Scotia, New Brunswick, Quebec, and Ontario.

Flowering period: May to early June.

Ecological notes: In dry woods and along fencerows. Native.

155. ***Prunus serrulata*** Lindl.

Japanese cherry, Oriental cherry, Japanese flowering cherry
cerisier à feuilles dentées en scie

SEM Figs. 309, 310; LM Figs. 462–464

Description: Grains tricolpate, oblate spheroidal in equatorial view; PEI 0.90; PAI 0.29; size 26.6–33.3 μm wide × 24.7–30.4 μm long; average size 30.7 μm wide × 27.7 μm long; sculpturing striate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows a coarse striate sculpturing pattern.

Distribution: Ontario and British Columbia.

Flowering period: May.

Ecological notes: A cultivated species. Introduced; a native of Japan and Korea.

156. ***Pyrus aucuparia*** (L.) Gaertn.

European mountain-ash, rowantree, mountain-ash, rowan
sorbier des oiseleurs, sorbier des oiseaux, cormier d'Europe

SEM Figs. 311, 312; LM Figs. 465–467

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.27; PAI 0.28; size 18.1–20.0 μm wide × 21.9–26.6 μm long; average size 19.0 μm wide × 24.3 μm long; sculpturing fine, striate; ektexine and

endexine about 1.5–1.9 μm thick; structure tectate. SEM shows lateral striations between the furrows, with puncta also present.

Distribution: Nova Scotia west to Ontario, Saskatchewan, Alberta, and British Columbia.

Flowering period: June.

Ecological notes: A species cultivated for its ornamental properties, spread to roadsides and moist woods. Introduced; a native of Europe.

157. ***Pyrus communis*** L.

common pear, pear, garden pear
poirier commun

SEM Figs. 313, 314; LM Figs. 468–470

Description: Grains tricolpate, prolate in equatorial view; PEI 1.35; PAI 0.26; size 20.0–22.8 μm wide × 26.6–31.4 μm long; average size 21.7 μm wide × 29.2 μm long; sculpturing striate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows lateral striations between the furrows with puncta also present.

Distribution: Southern Ontario and southwestern British Columbia.

Flowering period: May.

Ecological notes: A species long cultivated for its fruit, rarely escaping. Introduced; a native of Eurasia.

158. ***Pyrus coronaria*** L.

wild crab apple
pommier sauvage, pommier coronaire

SEM Figs. 315, 316; LM Figs. 471–473

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.32; PAI 0.28; size 22.8–26.6 μm wide × 30.4–34.2 μm long; average size 24.4 μm wide × 32.2 μm long; sculpturing striate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows lateral striations between the furrows, with puncta also present.

Distribution: Southwestern Ontario.

Flowering period: May to June.

Ecological notes: A species cultivated for its ornamental properties, escaping to woods, thickets, fencerows, and open slopes. Native.

159. ***Pyrus malus*** L.

apple, common apple
pommier commun, pommier nain, pommier sauvage, pommier

SEM Figs. 317, 318; LM Figs. 474–476

Description: Grains tricolpate, prolate spheroidal in equatorial view; PEI 1.05; PAI 0.32; size 24.7–28.5 μm wide × 24.7–29.5 μm long; average size 26.2 μm wide × 27.5 μm long; sculpturing striate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows longitudinal striations between the furrows.

Distribution: Newfoundland, west to British Columbia.

Flowering period: May to June.

Ecological notes: A cultivated crop. Introduced; a native of Eurasia.

160. ***Rosa multiflora*** Thunb.

Japanese rose
rosier à fleurs nombreuses, rosier grimpant, rosier multiflore

SEM Figs. 319, 320; LM Figs. 477–479

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.28; PAI 0.32; size 18.1–20.0 μm wide × 22.8–26.6 μm long; average size 18.9 μm wide × 24.1 μm long; sculpturing striate; ektexine and endexine about 1.9–2.3 μm thick; structure tectate.

Distribution: Nova Scotia, west to Ontario and British Columbia.

Flowering period: June.

Ecological notes: A cultivated species; a native of Eurasia.

161. ***Rubus idaeus*** L.

raspberry, garden raspberry, wild red raspberry
ronce du mont Ida, framboisier, framboisier des jardins, ronce framboisier, kiock

SEM Figs. 321, 322; LM Figs. 480–482

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.17; PAI 0.21; size 15.2–19.0 μm wide × 20.0–21.9 μm long; average size 18.0 μm wide × 21.1 μm long; sculpturing striate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a fine, striate sculpturing pattern, with puncta present.

Distribution: Keewatin and Mackenzie Districts, N.W.T.; Yukon Territory; Newfoundland, west to British Columbia.

Flowering period: June to August.

Ecological notes: A cultivated species escaped to thickets, clearings, along roadsides, and at the borders of woods. Native and introduced subspecies.

162. ***Rubus odoratus*** L.

flowering raspberry, purple flowering raspberry, thimbleberry
ronce odorante, framboisier sauvage, calottes, chapeaux rouges

SEM Figs. 323, 324; LM Figs. 483–485

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.16; PAI 0.27; size 17.1–19.0 μm wide × 20.0–22.8 μm long; average size 18.2 μm wide × 21.2 μm long; sculpturing poorly defined; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows an indistinctive sculpturing pattern with puncta present.

Distribution: Nova Scotia, New Brunswick, Quebec, and Ontario.

Flowering period: Late June to early July.

Ecological notes: In thickets and at the borders of woods. Native.

## SALICACEAE (willow family)

163. ***Salix discolor*** Muhl.

pussy willow, diamond willow, large pussy willow, northern pussy willow
saule discolore, chatons, chaton, petit minou, petit chaton

SEM Figs. 325, 326; LM Figs. 486–488

Description: Grains tricolpate, prolate in equatorial view; PEI 1.37; PAI 0.17; size 17.1–19.0 μm wide × 22.8–26.6 μm long; average size 18.0 μm wide × 24.6 μm long; sculpturing reticulate; ektexine and endexine about 1.5 μm thick; structure tectate.

Distribution: Mackenzie District, N.W.T.; Yukon Territory; Newfoundland, west to British Columbia.

Flowering period: April to early May.

Ecological notes: In damp thickets, swamps, and along shorelines. Native.

## SAXIFRAGACEAE (saxifrage family)

164. ***Ribes americanum*** Mill.

American black currant, wild black currant, black currant
gadellier Américain, gadellier d'Amérique, cassis sauvage, gadellier noir

SEM Figs. 327, 328; LM Figs. 489–491

Description: Grains periporate, spherical in equatorial view; diameter 22.8–28.5 μm; average size 26.0 μm; sculpturing verrucate, with psilate ridges; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows clearly defined psilate ridges with verrucate particles on concave faces surrounding the pores. Some concave faces have one pore, whereas others have two.

Distribution: Nova Scotia, west to Alberta.

Flowering period: May to June.

Ecological notes: In moist woods, rich thickets, and on slopes. Native.

165. ***Ribes aureum*** Pursh

golden currant, Missouri currant
gadelier doré, gadelier odorant

SEM Figs. 329, 330; LM Figs. 492–494

Description: Grains periporate, spherical in equatorial view; diameter 27.6–30.4 μm; average size 28.8 μm; sculpturing verrucate, with psilate ridges; ektexine and endexine about 1.5–1.9 μm thick; structure tectate. SEM shows clearly defined psilate ridges with verrucate particles on concave faces surrounding the pores. Some concave faces have one pore, whereas others have two.

Distribution: Quebec, Ontario, Saskatchewan, Alberta, and British Columbia.

Flowering period: May to June.

Ecological notes: In open prairie. Native.

166. ***Ribes glutinosum*** Bentham

winter currant

SEM Figs. 331, 332; LM Figs. 495–497

Description: Grains periporate, spherical in equatorial view; diameter 27.6–31.4 μm; average size 29.6 μm; sculpturing verrucate, with psilate ridges; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows psilate sculpturing between large verrucate pore membranes that surround a single operculate pore.

Distribution: Not yet known in Canada but found in California.

Flowering period: February to March.

Ecological notes: At the edges of mixed coniferous-deciduous woods and along streambanks. Native.

167. ***Ribes odoratum*** Wendl. f.
buffalo currant, golden currant
gadelier odorante

SEM Figs. 333, 334; LM Figs. 498–500

Description: Grains periporate, spherical in equatorial view; diameter 26.6–32.3 μm; average size 29.6 μm; sculpturing verrucate, with psilate ridges; ektexine and endexine about 1.5–1.9 μm thick; structure tectate. SEM shows psilate ridges with verrucate particles on concave faces surrounding a single pore.

Distribution: Ontario.

Flowering period: May.

Ecological notes: On cliffs and rocky hillsides. Introduced; a native of the central United States.

168. ***Ribes oxyacanthoides*** L.
northern gooseberry, wild gooseberry, northern smooth gooseberry
groseillier du Nord, groseillier sauvage

SEM Figs. 335, 336; LM Figs. 501–503

Description: Grains periporate, spherical in equatorial view; diameter 23.8–27.6 μm; average size 25.9 μm; sculpturing verrucate; ektexine and endexine about 1.1–1.5 μm thick; structure tectate. SEM shows psilate ridges with verrucate particles on concave faces surrounding the double pores.

Distribution: Yukon Territory; Prince Edward Island; Quebec, west to British Columbia. Reported in Newfoundland.

Flowering period: May to June.

Ecological notes: In moist woods. Native.

169. ***Ribes sanguineum*** Pursh

red-flowered currant, winter currant, red-flowering currant
groseillier sanguin

SEM Figs. 337, 338; LM Figs. 504–506

Description: Grains periporate, spherical in equatorial view; diameter 24.7–32.3 μm; average size 29.3 μm; sculpturing verrucate, with psilate ridges; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows clearly defined psilate ridges, with verrucate particles on concave faces surrounding the pores. Some concave faces have one pore, whereas others have two.

Distribution: British Columbia.

Flowering period: Mid May to June.

Ecological notes: A cultivated species that has spread to rocky soils, along roadsides and riverbanks, in mixed woods, and on slopes or hillsides. Native.

170. ***Ribes triste*** Pall.

American red currant, wild red currant, red currant, wild currant, bitter currant
gadellier amer, gadellier sauvage, gadelier rouge sauvage

SEM Figs. 339, 340; LM Figs. 507–509

Description: Grains periporate, spherical in equatorial view; diameter 22.8–26.6 μm; average size 24.2 μm; sculpturing verrucate, with psilate ridges; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows clearly defined psilate ridges, with verrucate particles on concave faces surrounding the pores. Some concave faces have one pore, whereas others have two.

Distribution: Mackenzie District, N.W.T.; Yukon Territory; Labrador and Newfoundland; Nova Scotia, west to British Columbia.

Flowering period: June to July.

Ecological notes: In cool woods, bogs, swamps, and subalpine ravines. Native.

## SCROPHULARIACEAE (figwort family)

171. ***Antirrhinum majus*** L.

common snapdragon, large snapdragon, garden snapdragon
gueule de lion, gueule de loup

SEM Figs. 341, 342; LM Figs. 510–512

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.01; PAI 0.29; size 17.1–21.9 μm wide × 18.1–20.9 μm long; average size 19.7 μm wide × 19.9 μm long; sculpturing reticulate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows a shallow reticulum.

Distribution: Cultivated throughout southern Canada.

Flowering period: June to September.

Ecological notes: A common garden ornamental. Introduced; a native of Europe.

172. ***Digitalis purpurea*** L.

foxglove, common foxglove
digitale pourpre

SEM Figs. 343, 344; LM Figs. 513–515

Description: Grains tricolporate, oblate spheroidal in equatorial view; PEI 0.98; PAI 0.15; size 18.1–22.8 μm wide × 17.1–22.8 μm long; average size 20.0 μm wide × 19.7 μm long; sculpturing punctate; ektexine and endexine about 1.5–1.9 μm thick; structure tectate. SEM shows a microreticulate-punctate sculpturing pattern.

Distribution: Planted in gardens throughout Canada.

Flowering period: June to September.

Ecological notes: A cultivated species that has escaped to clearings and old fields, locally abundant in Newfoundland. Introduced; a native of Europe.

173. ***Linaria vulgaris*** Miller

yellow toadflax, butter-and-eggs, common linaria, toadflax, common toadflax, wild snapdragon
linaire vulgarie, linaire commune, linaire, gueule de lion, gueule de lion des champs, lin des crapauds, muflier sauvage, pain et beurre, pisse de chien, linaire vulgaire

SEM Figs. 345, 346; LM Figs. 516–518

Description: Grains tricolpate, prolate spheroidal in equatorial view; PEI 1.09; PAI 0.28; size 14.3–16.9 μm wide × 15.2–19.0 μm long; average size 16.0 μm wide × 17.4 μm long; sculpturing foveolate-reticulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows a foveolate-reticulum.

Distribution: Mackenzie District, N.W.T.; Newfoundland, west to British Columbia.

Flowering period: June to September.

Ecological notes: A common weed of fields and waste places. Introduced; a native of Eurasia.

174. ***Penstemon gracilis*** Nutt.

slender penstemon
penstémon grêle

SEM Figs. 347, 348; LM Figs. 519–521

Description: Grains tricolpate, prolate spheroidal in equatorial view; PEI 1.09; PAI 0.17; size 15.2–20.9 μm wide × 17.1–20.9 μm long; average size 17.8 μm wide × 19.4 μm long; sculpturing microreticulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows the furrows extending almost to the poles.

Distribution: Manitoba, Saskatchewan, and Alberta.

Flowering period: June to July.

Ecological notes: In open woods and on prairie. Native.

## SIMAROUBACEAE (quassia family)

175. ***Ailanthus altissima*** (Mill.) Swingle

Chinese-sumac, tree-of-heaven, copaltree
frêne puant

SEM Figs. 349, 350; LM Figs. 522–524

Description: Grains tricolpate, subprolate in equatorial view; PEI 1.30; PAI 0.20; size 19.0–24.7 μm wide × 26.6–34.2 μm long; average size 22.5 μm wide × 29.3 μm long; sculpturing reticulate; ektexine and endexine about 3.0 μm thick; structure tectate. SEM shows an irregular spacing of the reticulum.

Distribution: Southwestern Ontario and British Columbia.

Flowering period: June.

Ecological notes: Cultivated as a shade tree. Introduced; a native of Asia.

## SOLANACEAE (nightshade family)

176. ***Nicotiana tabacum*** L.

tobacco
tabac

SEM Figs. 351, 352; LM Figs. 525–527

Description: Grains tetracolpate, prolate in equatorial view; PEI 1.33; PAI 0.37; size 20.0–24.7 μm wide × 27.6–32.3 μm long; average size 22.7 μm wide × 30.1 μm long; sculpturing psilate; ektexine and endexine about 1.13–1.5 μm thick; structure tectate. SEM shows no sculpturing pattern.

Distribution: Ontario, Quebec, and British Columbia.

Flowering period: August to September.

Ecological notes: A cultivated species. Introduced; a native of tropical America.

177. ***Petunia hybrida*** Hort. ex Vilm.

petunia
pétune, pétunia

SEM Figs. 353, 354; LM Figs. 528–530

Description: Grains tricolporate, spherical in equatorial view; PAI 0.14; size 24.7–28.5 μm wide × 23.8–30.4 μm long; average size 26.7 μm wide × 26.8 μm long; sculpturing rugulate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows a coarse rugulate sculpturing pattern, with furrows extending almost to the poles.

Distribution: Planted throughout Canada.

Flowering period: June to September.

Ecological notes: A widely cultivated species. Introduced; a native of South America.

## TILIACEAE (linden family)

178. ***Tilia americana*** L.

American linden, basswood, lime, linden, whitewood
bois blanc, tilleul d'Amérique

SEM Figs. 355, 356; LM Figs. 531–534

Description: Grains tricolporate with vestibulate pores, the grains spherical in polar view, isopolar in equatorial view; PEI 1.37; PAI 0.69; size 34.2–40.0 μm wide × 24.7–29.5 μm long; average size 37.2 μm wide × 27.2 μm long; sculpturing fine, reticulate; ektexine and endexine about 2.3–2.6 μm thick; structure tectate. SEM shows isopolar symmetry and a fine reticulum.

Distribution: New Brunswick, west to Saskatchewan.

Flowering period: Late June to July.

Ecological notes: In moist fertile soils and rich woods. Native.

179. ***Tilia cordata*** Mill.

littleleaf linden, small-leaved lime, small-leaved European linden
tilleul à petites feuilles

SEM Figs. 357, 358; LM Figs. 535–538

Description: Grains tricolporate with vestibulate pores, the grains spherical in polar view, isopolar in equatorial view; PEI 1.52; PAI 0.61; size 29.5–35.2 μm wide × 20.0–23.8 μm long; average size 32.7 μm wide × 21.5 μm long; sculpturing fine, reticulate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows isopolar symmetry and a fine reticulum.

Distribution: Nova Scotia, west to Manitoba.

Flowering period: Late June to Mid July.

Ecological notes: A cultivated species rarely escaping. Introduced; a native of Europe.

180. ***Tilia xeuropaea*** L.

SEM Figs. 359, 360; LM Figs. 539–542

Description: Grains tricolporate with vestibulate pores, the grains spherical in polar view, isopolar in equatorial view; PEI 1.56; PAI 0.74; size

28.5–34.2 μm wide × 19.0–23.8 μm long; average size 31.8 μm wide × 20.4 μm long; sculpturing fine, reticulate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows isopolar symmetry and a fine reticulum.

Distribution: Nova Scotia, New Brunswick, Quebec, and Ontario.

Flowering period: Mid June to early July.

Ecological notes: A cultivated species, occasionally found around old dwellings, schools, and waste places. Introduced; a native of Europe.

181. ***Tilia platyphyllos*** Scop.
bigleaf linden, largeleaf linden
tilleul à grandes feuilles

SEM Figs. 361, 362; LM Figs. 543–546

Description: Grains tricolporate with vestibulate pores, the grains spherical in polar view, isopolar in equatorial view; PEI 1.58; PAI 0.69; size 33.3–36.1 μm wide × 20.9–24.7 μm long; average size 35.3 μm wide × 22.3 μm long; sculpturing fine, reticulate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows isopolar symmetry and a fine reticulum.

Distribution: New Brunswick, Quebec, and Ontario.

Flowering period: June.

Ecological notes: A cultivated species rarely escaping. Introduced; a native of Europe.

## **UMBELLIFERAE** (parsley family)

182. ***Angelica atropurpurea*** L.
angelica, alexanders
angélique, angélique noire-pourprée, angélique pourpre foncé

SEM Figs. 363, 364; LM Figs. 547–549

Description: Grains tricolporate, perprolate in equatorial view; PEI 2.16; PAI 0.40; size 11.4–14.3 μm wide × 26.6–30.4 μm long; average size 13.1 μm wide × 28.3 μm long; sculpturing rugulate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows small pores within the furrows.

Distribution: Keewatin District, N.W.T.; Labrador and Newfoundland, west to Ontario. Abundant on Cape Breton Island.

Flowering period: June to July.

Ecological notes: In rich thickets, bottomlands, and swamps. Native.

183. ***Carum carvi*** L.

caraway, common caraway
anis canadien, carvi commun, anis, anis bâtard, aneine, anis des vosges, anis sauvage, carvic cumin, cumin des prés, care carvi

SEM Figs. 365, 366; LM Figs. 550–552

Description: Grains tricolporate, perprolate in equatorial view; PEI 2.21; PAI 0.43; size 11.4–13.3 μm wide × 26.6–29.5 μm long; average size 12.4 μm wide × 27.4 μm long; sculpturing not clearly defined; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows small pores within the furrows.

Distribution: Newfoundland, Nova Scotia, west to British Columbia.

Flowering period: June to July.

Ecological notes: In abandoned fields, waste places, and along roadsides. Introduced; a native of Eurasia.

184. ***Daucus carota*** L.

wild carrot, devil's-plague, Queen Anne's-lace, bird's-nest
carotte sauvage, carotte potagère, carotte, carotte commune, carotte douce

SEM Figs. 367, 368; LM Figs. 553–555

Description: Grains tricolporate, perprolate in equatorial view; PEI 2.06; PAI 0.41; size 12.4–13.3 μm wide × 24.7–28.5 μm long; average size 13.0 μm wide × 26.8 μm long; sculpturing rugulate; ektexine and endexine about 1.5–1.9 μm thick; structure tectate. SEM shows small pores within the furrows.

Distribution: Labrador, Newfoundland, Prince Edward Island, New Brunswick, west to Saskatchewan and British Columbia.

Flowering period: June to September.

Ecological notes: A common weed of dry fields, pastures, and waste places. Introduced; a native of Eurasia.

185. ***Pastinaca sativa*** L.

wild parsnip, parsnip, common parsnip
panais sauvage, panais cultivé, panais, panais commun, panais potager, carotte blanche

SEM Figs. 369, 370; LM Figs. 556–558

Description: Grains tricolporate, prolate in equatorial view; PEI 1.83; PAI 0.35; size 14.3–16.9 μm wide × 26.6–28.5 μm long; average size 15.1 μm wide × 27.7 μm long; sculpturing rugulate-striate; ektexine and endexine about 1.5 μm thick; structure tectate. SEM shows small pores within the furrows.

Distribution: Yukon Territory, Newfoundland, west to British Columbia.

Flowering period: June to September.

Ecological notes: A cultivated crop that has escaped to waste places, fields, and along roadsides. Introduced; a native of Europe.

## VERBENACEAE (vervain family)

186. ***Verbena hastata*** L.

blue vervain, simpler's-joy, ironweed
verveine hastée, vervaine bleue

SEM Figs. 371, 372; LM Figs. 559–561

Description: Grains tricolporate, oblate spheroidal in equatorial view; PEI 0.98; PAI 0.30; size 22.8–26.6 μm wide × 22.8–28.5 μm long; average size 25.0 μm wide × 24.5 μm long; sculpturing psilate; ektexine and endexine about 1.9–2.3 μm thick; structure tectate. SEM shows a short furrow extending through the annulate pore.

Distribution: Nova Scotia, west to Saskatchewan and British Columbia.

Flowering period: July to September.

Ecological notes: In damp thickets, at the edges of marshes, slews, woodlands, and river valleys. Native.

## VIOLACEAE (violet family)

187. ***Viola palustris*** L.

alpine marsh violet, marsh violet, northern marsh violet
violette des marais

SEM Figs. 373, 374; LM Figs. 562–564

Description: Grains tricolpate, prolate spheroidal in equatorial view; PEI 1.13; PAI 0.33; size 26.6–30.4 μm wide × 28.5–34.2 μm long; average size 28.4 μm wide × 32.3 μm long; sculpturing psilate; ektexine and endexine about 1.9 μm thick; structure tectate. SEM shows an indistinctive sculpturing pattern.

Distribution: Keewatin District, N.W.T.; Labrador; Quebec; Ontario; Manitoba; Alberta; and British Columbia. Reported from Mackenzie District, N.W.T.; Yukon Territory; Newfoundland; and Saskatchewan.

Flowering period: June to August.

Ecological notes: In moist or wet localities, bogs, and along streambanks. Native.

## VITACEAE (vine family)

188. ***Vitis vinifera*** L.

wine grape
vitis vinifère

SEM Figs. 375, 376; LM Figs. 565–567

Description: Grains tricolporate, prolate spheroidal in equatorial view; PEI 1.03; PAI 0.28; size 18.1–20.9 μm wide × 19.0–22.8 μm long; average size 19.9 μm wide × 20.5 μm long; sculpturing microreticulate; ektexine and endexine about 2.3 μm thick; structure tectate. SEM shows an indistinctive sculpturing pattern.

Distribution: Nova Scotia, Quebec, Ontario, and British Columbia.

Flowering period: July.

Ecological notes: A cultivated crop occasionally escaping into woodlands and along fencerows. An introduced native of Europe.

# Glossary

The descriptive terms used in this publication are contained in the *Morphologic Encyclopedia of Palynology* (Kremp 1965).

**acetolize** To oxidize and dissolve the cytoplasm and organic wall materials, rendering the cellular envelope clear for microscopic examination.
**areolate** A fine, shallow, reticulate sculpturing pattern.
**annulus** (adj., **annulate**) A ring-like thickening of the ektexine around a pore.
**aperture** An opening in the pollen grain wall from which the pollen grain tube emerges to effect fertilization.

**bacculae** Structural elements of the wall, which are rod-like when viewed in profile.

**colpi** Germinal furrows located in the meridional zone of the grain and normally at right angles to the equator of the grain.
**columellae** Small rod-like pillar structures connecting layers within the pollen grain wall.

**dicolporate** Possessing two furrows and two pores.

**echina** (**echinae**) Spine.
**echinate** Having spiny sculptural elements more than 1 μm high.
**echinolophate** With the surface of the grain consisting of strong crested ridges, whose crests are ornamented with spines. Normally associated with pollen grains of two tribes in the sunflower family.
**ektexine** Outer laminated wall of grain.
**endexine** Inner laminated wall of grain.
**equator** The area encircled by an imaginary line midway between the poles of the pollen grains.
**exine** The outer layer of the pollen grain wall.

**foveolate** A type of sculpturing consisting of minute holes or pits 1 μm or less in diameter.
**furrow** See colpi.

**gemmate** Having a flattened granule with the base constricted so that the granule is larger in diameter than height.
**glomerate** A type of sculpturing consisting of clustered irregular particles.

**heterocolpate** (of **furrows**) A pollen grain having some furrows with pores and other furrows without pores; the pores are never free of the furrows, i.e., they are not free-standing.
**heteropolar** With subisopolar grains possessing pores that have morphological differences (differences in shape) between the distal or proximal faces.

**intectate** (of **grains**) With the outer sculpturing elements (if present) free and isolated from each other.
**interporal** The area between the pores.
**isopolar** (of **grains**) Having no differences between the hemispheres or between the proximal or distal faces.

**lacunae** A large pit or cavity that is not a germ pore or a furrow; furrows or pores may be contained therein.
**lumina** The spaces or meshes of a reticulum that are bordered by the muri.

**melissopalynology** The study of pollen grains contained in honey.
**micro** (prefix) (of **sculpturing elements**) Less than 1 μm.
**monoaperturate** With one pore or one furrow.
**monocolpate** With one germinal furrow.
**monoporate** With one pore.
**mucronate** A conical spine arising from a globe-like protuberance.
**muri** The ridgelike network that forms the border to the meshes of a reticulum.

**oblate** Distinctly flattened at the poles, with the equatorial width greater than the polar length.
**oblate spheroidal** The shape of a grain when the polar equatorial index ranges from 0.100 to 0.88.
**operculate** Having a plug or cap over the pore or the furrow.
**operculum** The plug over a pore or a furrow.

**palynology** The discipline of pollen grain study.
**pentacolpate** Having five furrows.
**pericolpate** With several furrows uniformly distributed over the surface of a grain.
**pericolporate** With several pores uniformly distributed over the surface of a grain.
**periporate** With several pores uniformly distributed over the surface of a grain but not equally along the equator.
**peroblate** The shape of a grain when the PEI is greater than 0.50.
**perprolate** The shape of a grain when the PEI is greater than 2.0.

**perreticulate** (of **grains**) Having a reticulum that is interrupted with slight perforations.

**pertectate** (of **grains**) Having a roof-like tectum layer that has perforations.

**perstriate** (of **striations**) With minute perforations.

**phenology** The study of flowering periods.

**pila** Rod-like structures or clavate (club-like) processes positioned closely together so that the heads nearly touch and give the impression of a network.

**pilate** With small rods (pila).

**polar area** The area of the pole on bipolar grains delimited by the ends of the colpi.

**polar area index (PAI)** The ratio between the polar dimension (the space between the colpi in polar view) and the largest transverse equatorial dimension of the grain (in polar view).

**polar equatorial index (PEI)** A set of ratios used to define shape classes of pollen grains (see shape classes).

**prolate** Having elliptical isopolar grains with extended or elongated poles. The length of the polar axis is larger than that of the equatorial diameter.

**prolate spheroidal** The shape of a grain when the polar equatorial index ranges from 1.14 to 1.00.

**proximal area** Where tetrads are connected.

**psilate** (of **sculpturing**) Absent or nearly so.

**punctae** Minute shallow pits on the surface of grain.

**reticulate** (of **sculpturing elements**) Forming a network.

**reticulate** (of **grains**) The sculpturing network having lumina larger than the muri.

**rhomboidal tetrad** A group of four compound grains whose shapes approaches a quadrangle with obtuse lateral angles.

**rugulate** (of **sculpturing**) Consisting of elongated irregular elements.

**sculpture** The surface appearance normally viewed in relief without reference to the structure.

**semitectate** (of the **tectum**) Disconnected.

**shape classes** perprolate (PEI = greater than 2.0); prolate (PEI = 2.0–1.33); subprolate (PEI = 1.33–1.14); prolate spheroidal (PEI = 1.14–1.00); oblate spheroidal (PEI = 1.00–0.88); suboblate (PEI = 0.88–0.75); oblate (PEI = 0.75–0.50); peroblate (PEI = less than 0.50).

**sporopollenin** The wall of the pollen grain and spore which resists decomposition due to its unique chemical composition.

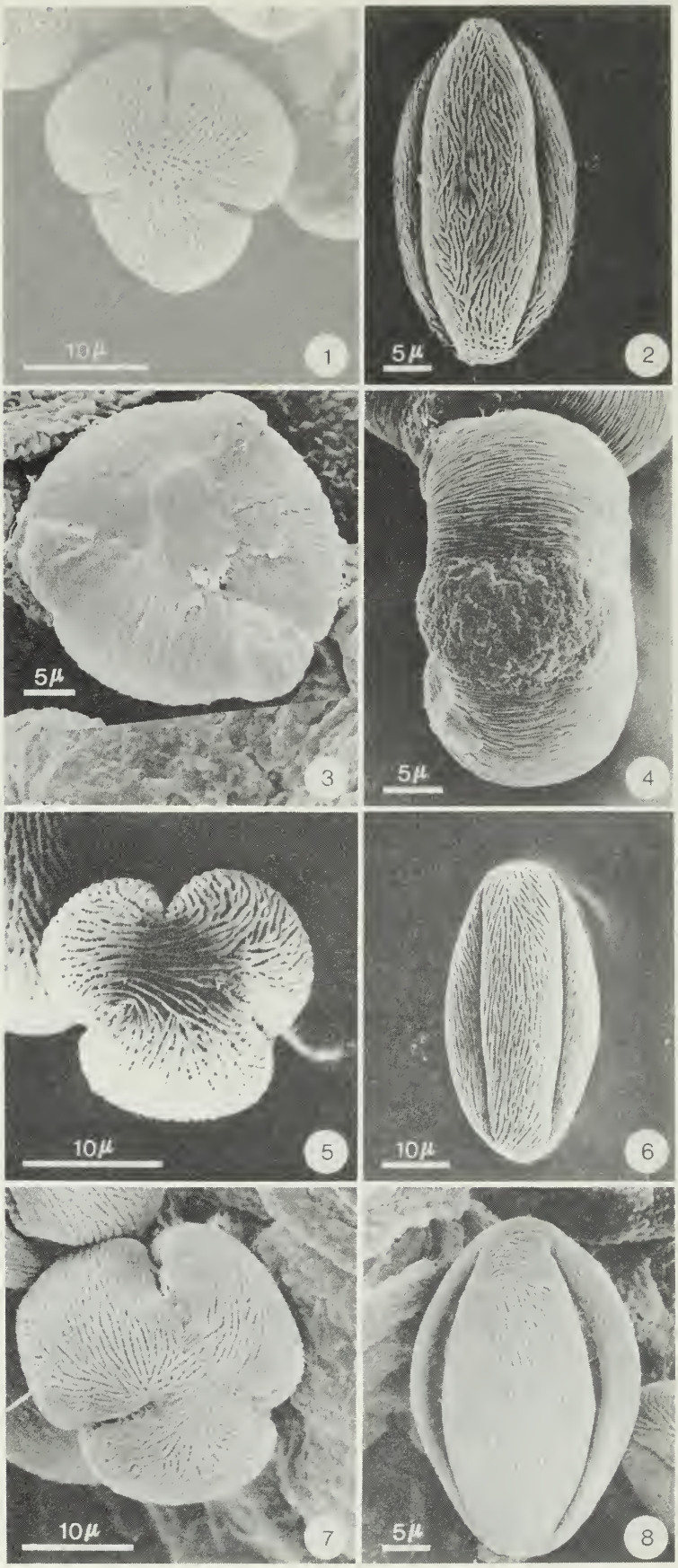
**stephanocolporate** (of a **grain**) With four or more meridional furrows, each having an equatorial pore.

**stephanoporate** Having four or more meridional pores.
**striate** (of **sculpturing**) Having elements that are streaked in more or less parallel bands or grooves.
**structure** The wall of the grain when viewed in profile, sectioned either optically or mechanically.
**subisopolar** Having morphological features or shape differing from one hemisphere or pole to the other; having slight differences between the proximal and the distal faces.
**suboblate** The shape of a grain when the polar equatorial index ranges from 0.88 to 0.75.
**subprolate** The shape of a grain when the polar equatorial index ranges from 1.33 to 1.14.
**subtriangular** Slightly triangular.

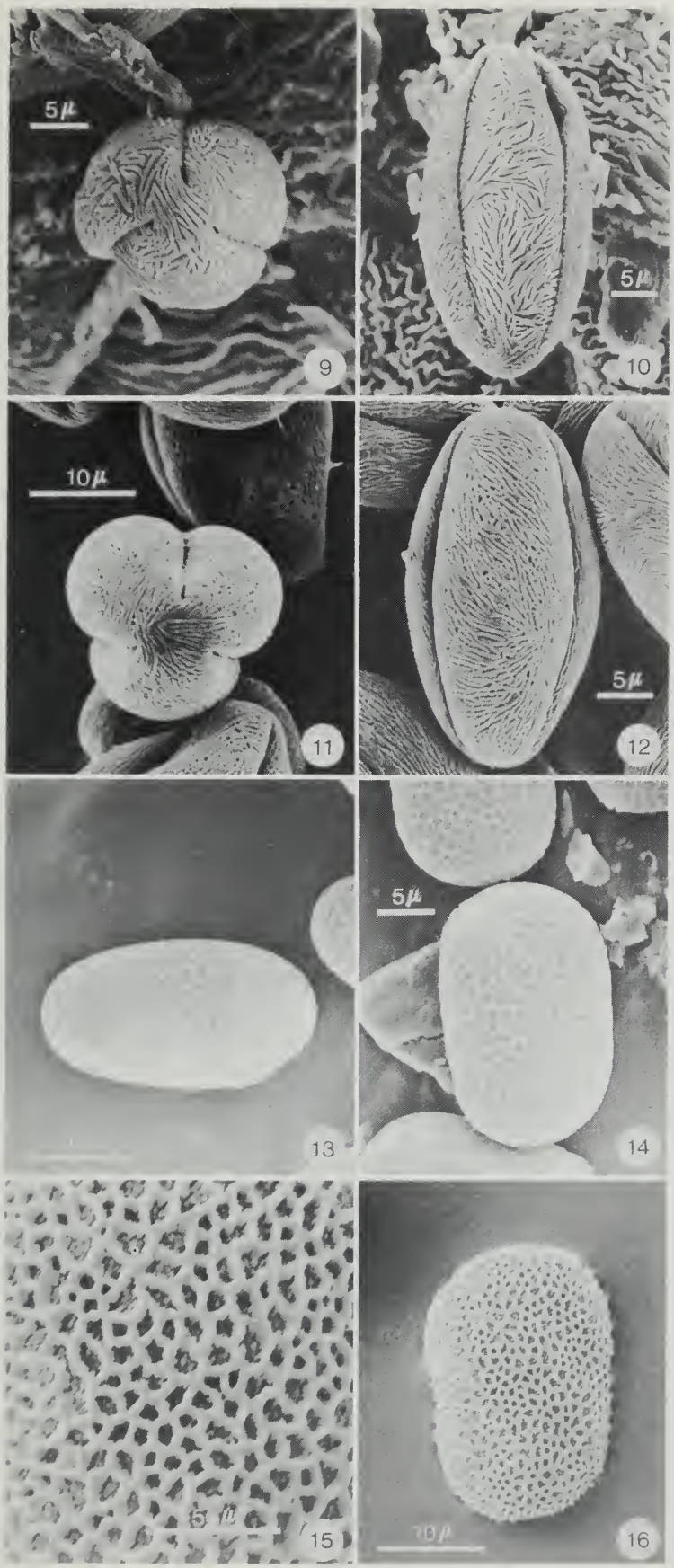
**tectate** (of **grain**) Having a tectum.
**tectum** A second membrane with a roof-like structure that may or may not be separated by a distinct cavity.
**tetracolpate** With four furrows.
**tetracolporate** With four furrows and four pores.
**tetrad** A group of four pollen grains.
**tetrahedral, tetragonal** (of a **tetrad**) Four-sided.
**tetraporate** Having four pores.
**tricolpate** Having three colpi, or furrows.
**tricolporate** Having three colpi, or furrows, containing three pores.
**triporate** Having three pores.
**tuberculate** (of **sculpturing**) Consisting of globose elements.

**valla** (pl. **vallae**) Ridges of striate or rugulate sculpturing.
**verrucate** Having warty, irregular-shaped sculpture projections whose base is usually twice the dimension of the height.
**vestibulate** Having a compartment (vestibule) between the outer and inner pore resulting from a separation of the structural layers within the wall of the pollen grain.

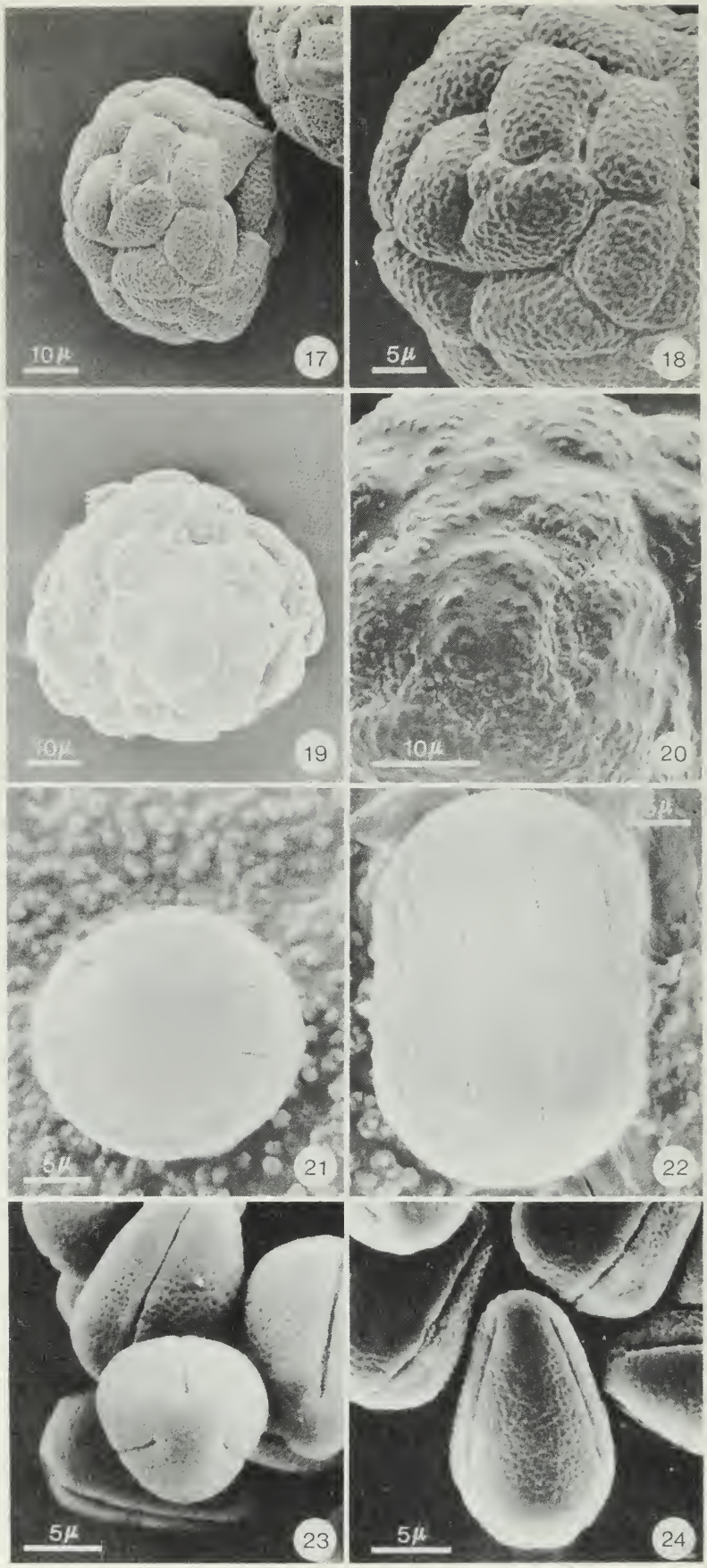
# Plates 1–47: Scanning electron microscope (SEM) photomicrographs



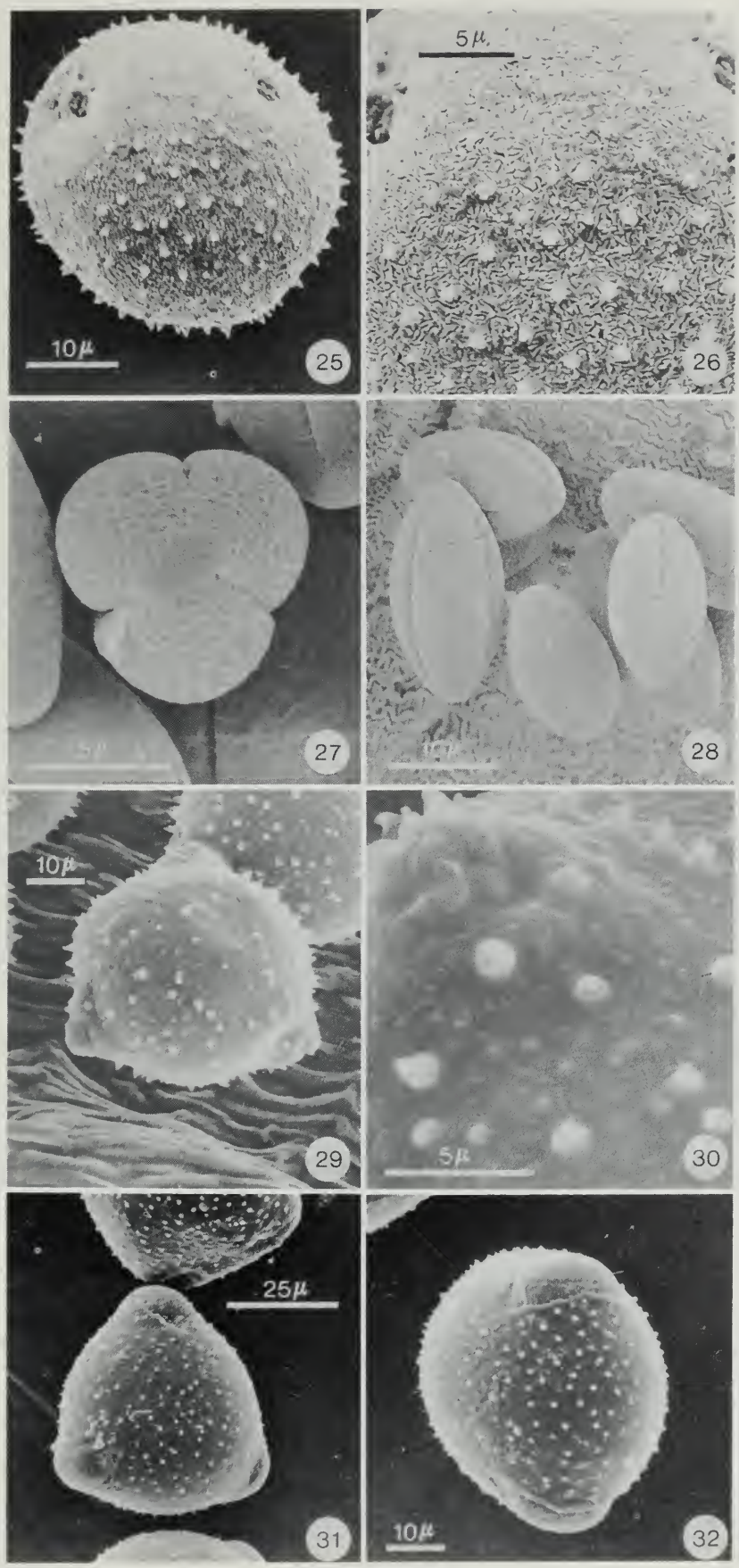

SEM Plate 1 Figs. 1, 2: *Acer circinatum*; Figs. 3, 4: *A. macrophyllum*; Figs. 5, 6: *A. platanoides*; Figs. 7, 8: *A. pseudo-platanus*.



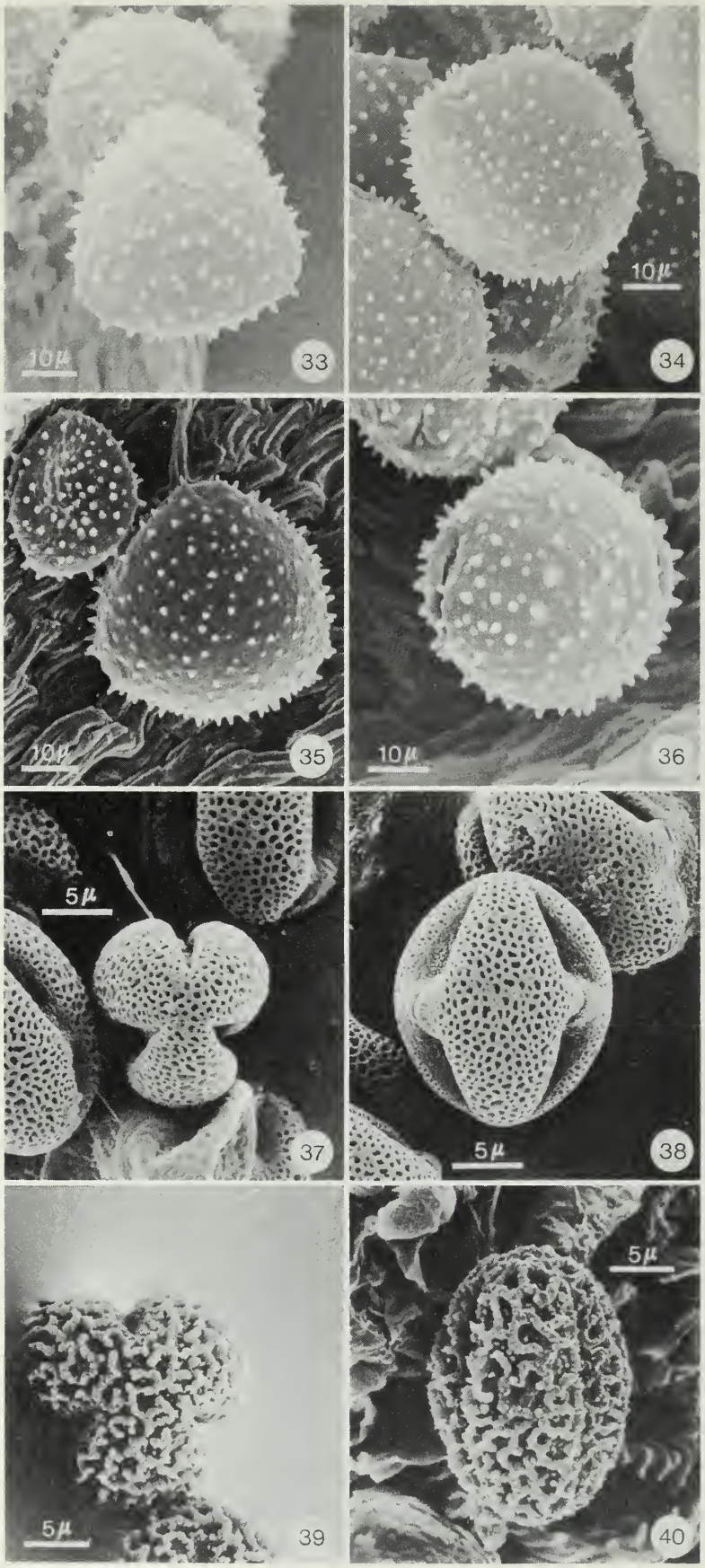

SEM Plate 2 Figs. 9, 10: *Acer rubrum*; Figs. 11, 12: *A. tataricum*; Figs. 13, 14: *Impatiens capensis*; Figs. 15, 16: *I. glandulifera*.



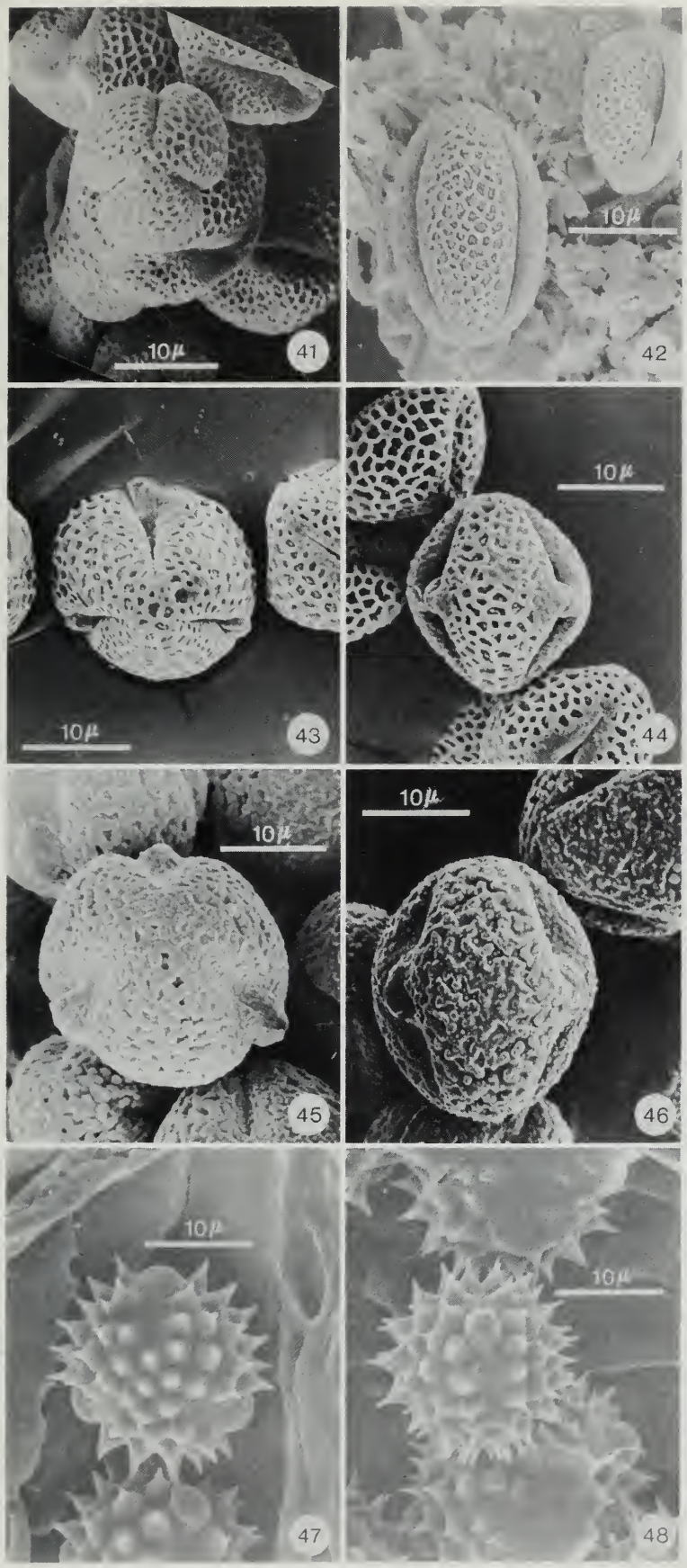

SEM Plate 3 Figs. 17, 18: *Catalpa ovata*; Figs. 19, 20: *C. speciosa*; Figs. 21, 22: *Borago officinalis*; Figs. 23, 24: *Echium vulgare*.



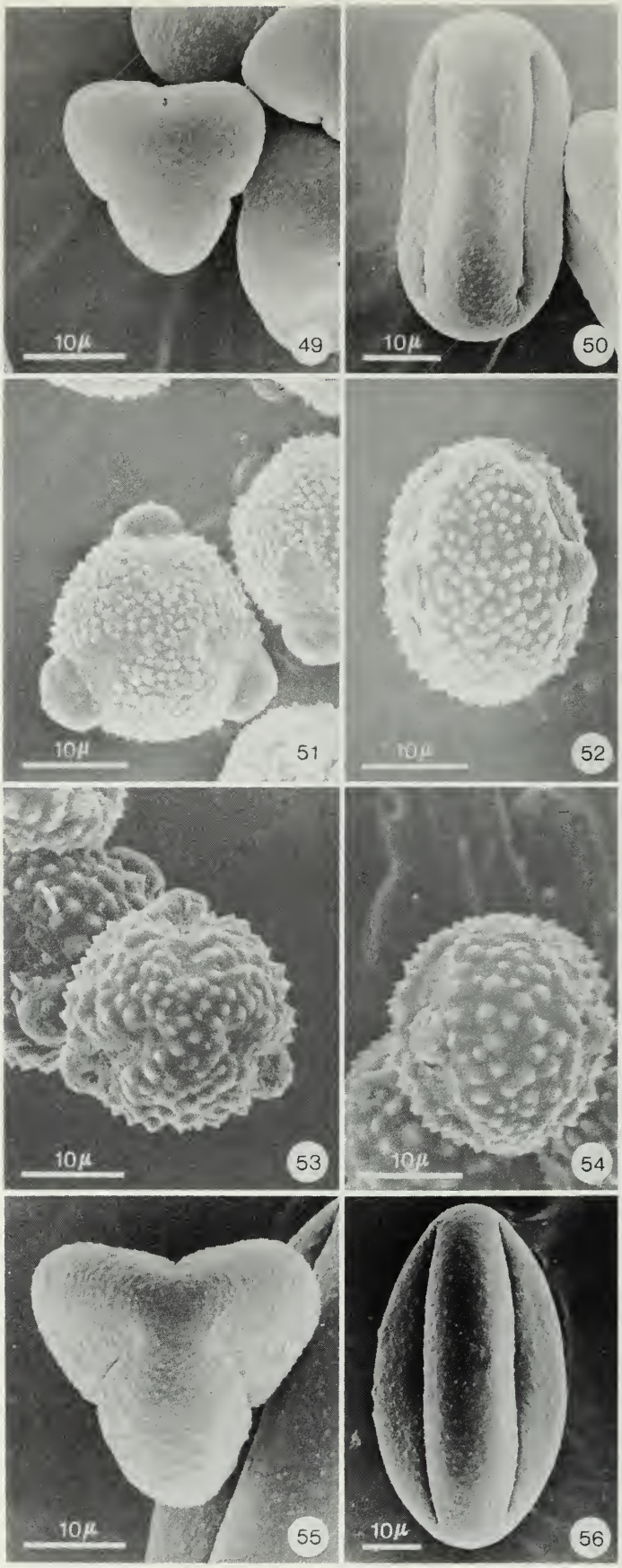

SEM Plate 4 Figs. 25, 26: *Campanula rapunculoides*; Figs. 27, 28: *Cleome serrulata*; Figs. 29, 30: *Diervilla lonicera*, Figs. 31, 32: *Lonicera involucrata*.



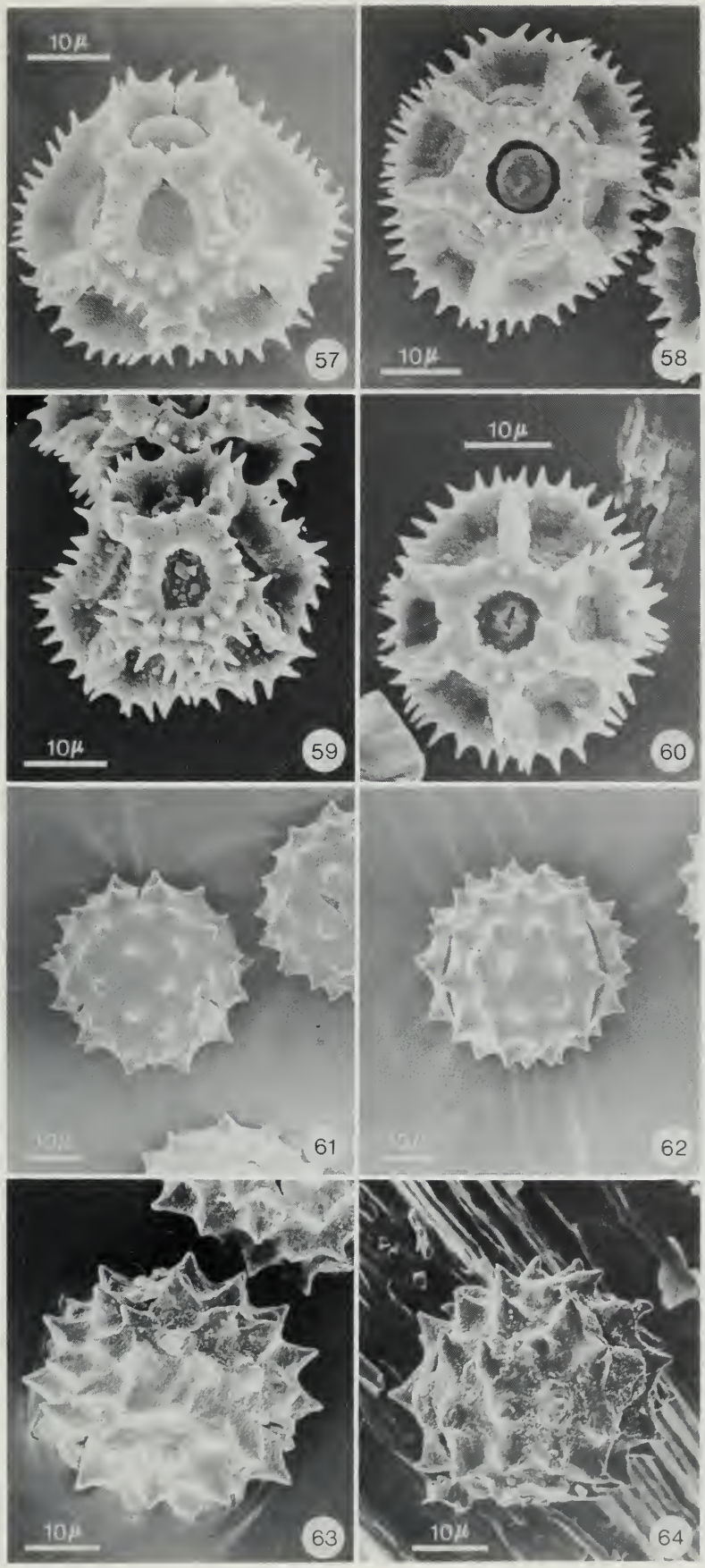

SEM Plate 5 Figs. 33, 34: *Lonicera morrowi*; Figs. 35, 36: *L. tatarica*; Figs. 37, 38: *Sambucus canadensis*; Figs. 39, 40: *Viburnum lentago*.



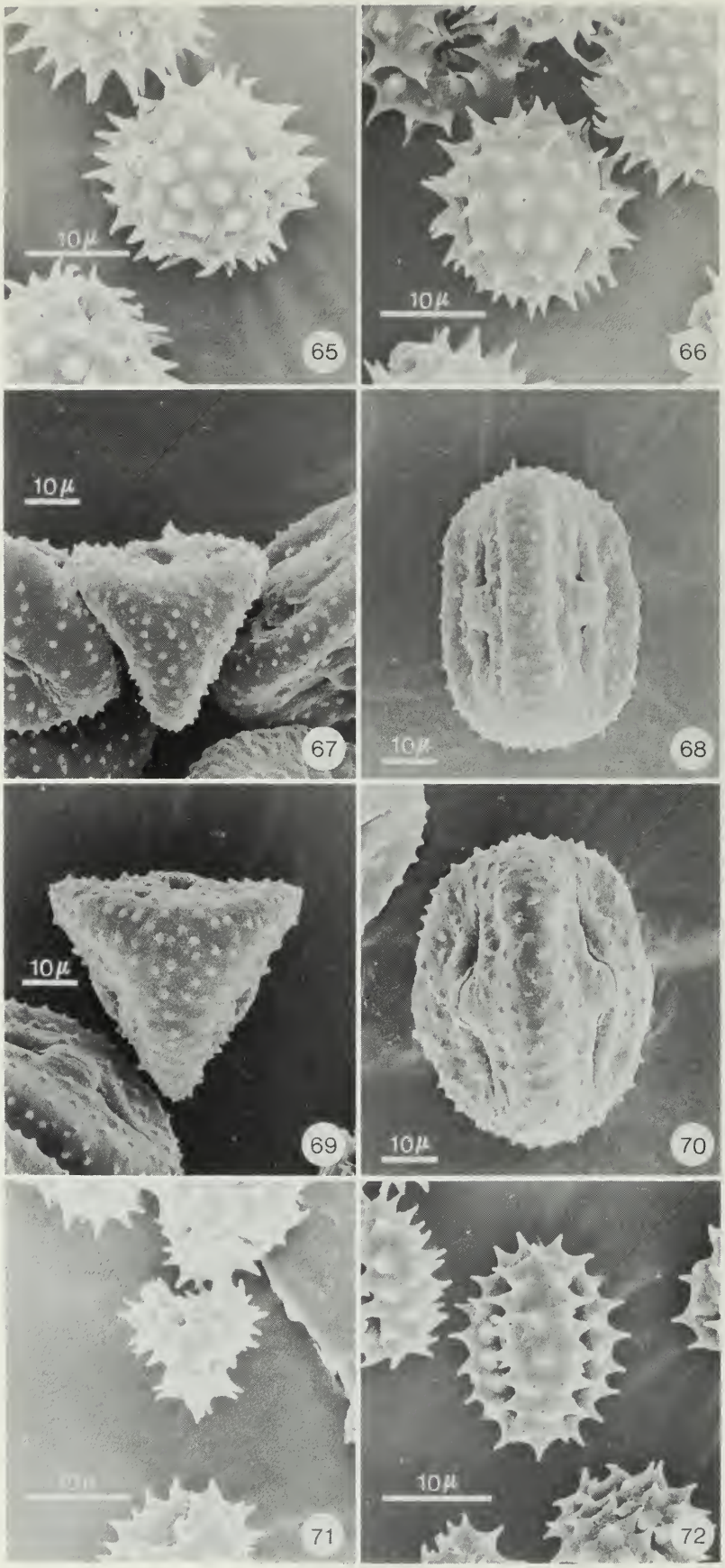

SEM Plate 6 Figs. 41, 42: *Viburnum opulus*; Figs. 43, 44: *V. plicatum*; Figs. 45, 46: *V. prunifolium*; Figs. 47, 48: *Aster novae-angliae*.



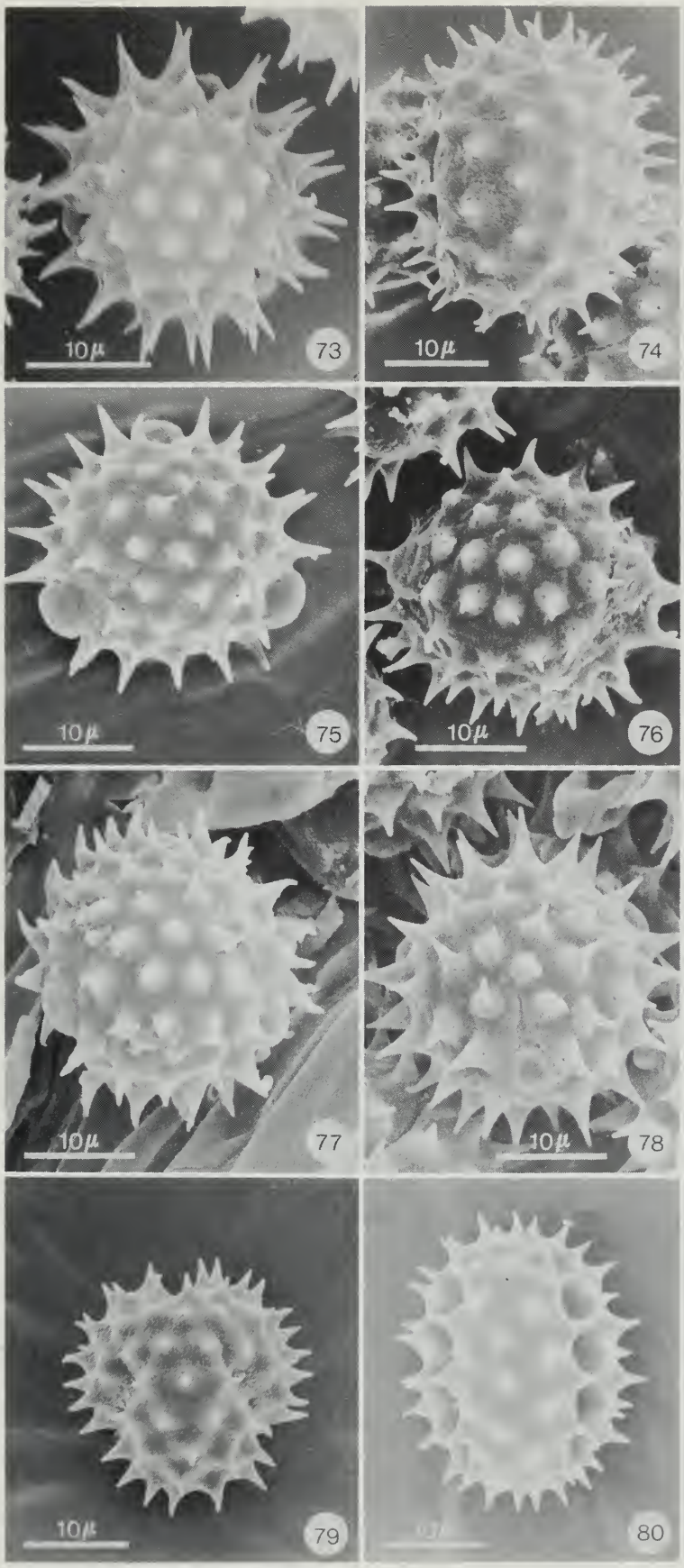

SEM Plate 7 Figs. 49, 50: *Centaurea cyanus*; Figs. 51, 52: *C. diffusa*; Figs. 53, 54: *C. maculosa*; Figs. 55, 56: *C. montana*.



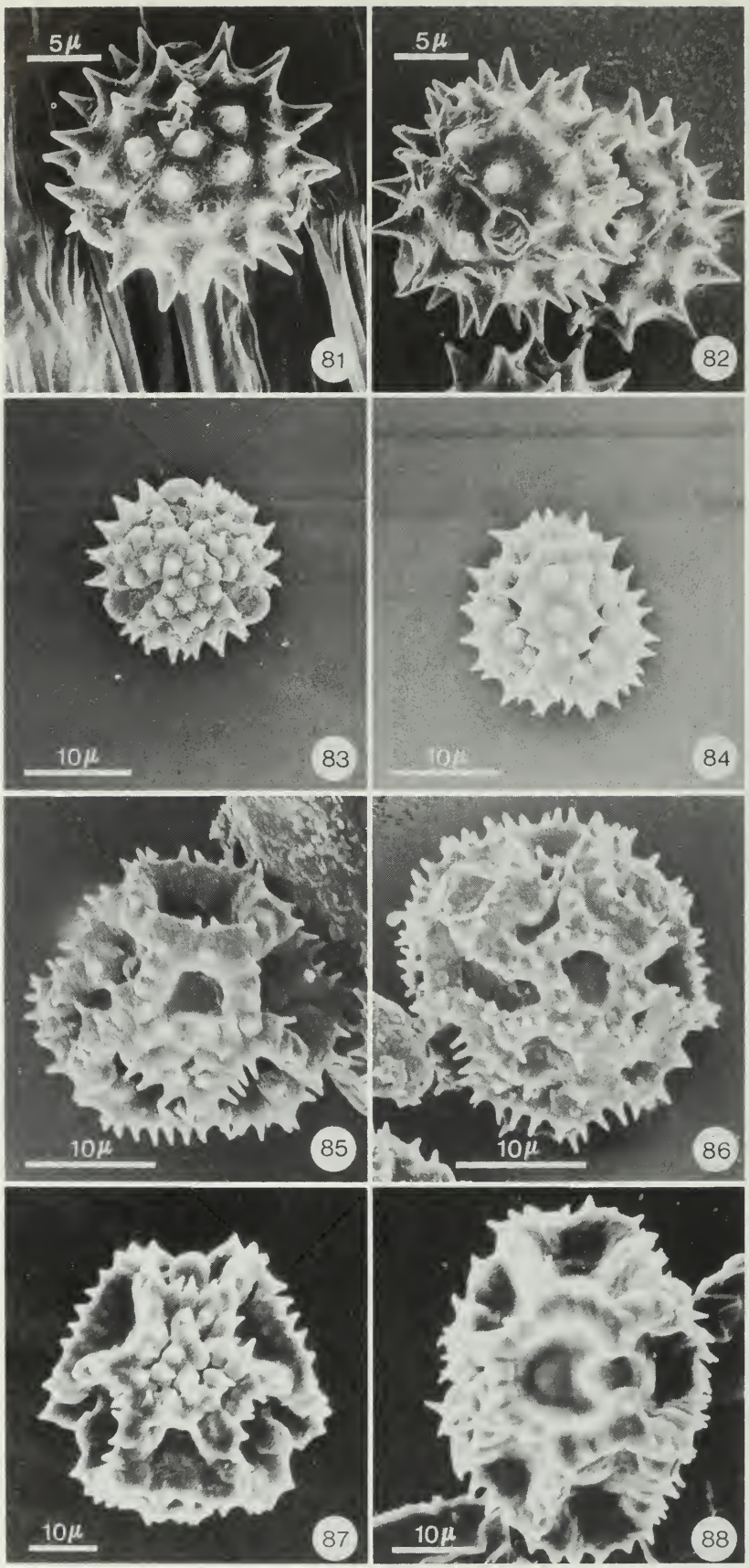

SEM Plate 8 Figs. 57, 58: *Cichorium endiva*; Figs. 59, 60: *C. intybus*; Figs. 61, 62: *Cirsium muticum*; Figs. 63, 64: *C. vulgare*.



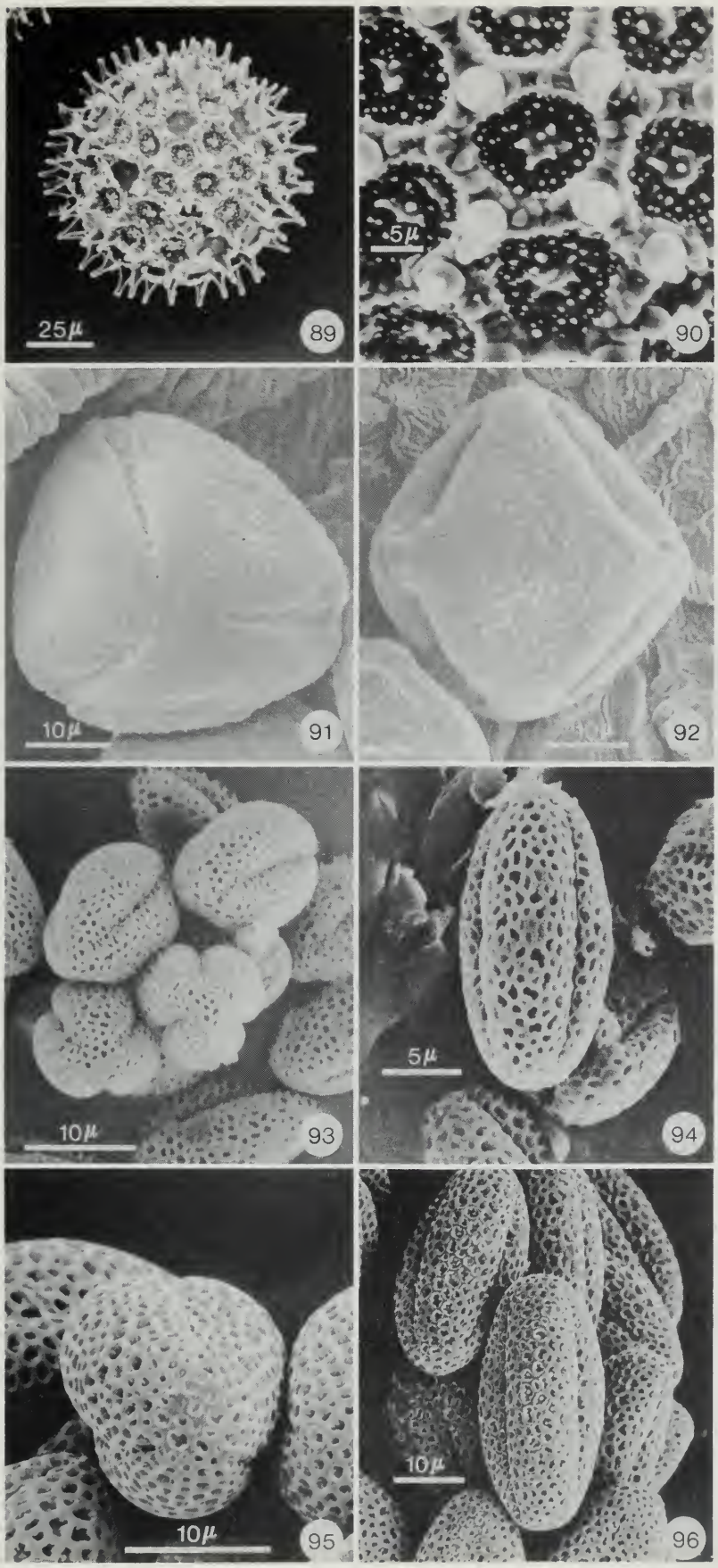

SEM Plate 9 Figs. 65, 66: *Cosmos bipinnatus*; Figs. 67, 68: *Echinops exaltatus*; Figs. 69, 70: *E. sphaerocephalus*; Figs. 71, 72: *Eupatorium perfoliatum*.



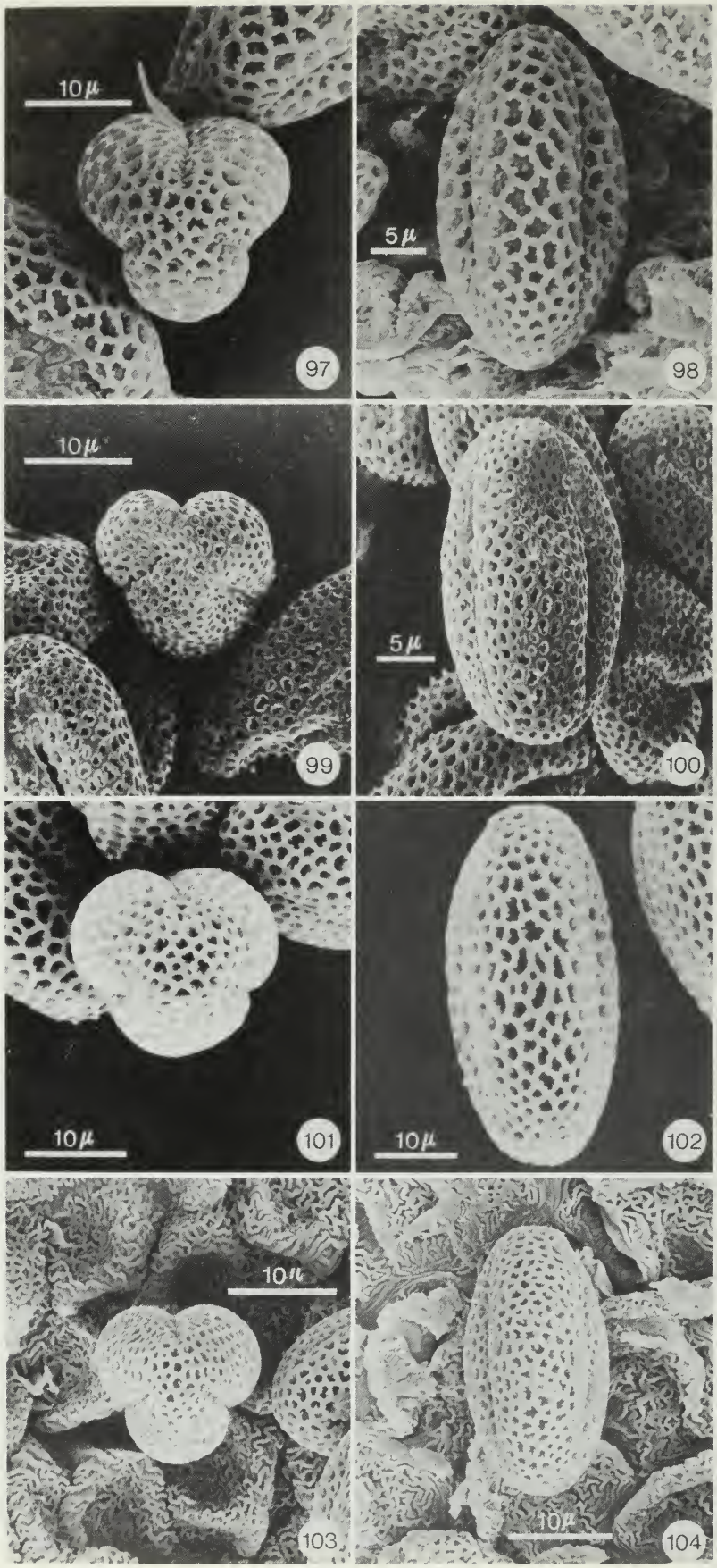

SEM Plate 10 Figs. 73, 74: *Helianthus annuus*; Figs. 75, 76: *H. petiolaris*; Figs. 77, 78: *H. salicifolius*; Figs. 79, 80: *Liatris cylindracea*.



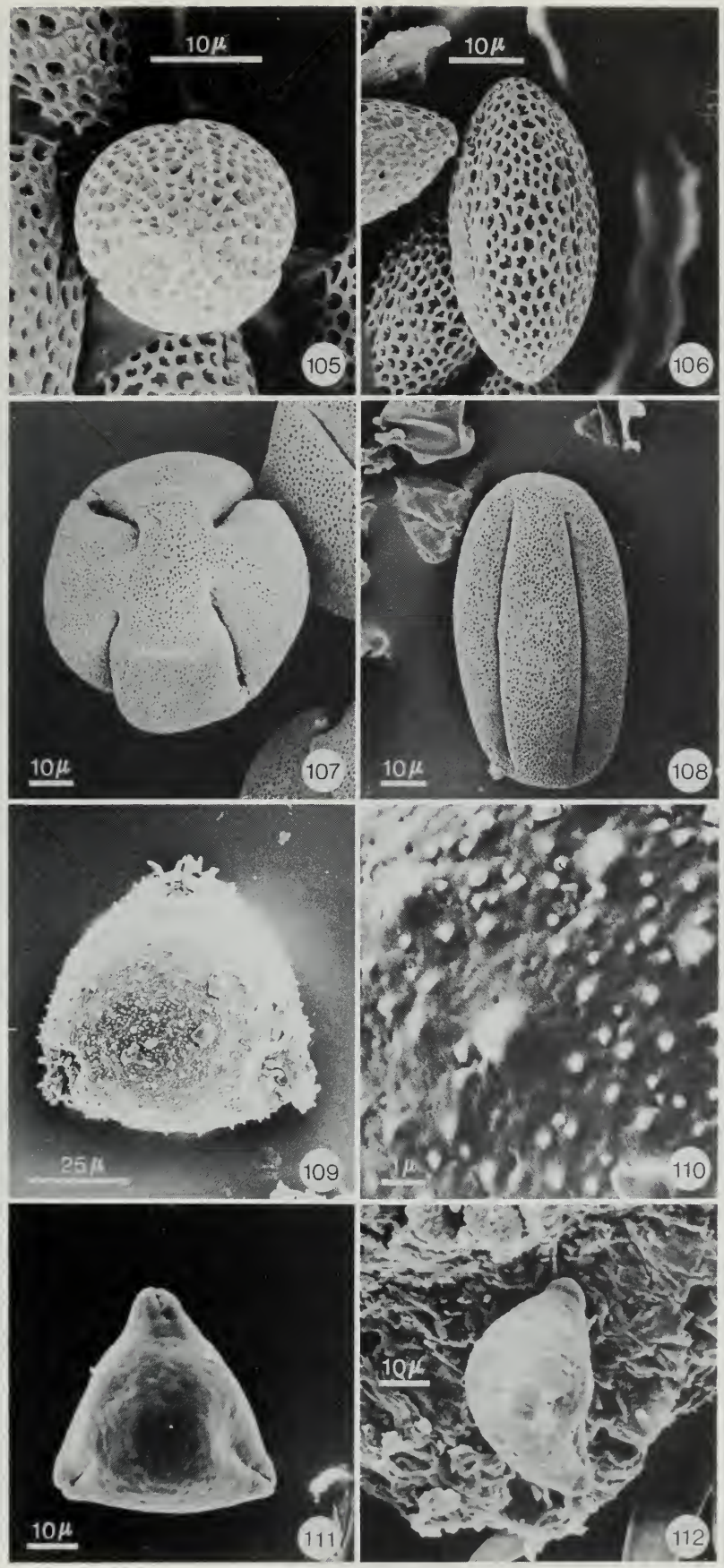

SEM Plate 11 Figs. 81, 82: *Rudbeckia hirta*; Figs. 83, 84: *Solidago canadensis*; Figs. 85, 86: *Taraxacum officinale*; Figs. 87, 88: *Tragopogon dubius*.



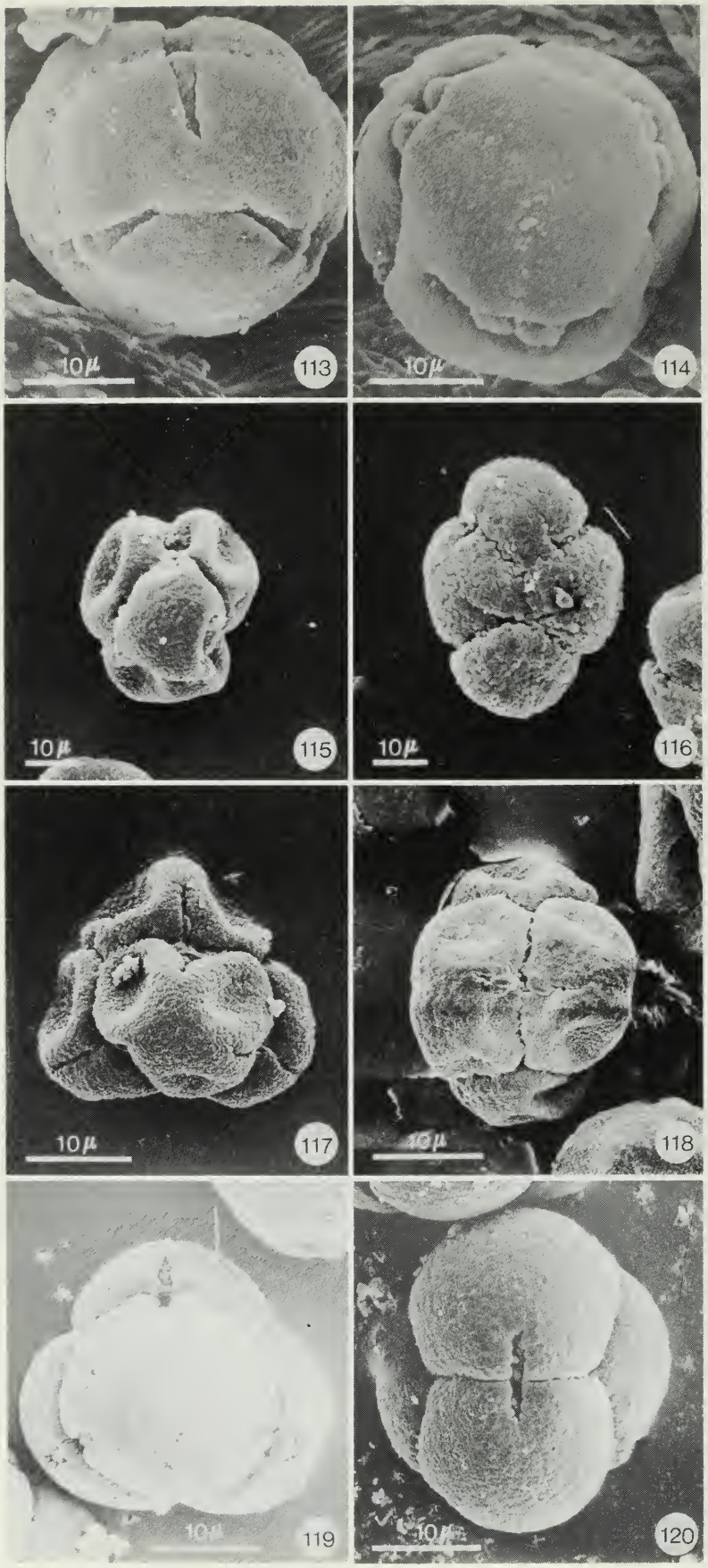

SEM Plate 12 Figs. 89, 90: *Ipomoea purpurea*; Figs. 91, 92: *Cornus stolonifera*; Figs. 93, 94: *Alyssum saxatile*; Figs. 95, 96: *Brassica napus*.



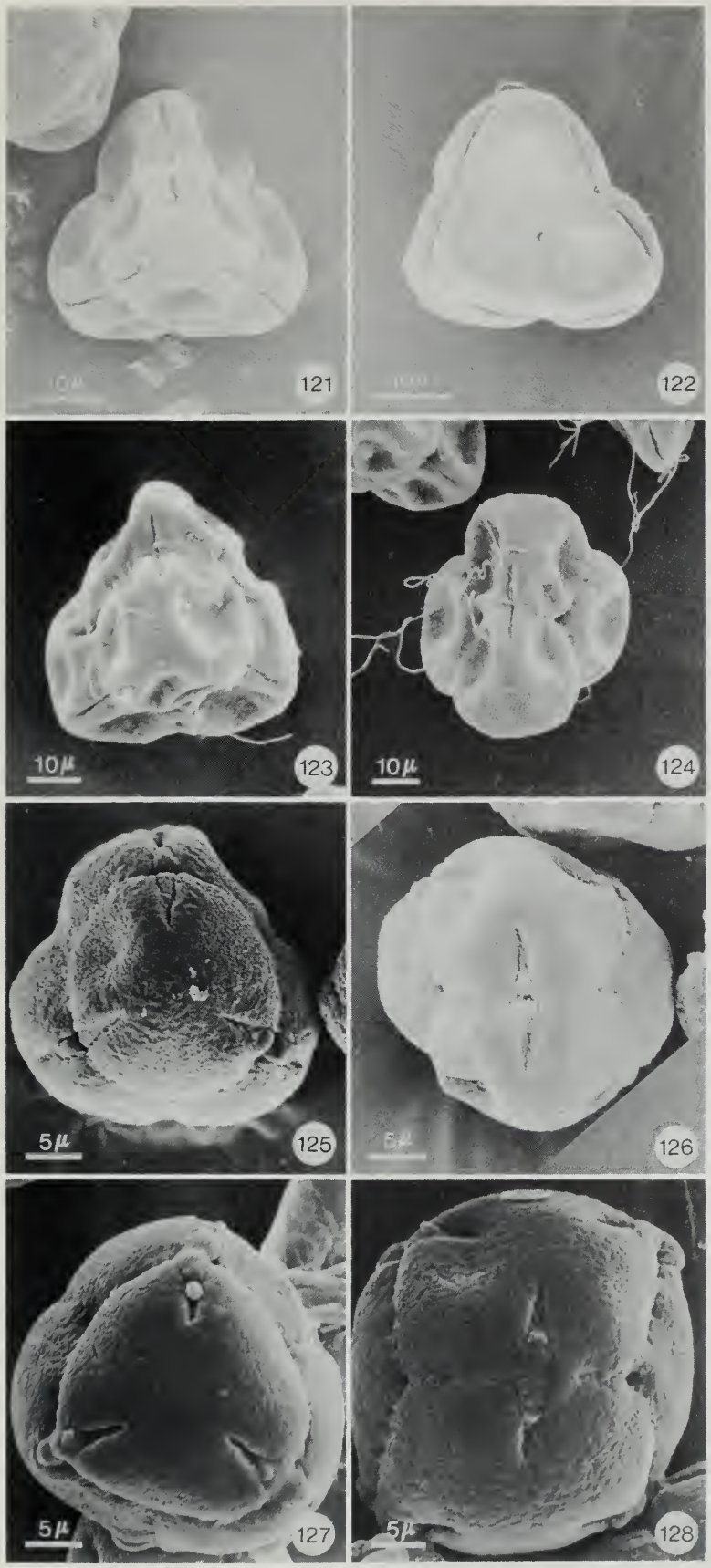

SEM Plate 13 Figs. 97, 98: *Brassica nigra*; Figs. 99, 100: *B. rapa*; Figs. 101, 102: *Diplotaxis tenuifolia*; Figs. 103, 104: *Raphanus raphanistrum*.



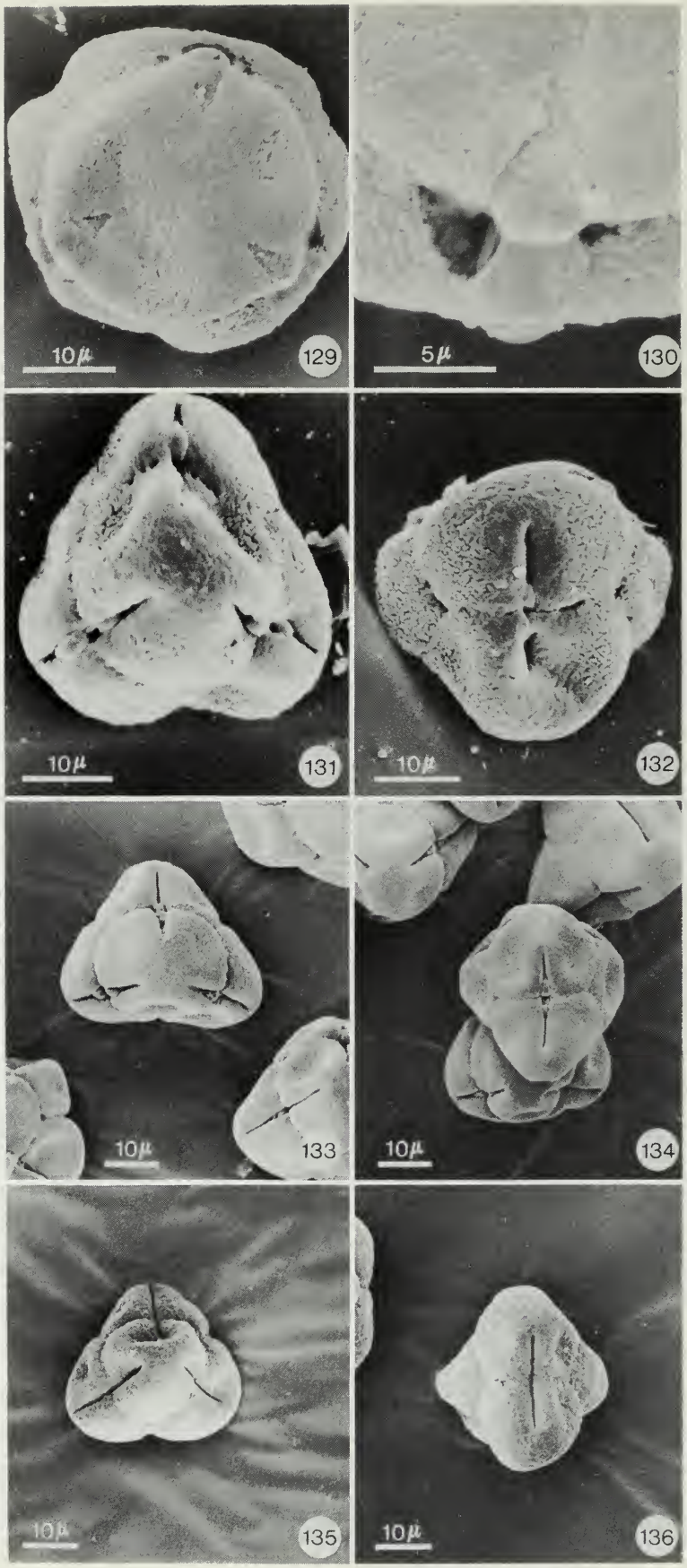

SEM Plate 14 Figs. 105, 106: *Sinapis alba*; Figs. 107, 108: *Echinocystis lobata*; Figs. 109, 110: *Dipsacus sylvestris*; Figs. 111, 112: *Elaeagnus commutata*.



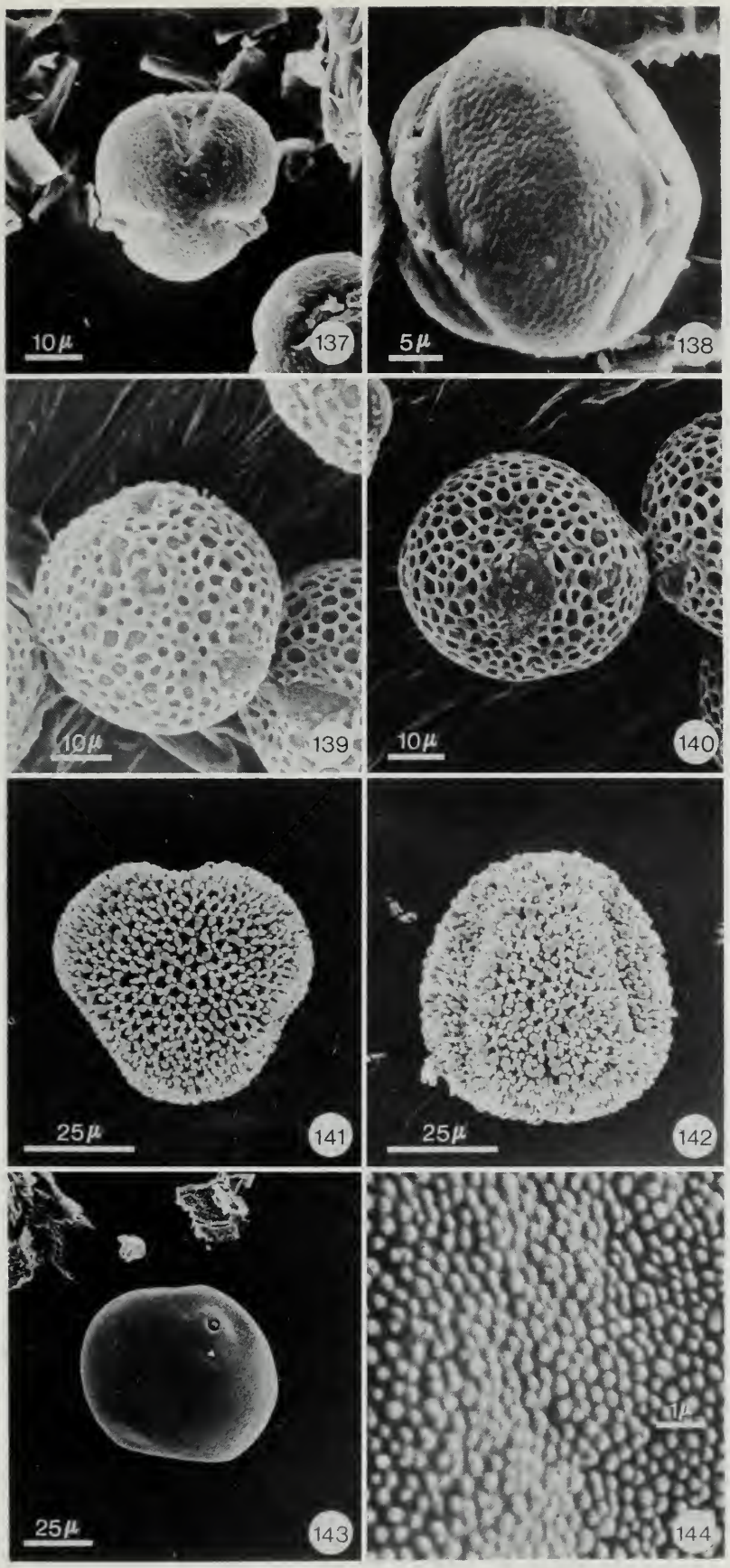

SEM Plate 15 Figs. 113, 114: *Arctostaphylos uva-ursi*; Figs. 115, 116: *Calluna vulgaris*; Figs. 117, 118: *Kalmia angustifolia*; Figs. 119, 120: *K. latifolia*.




SEM Plate 16 Figs. 121, 122: *Ledum groenlandicum*; Figs. 123, 124: *Rhododendron canadense*; Figs. 125, 126: *Vaccinium angustifolium*; Figs. 127, 128: *V. arboreum*.

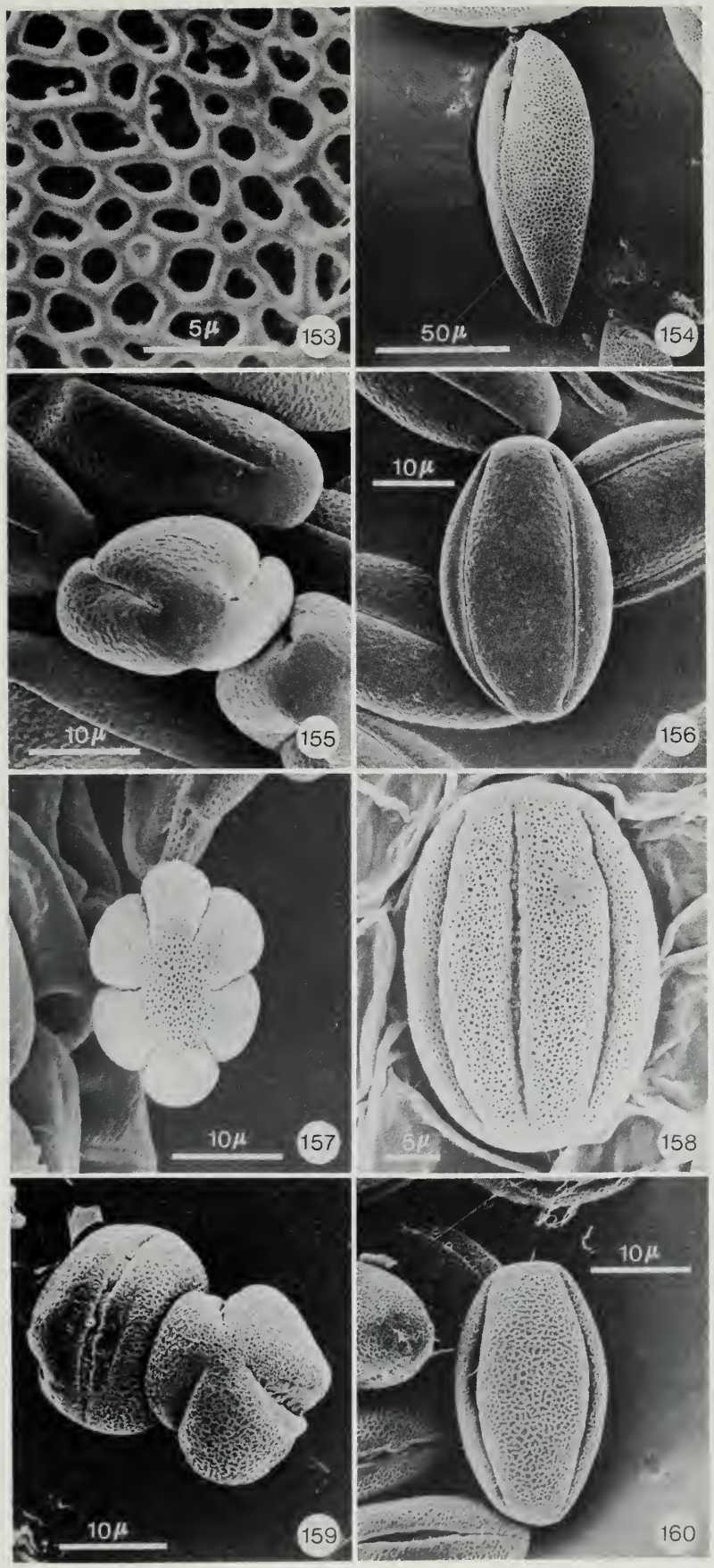



SEM Plate 17 Figs. 129, 130: *Vaccinium corymbosum*; Figs. 131, 132: *V. macrocarpon*; Figs. 133, 134: *V. myrtilloides*; Figs. 135, 136: *V. vitis-idaea*.

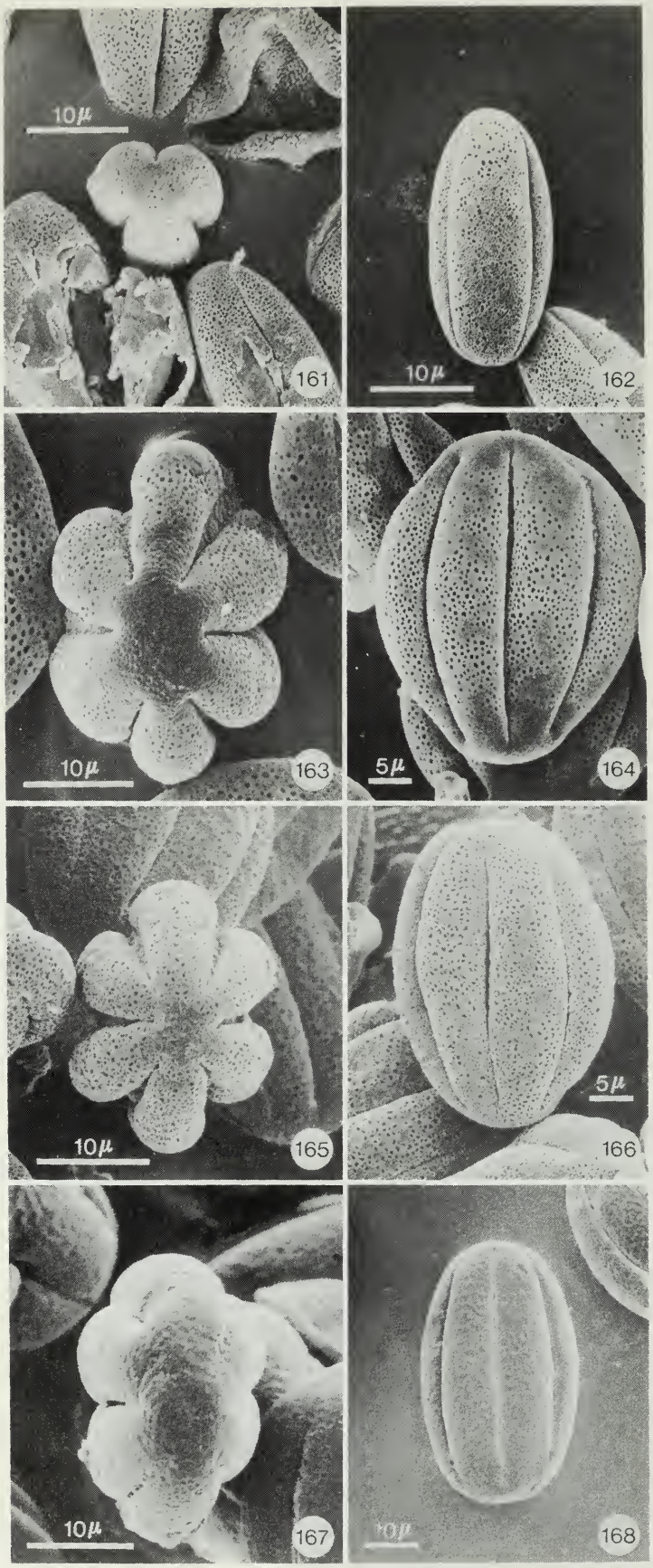



SEM Plate 18 Figs. 137, 138: *Euphorbia esula*; Figs. 139, 140: *Gentianella crinata*; Figs. 141, 142: *Geranium bicknelli*; Figs. 143, 144: *Zea mays*.

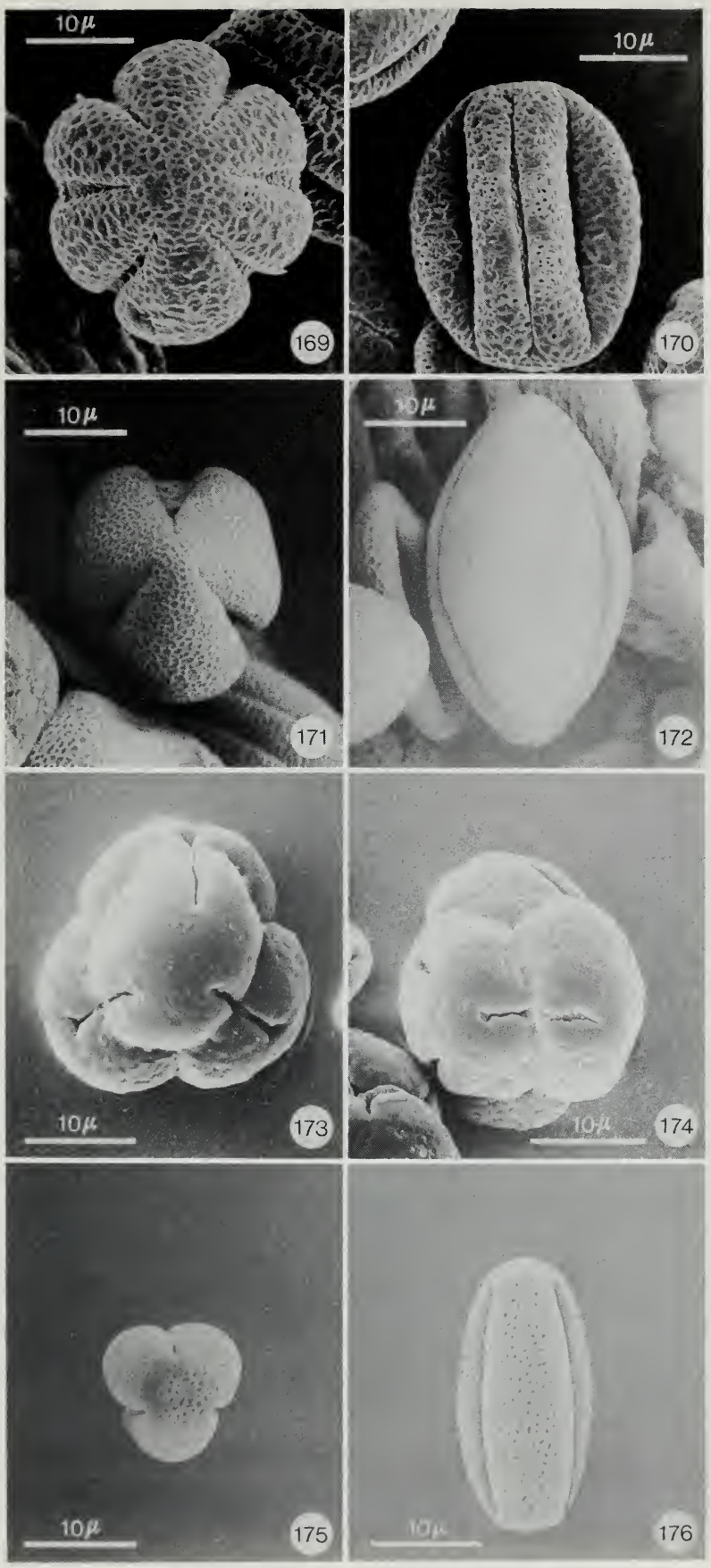

SEM Plate 19 Figs. 145, 146: *Hamamelis virginiana*; Figs. 147, 148: *Aesculus hippocastaneum*; Figs. 149, 150: *Phacelia linearis*; Figs. 151, 152: *Hypericum perforatum*.



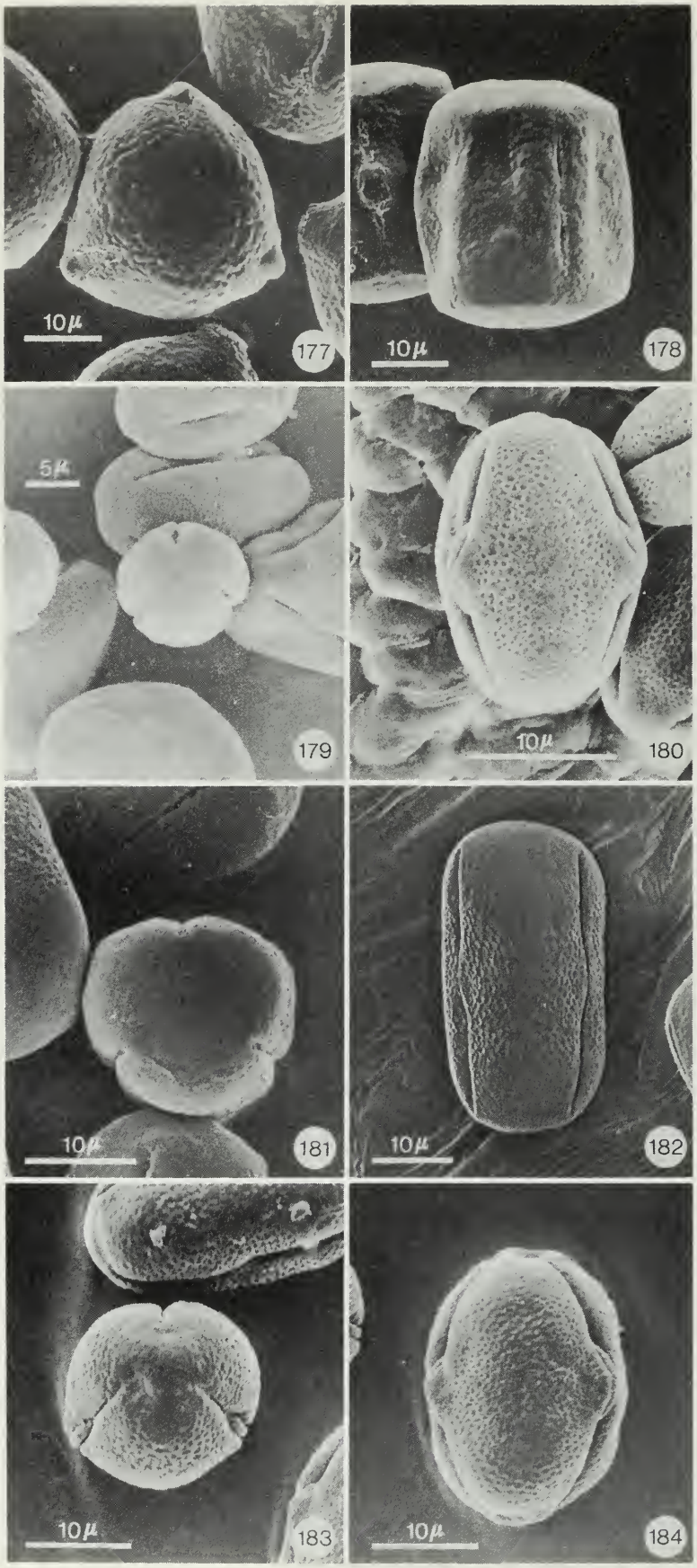

SEM Plate 20 Figs. 153, 154: *Iris versicolor*; Figs. 155, 156: *Ajuga reptans*; Figs. 157, 158: *Dracocephalum parviflorum* ; Figs. 159, 160: *Leonurus cardiaca*.



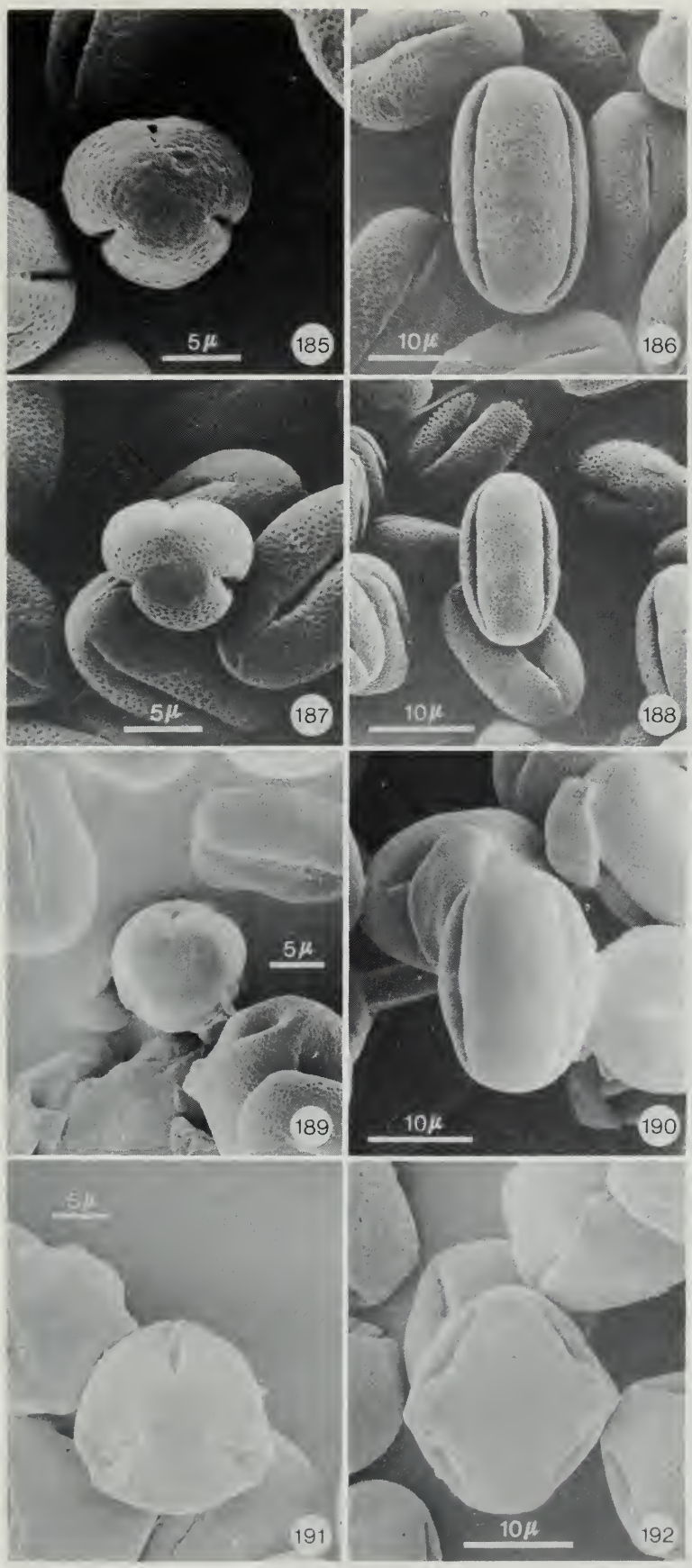

SEM Plate 21 Figs. 161, 162: *Mentha spicata*; Figs. 163, 164: *Monarda fistulosa*; Figs. 165, 166: *Nepeta cataria*; Figs. 167, 168: *Prunella vulgaris*.



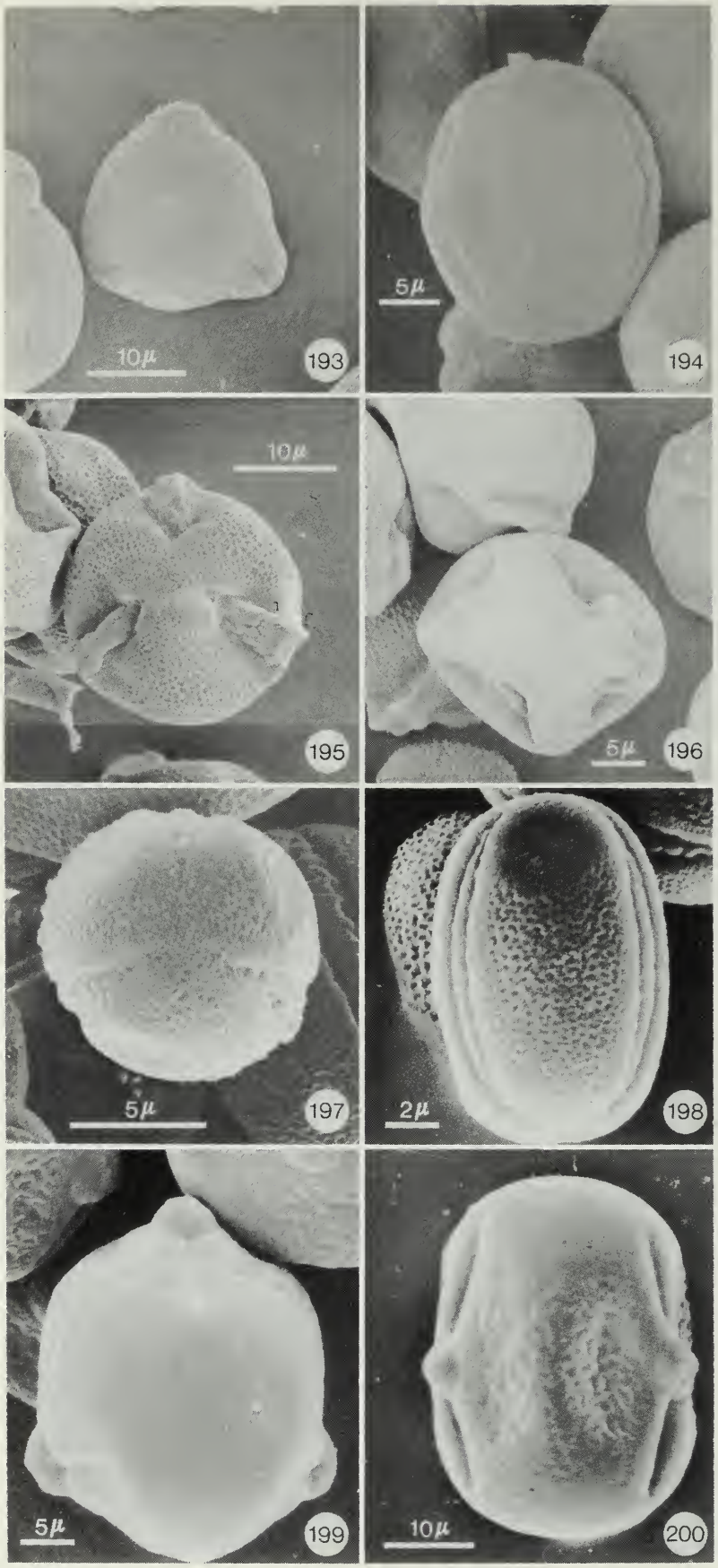

SEM Plate 22 Figs. 169, 170: *Salvia officinalis*; Figs. 171, 172: *Stachys palustris*; Figs. 173, 174: *Loiseleuria procumbens*; Figs. 175, 176: *Amorpha fruticosa*.



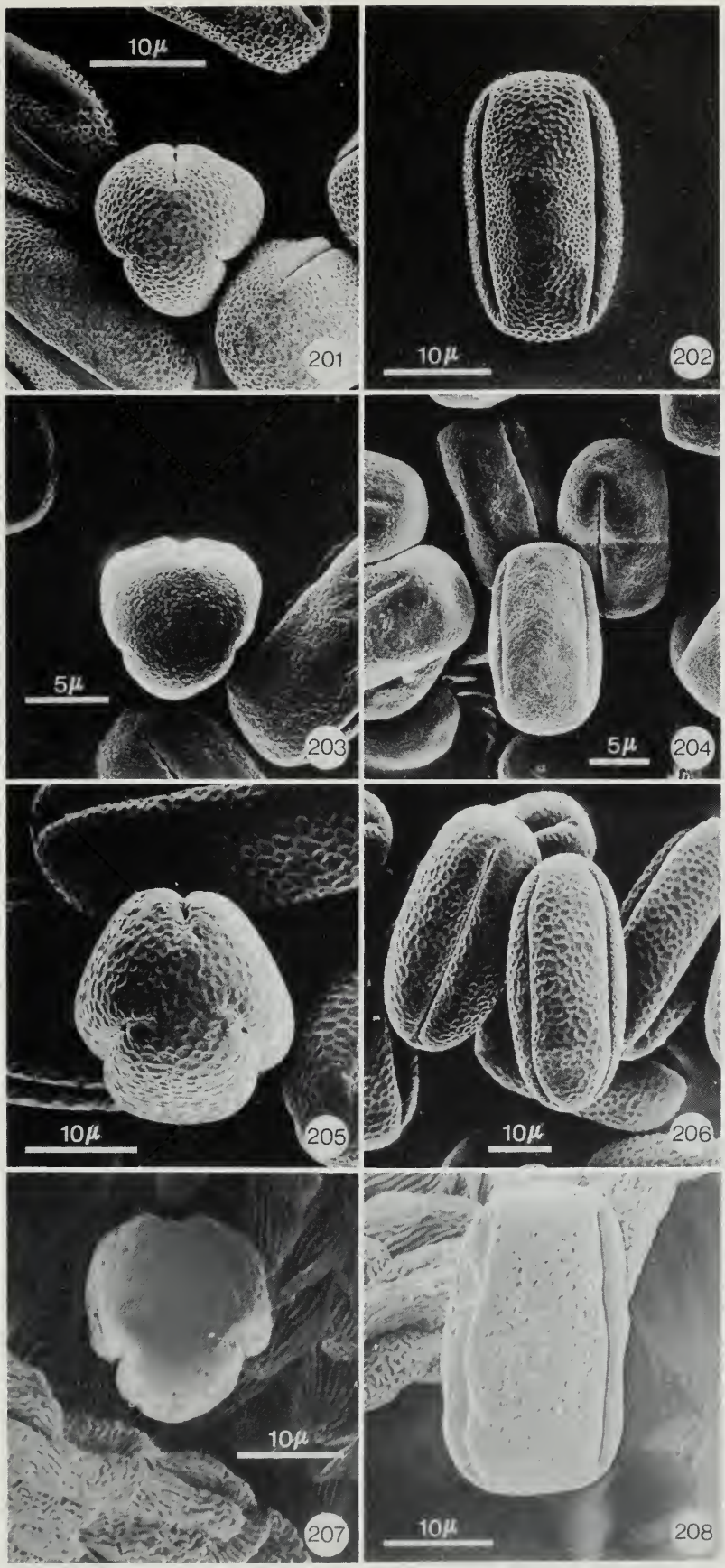

SEM Plate 23 Figs. 177, 178: *Anthyllis vulneraria*; Figs. 179, 180: *Astragalus alpinus*; Figs. 181, 182: *A. cicer*; Figs. 183, 184: *A. striatus*.



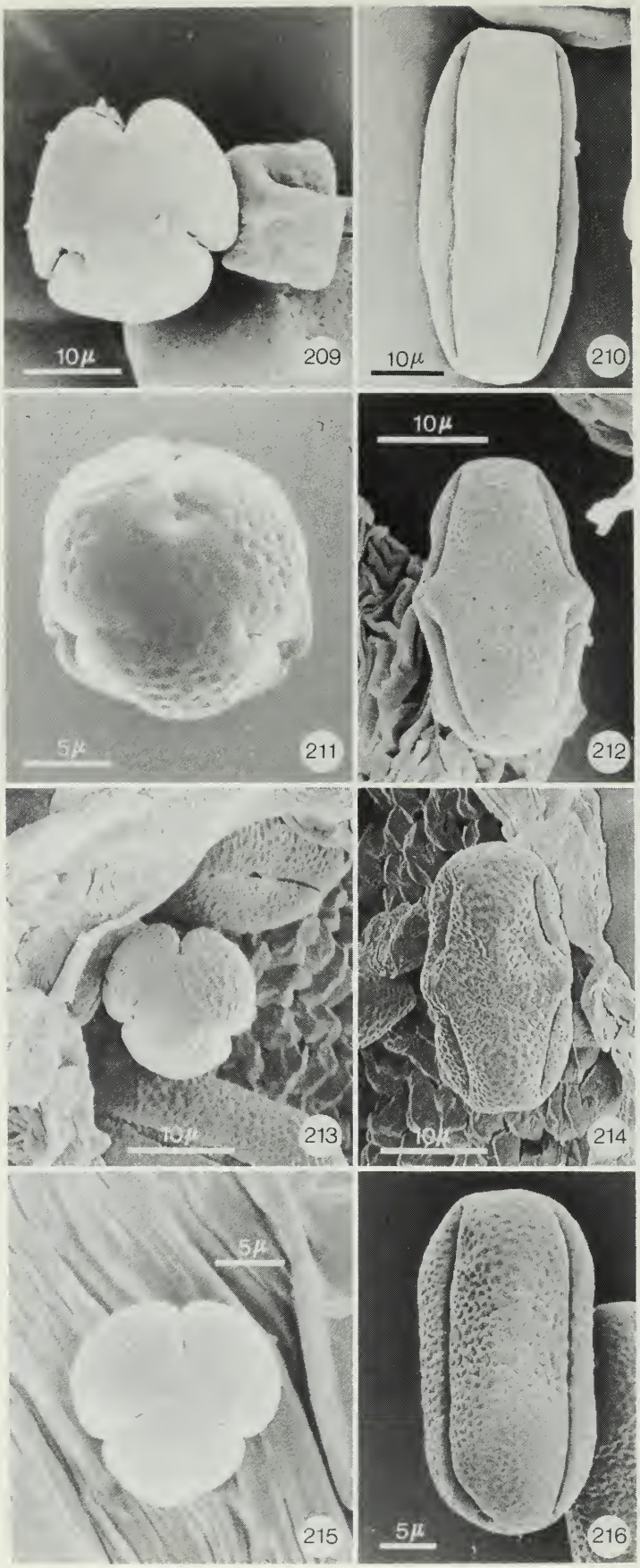

SEM Plate 24 Figs. 185, 186: *Baptisia australis*; Figs. 187, 188: *B. tinctoria*; Figs. 189, 190: *Caragana arborescens*; Figs. 191, 192: *Cercis canadensis*.



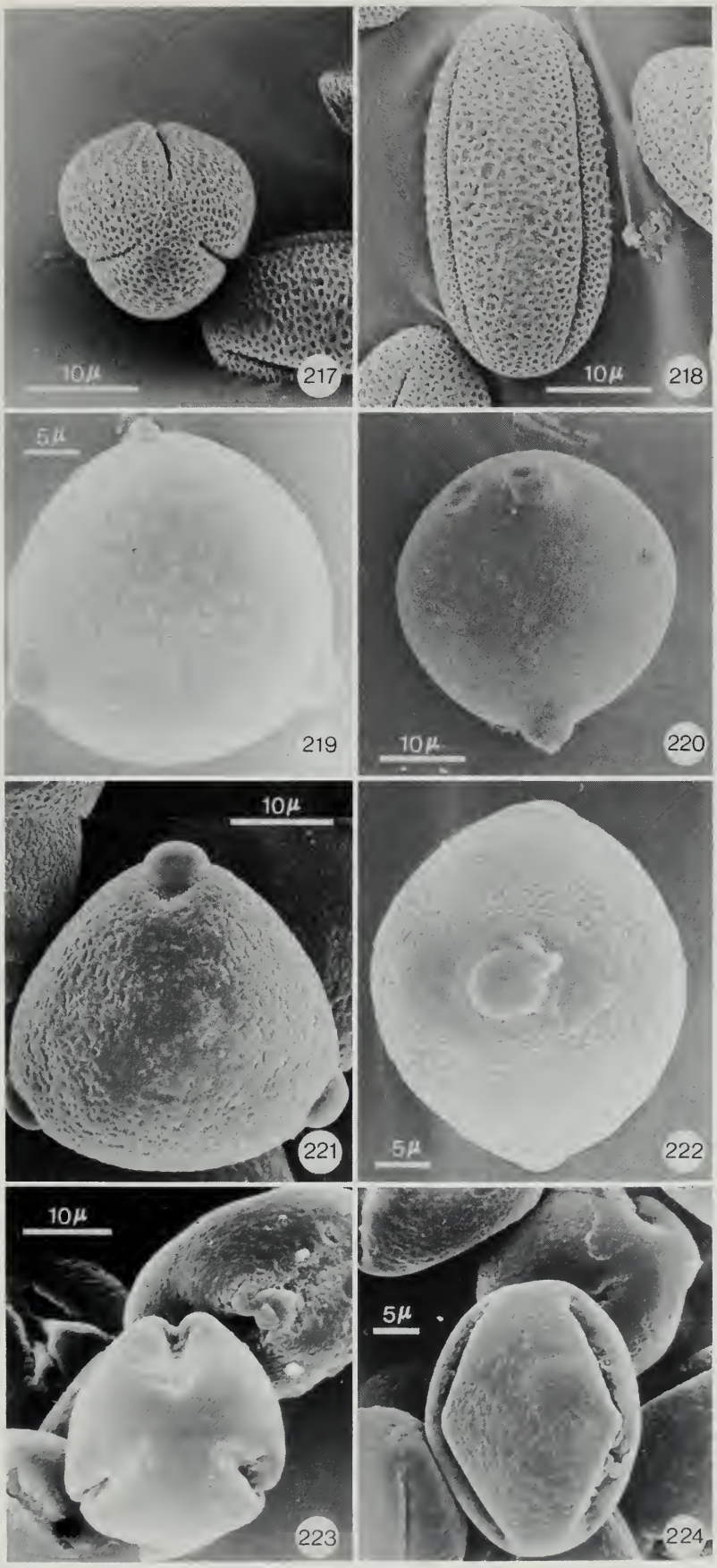

SEM Plate 25 Figs. 193, 194: *Coronilla varia*; Figs. 195, 196: *Cytisus scoparius*; Figs. 197, 198: *Hedysarum boreale*; Figs. 199, 200: *Lathyrus tuberosus*.



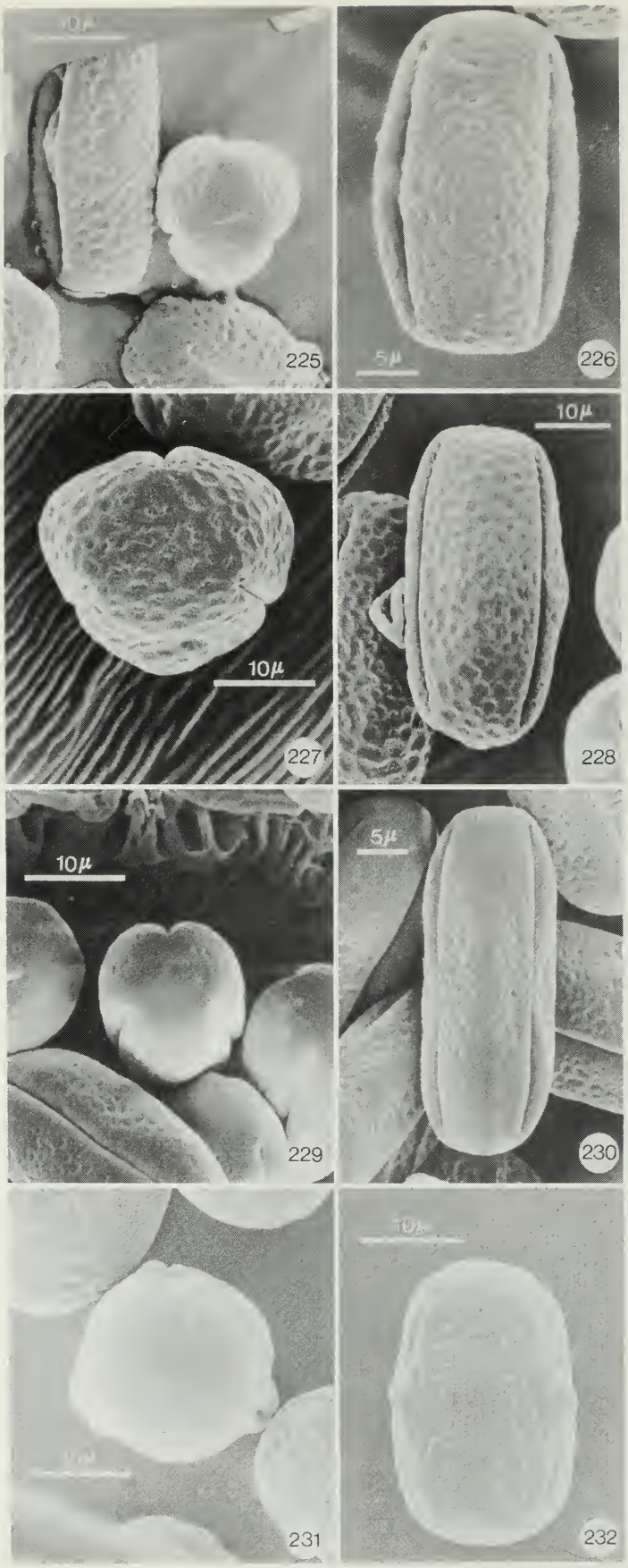

SEM Plate 26 Figs. 201, 202: *Lespedeza bicolor*; Figs. 203, 204: *Lotus corniculatus*; Figs. 205, 206: *Lupinus argenteus*; Figs. 207, 208: *Medicago lupulina*.



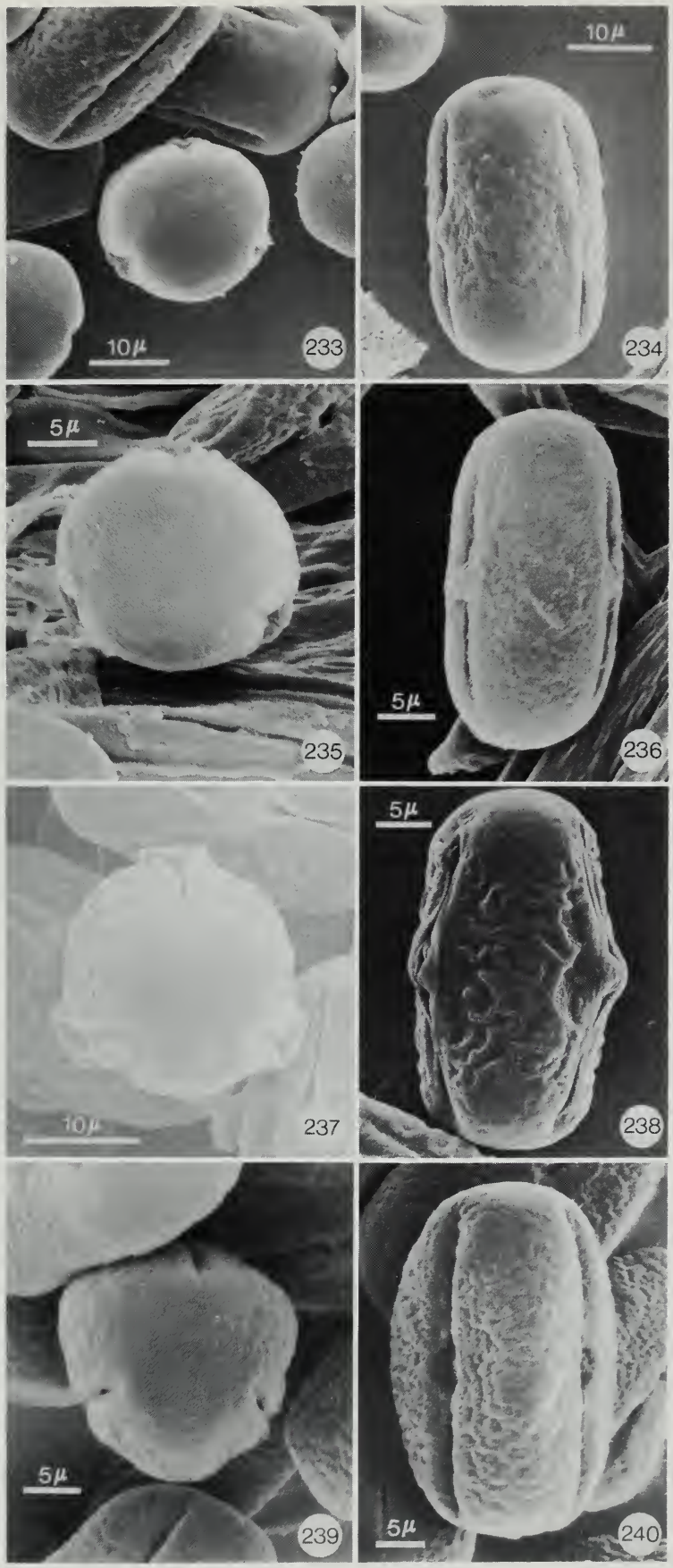

SEM Plate 27 Figs. 209, 210: *Medicago sativa*; Figs. 211, 212: *Melilotus alba*; Figs. 213, 214: *M. indica*; Figs. 215, 216: *M. officinalis*.



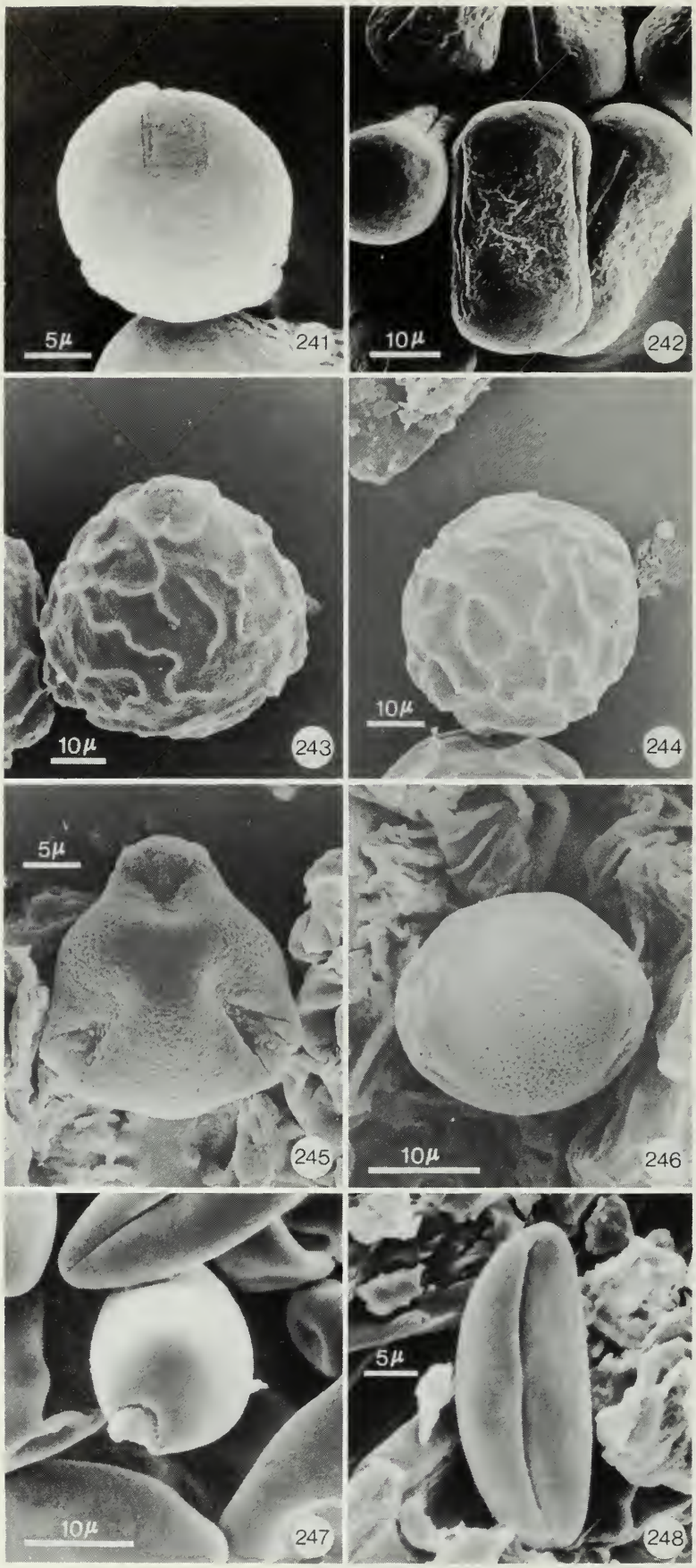

SEM Plate 28 Figs. 217, 218: *Onobrychis viciaefolia*; Figs. 219, 220: *Phaseolus coccineus*; Figs. 221, 222: *P. vulgaris*; Figs. 223, 224: *Robinia pseudo-acacia*.



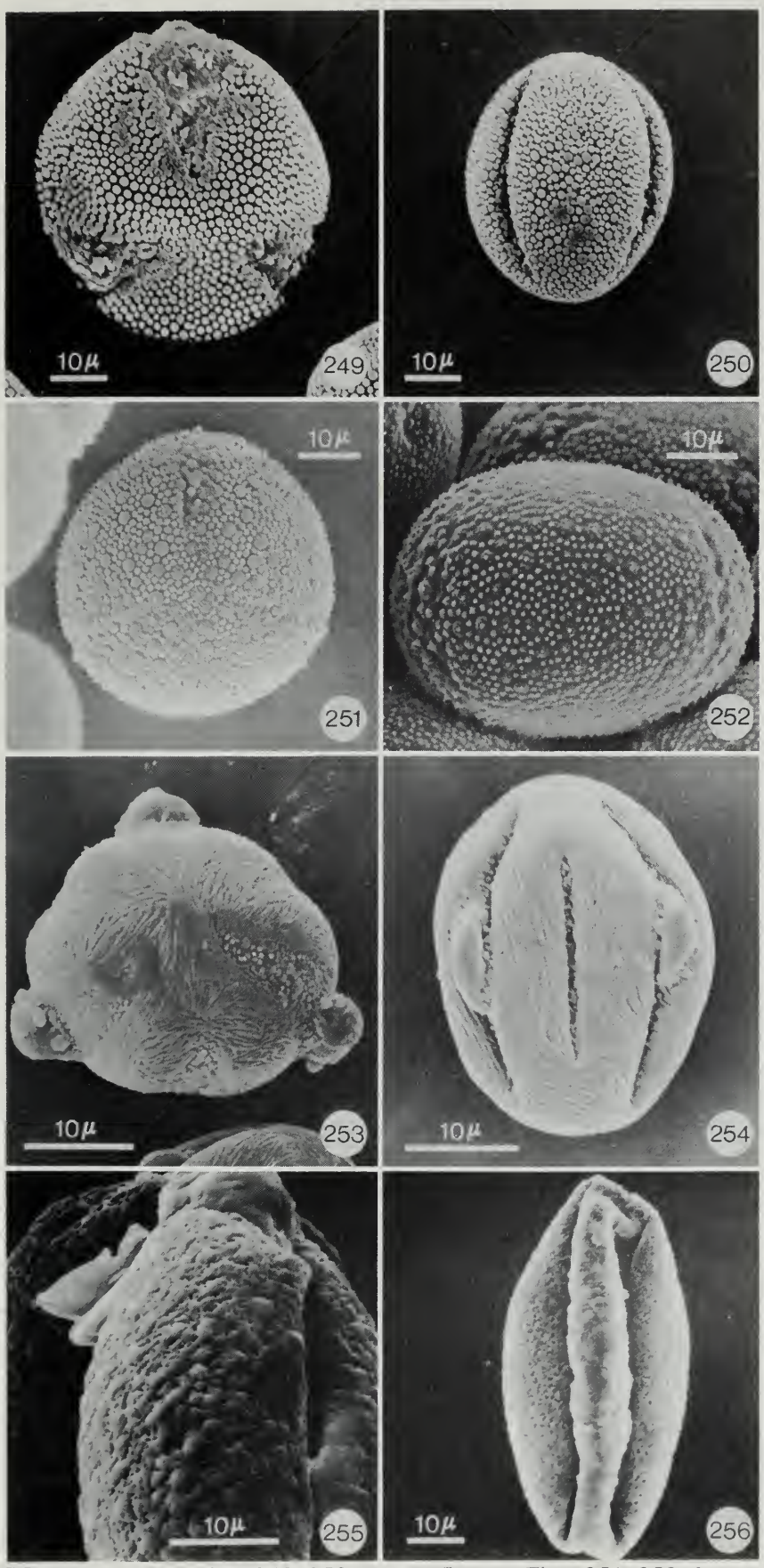

SEM Plate 29 Figs. 225, 226: *Trifolium hybridum*; Figs. 227, 228: *T. pratense* Figs. 229, 230: *T. repens*; Figs. 231, 232: *Vicia angustifolia*.



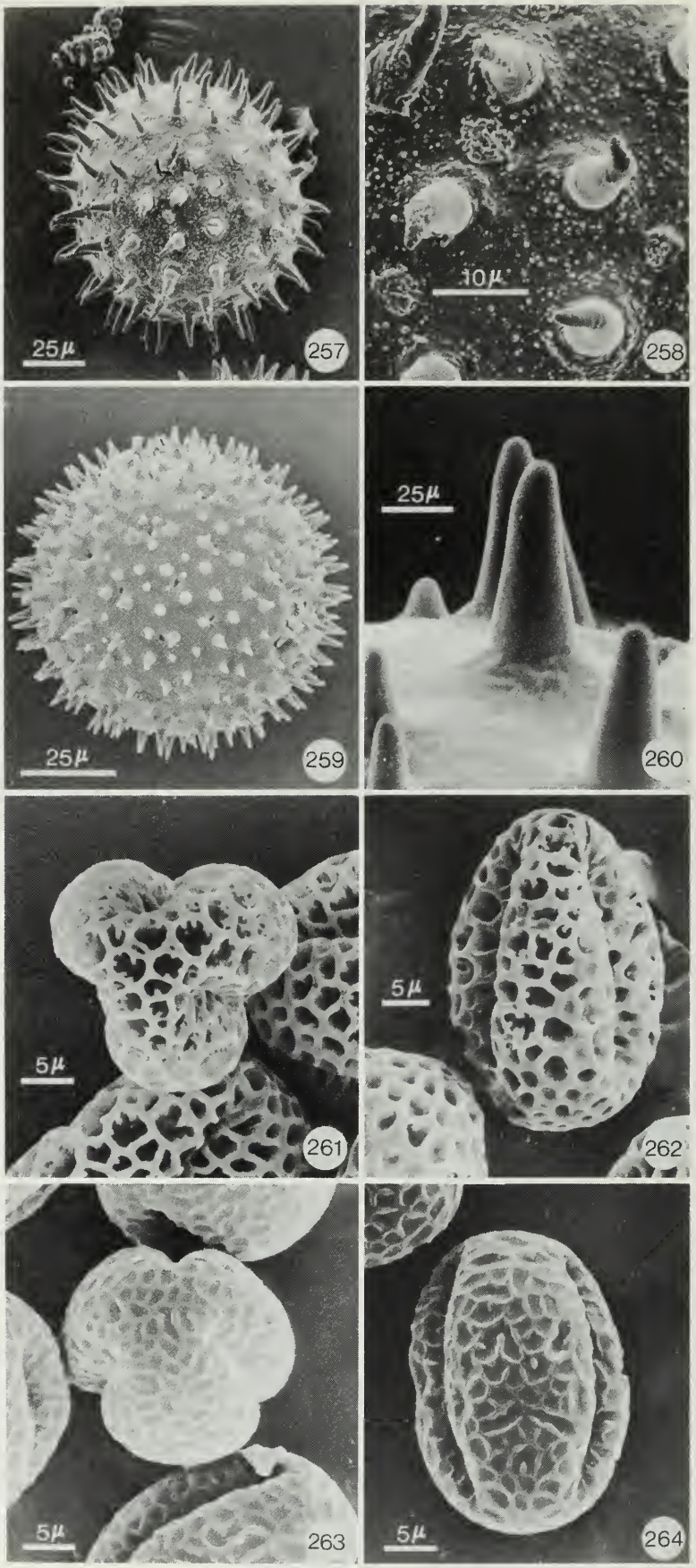

SEM Plate 30 Figs. 233, 234: *Vicia americana*; Figs. 235, 236: *V. cracca*; Figs. 237, 238: *V. faba*; Figs. 239, 240: *V. sativa*.



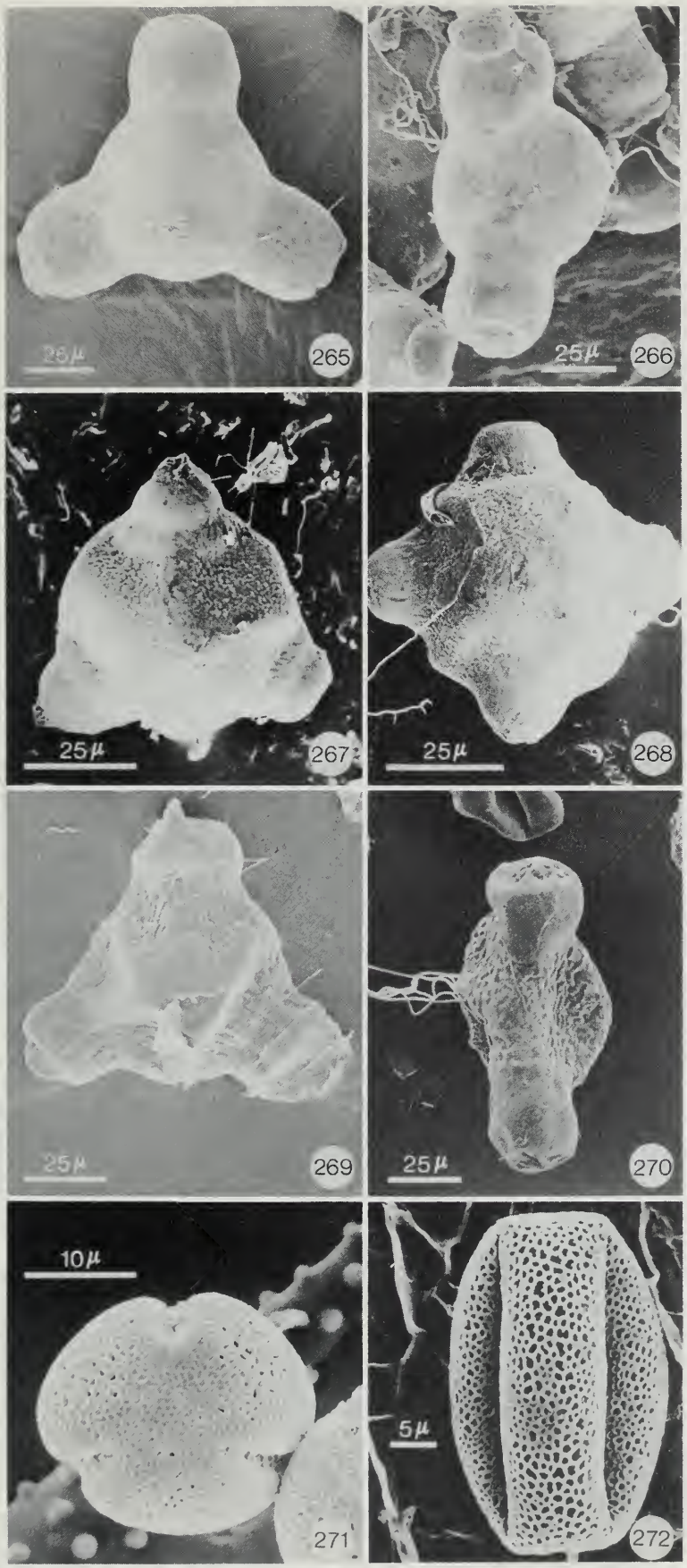

SEM Plate 31 Figs. 241, 242: *Vicia villosa*; Figs. 243, 244: *Vigna sinensis*; Figs. 245, 246: *Wisteria floribunda*; Figs. 247, 248: *Allium cernuum*.



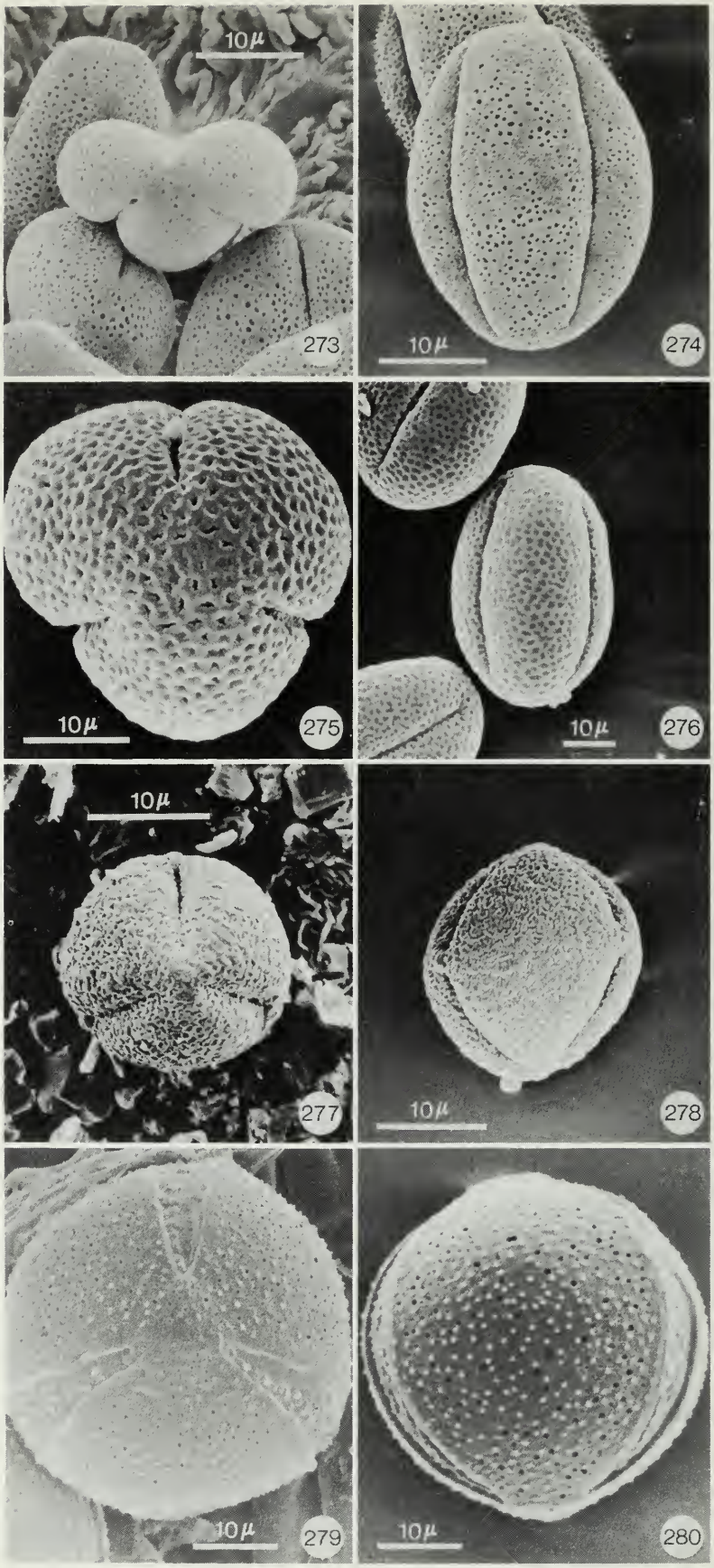

SEM Plate 32 Figs. 249, 250: *Linum flavum*; Figs. 251, 252: *L. perenne*; Figs. 253, 254: *Lythrum salicaria*; Figs. 255, 256: *Liriodendron tulipifera*.



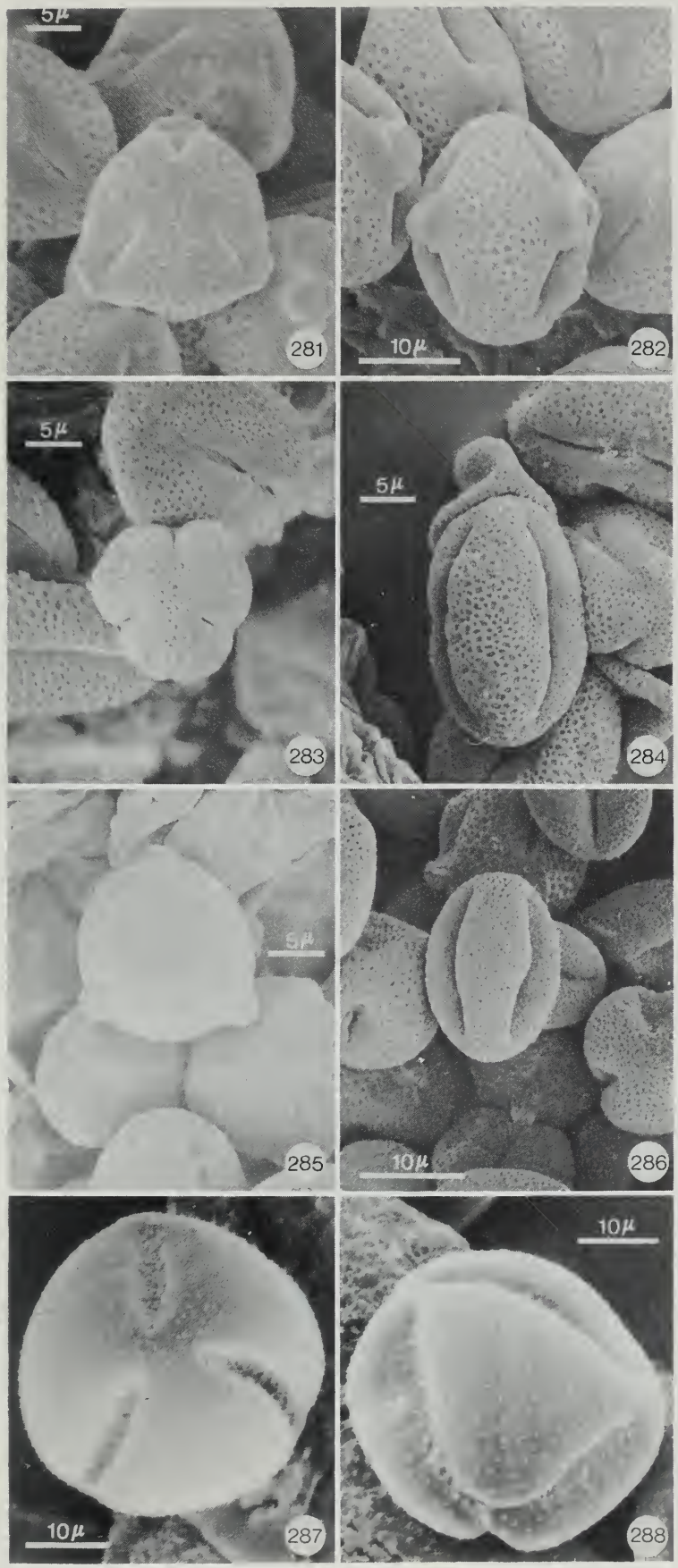

SEM Plate 33 Figs. 257, 258: *Hibiscus trionum*; Figs. 259, 260: *Malva moschata*; Figs. 261, 262: *Ligustrum japonicum*; Figs. 263, 264: *L. vulgare*.



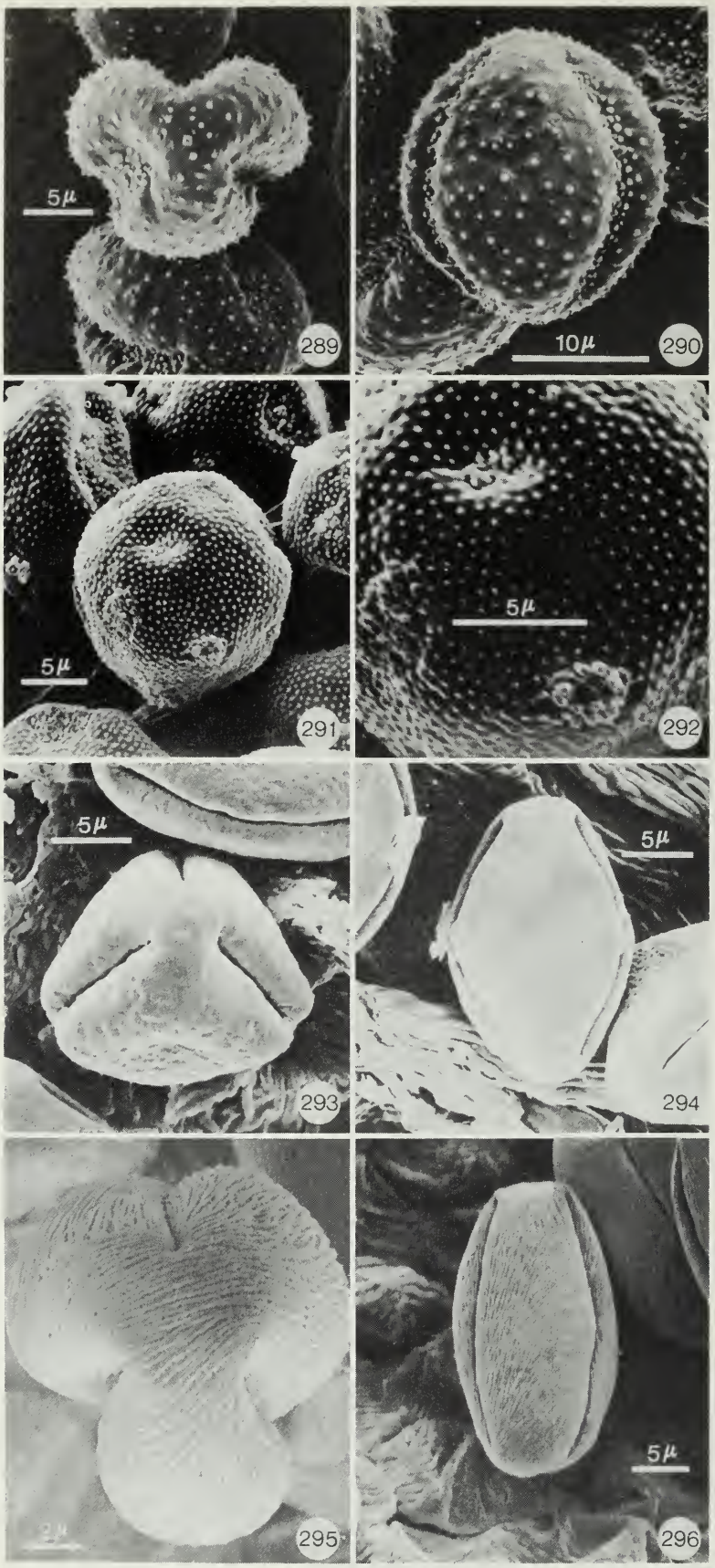

SEM Plate 34 Figs. 265, 266: *Clarkia* sp.; Figs. 267, 268: *Epilobium angustifolium*; Figs. 269, 270: *Oenothera biennis*; Figs. 271, 272: *Oxalis stricta*.



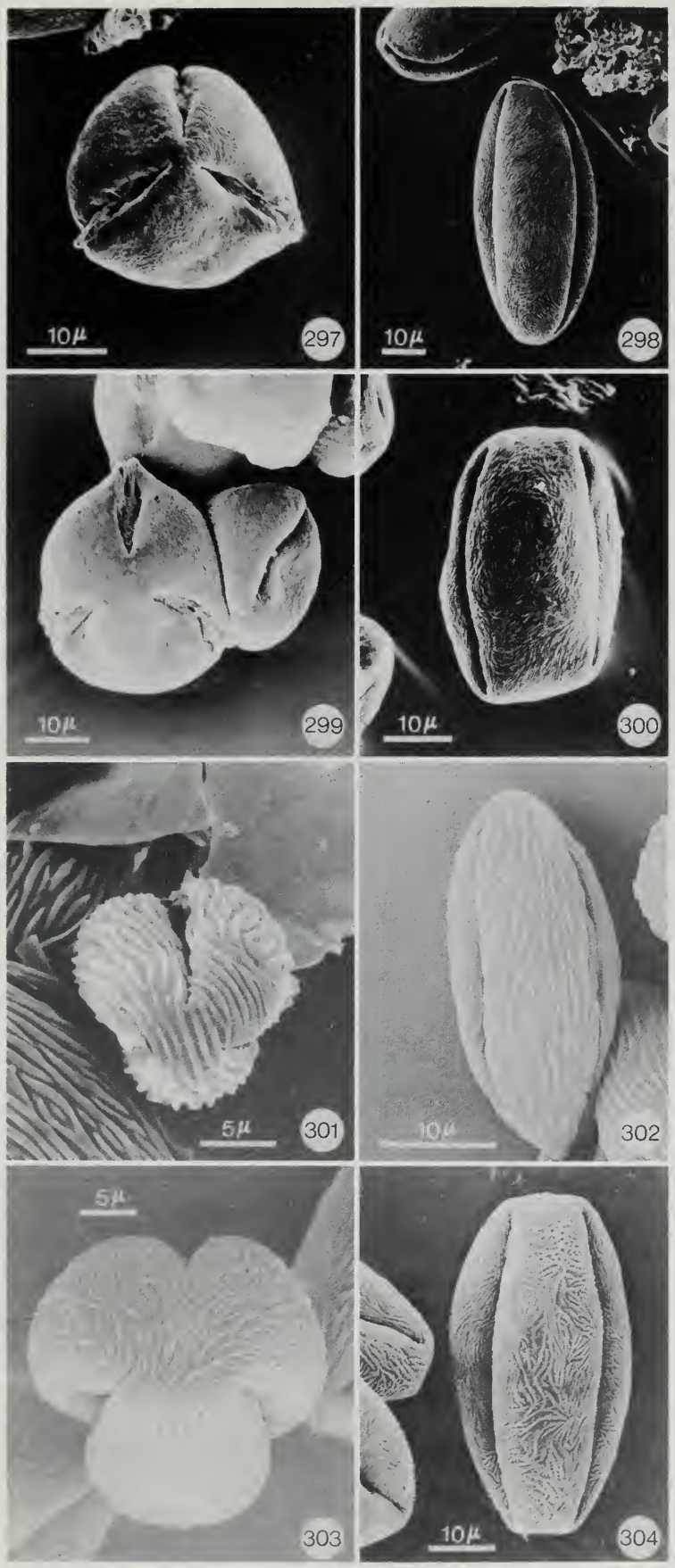

SEM Plate 35 Figs. 273, 274: *Phryma leptostachya*; Figs. 275, 276: *Fagopyrum esculenteum*; Figs. 277, 278: *Polygonum cilinode*; Figs. 279, 280: *Claytonia virginica*.



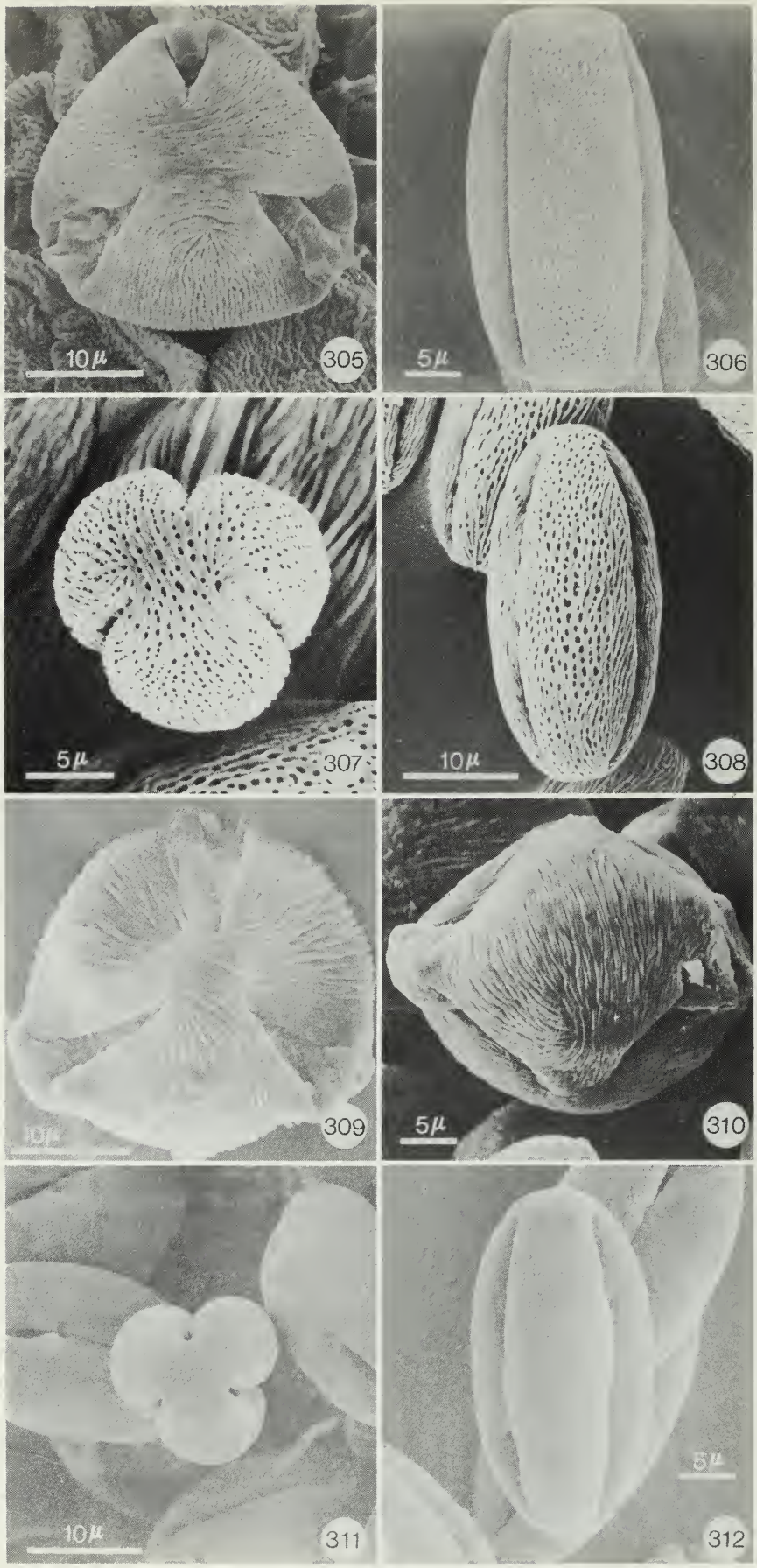

SEM Plate 36 Figs. 281, 282: *Lysimachia punctata*; Figs. 283, 284: *L. terrestris*; Figs. 285, 286: *L. thrysiflora*; Figs. 287, 288: *Anemone patens*.



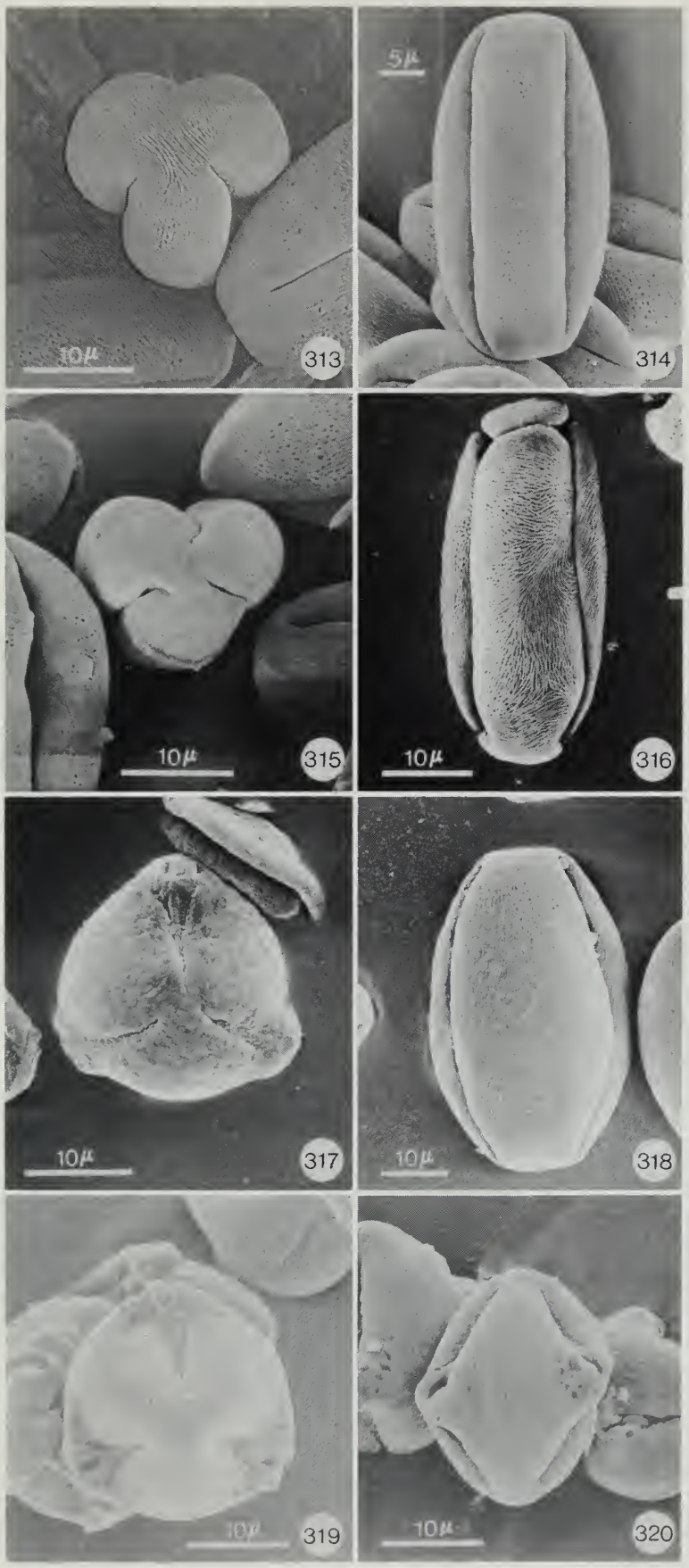

SEM Plate 37 Figs. 289, 290: *Clematis virginiana*; Figs. 291, 292: *Thalictrum occidentale*; Figs. 293, 294: *Rhamnus alnifolia*; Figs. 295, 296: *Amelanchier alnifolia*.




SEM Plate 38 Figs. 297, 298: *Crataegus crus-galli*; Figs. 299, 300: *C. monogyna*; Figs. 301, 302: *Fragaria virginiana*; Figs. 303, 304: *Prunus domestica*.

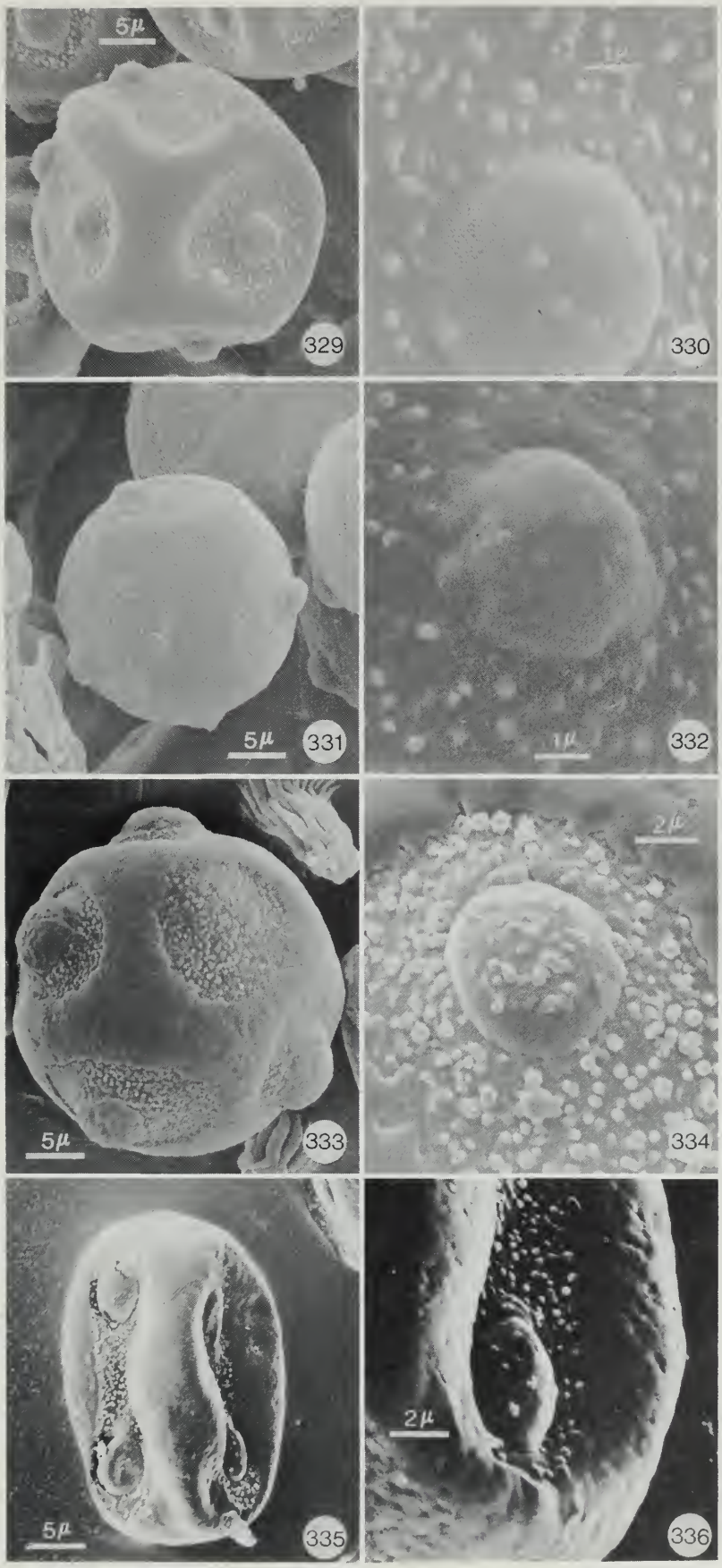



SEM Plate 39 Figs. 305, 306: *Prunus pensylvanica*; Figs. 307, 308: *P. serotina*; Figs. 309, 310: *P. serrulata*; Figs. 311, 312: *Pyrus aucuparia*.

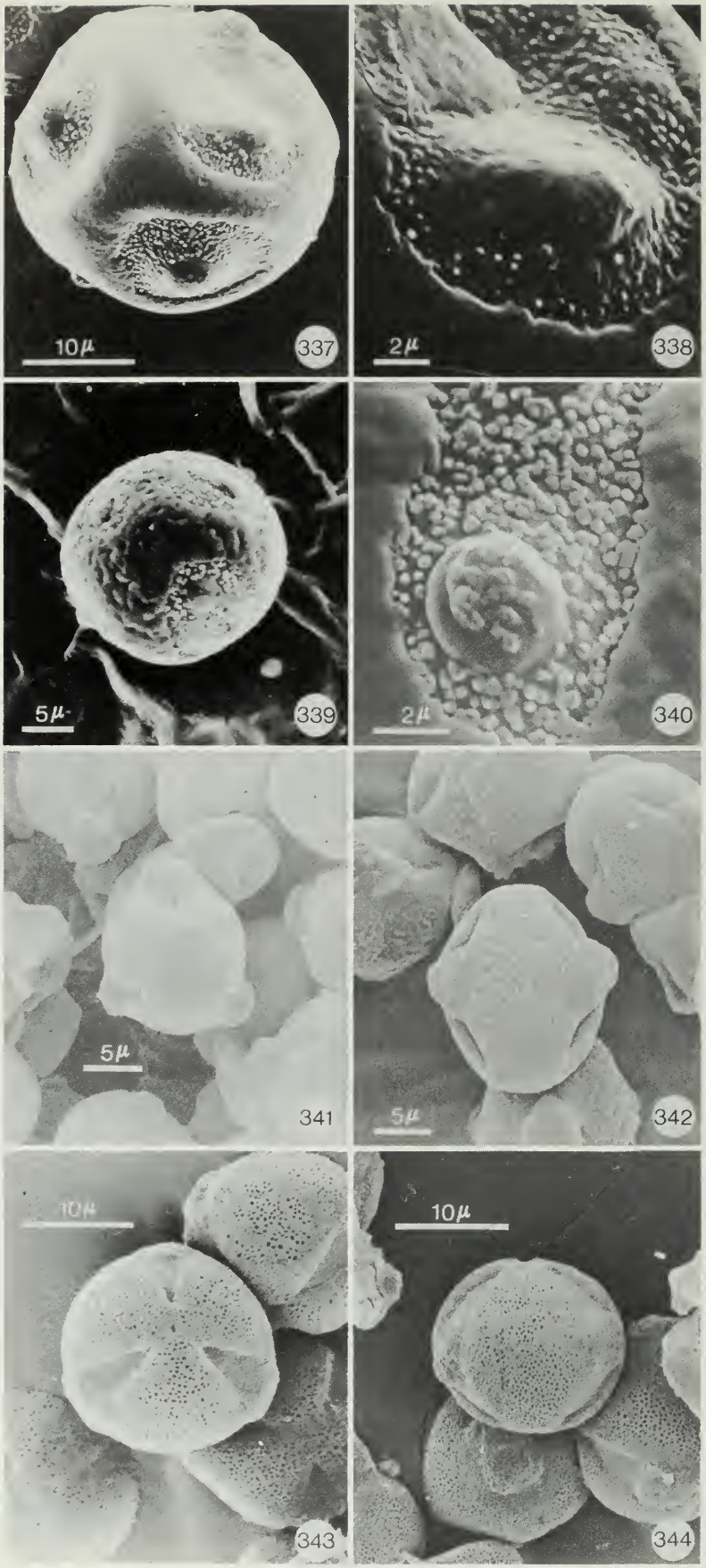



SEM Plate 40 Figs. 313, 314: *Pyrus communis*; Figs. 315, 316: *P. coronaria*; Figs. 317, 318: *P. malus*; Figs. 319, 320: *Rosa multiflora*.

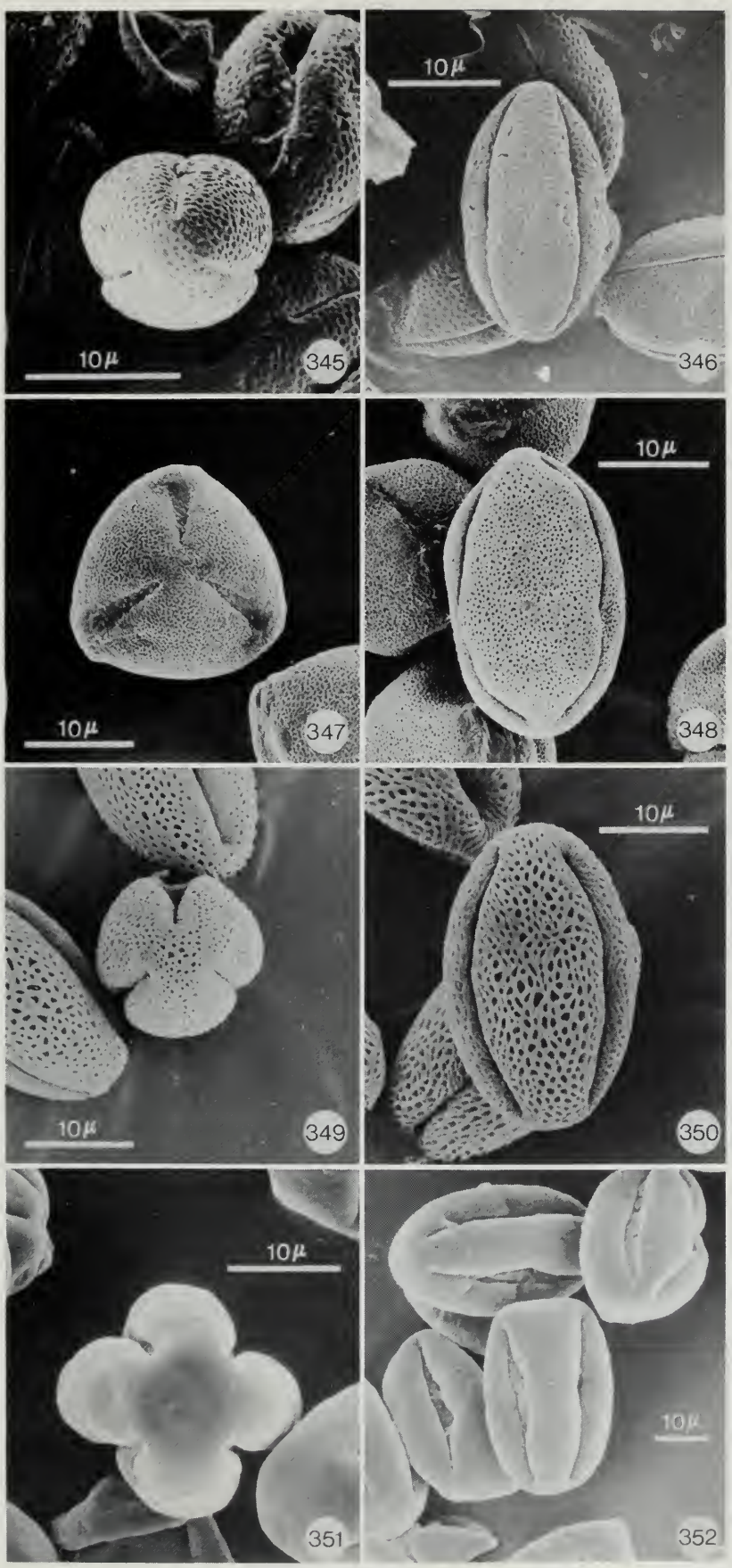

SEM Plate 41 Figs. 321, 322: *Rubus idaeus*; Figs. 323, 324: *R. odoratus*; Figs. 325, 326: *Salix discolor*; Figs. 327, 328: *Ribes americanum*.



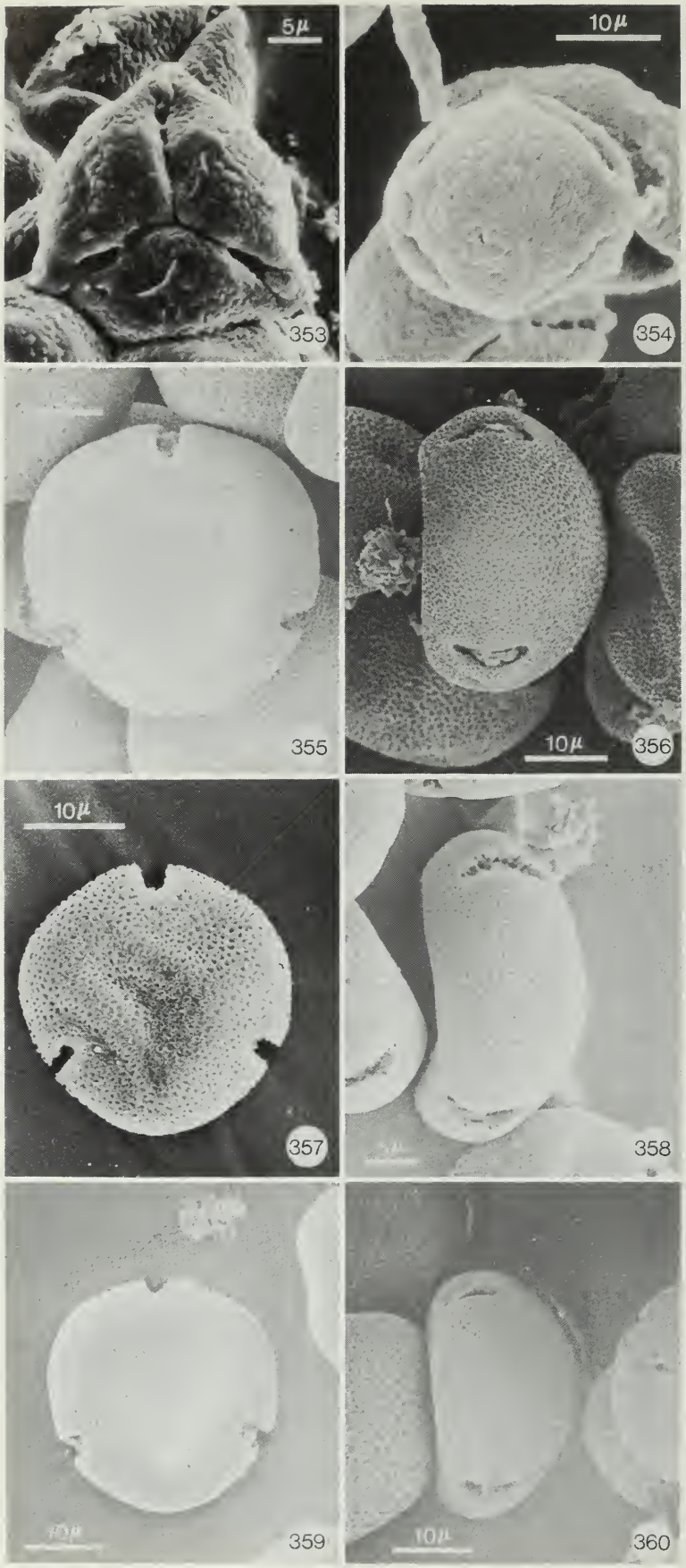

SEM Plate 42 Figs. 329, 330: *Ribes aureum*; Figs. 331, 332: *R. glutinosum*; Figs. 333, 334: *R. odoratum*; Figs. 335, 336: *R. oxyacanthoides*.



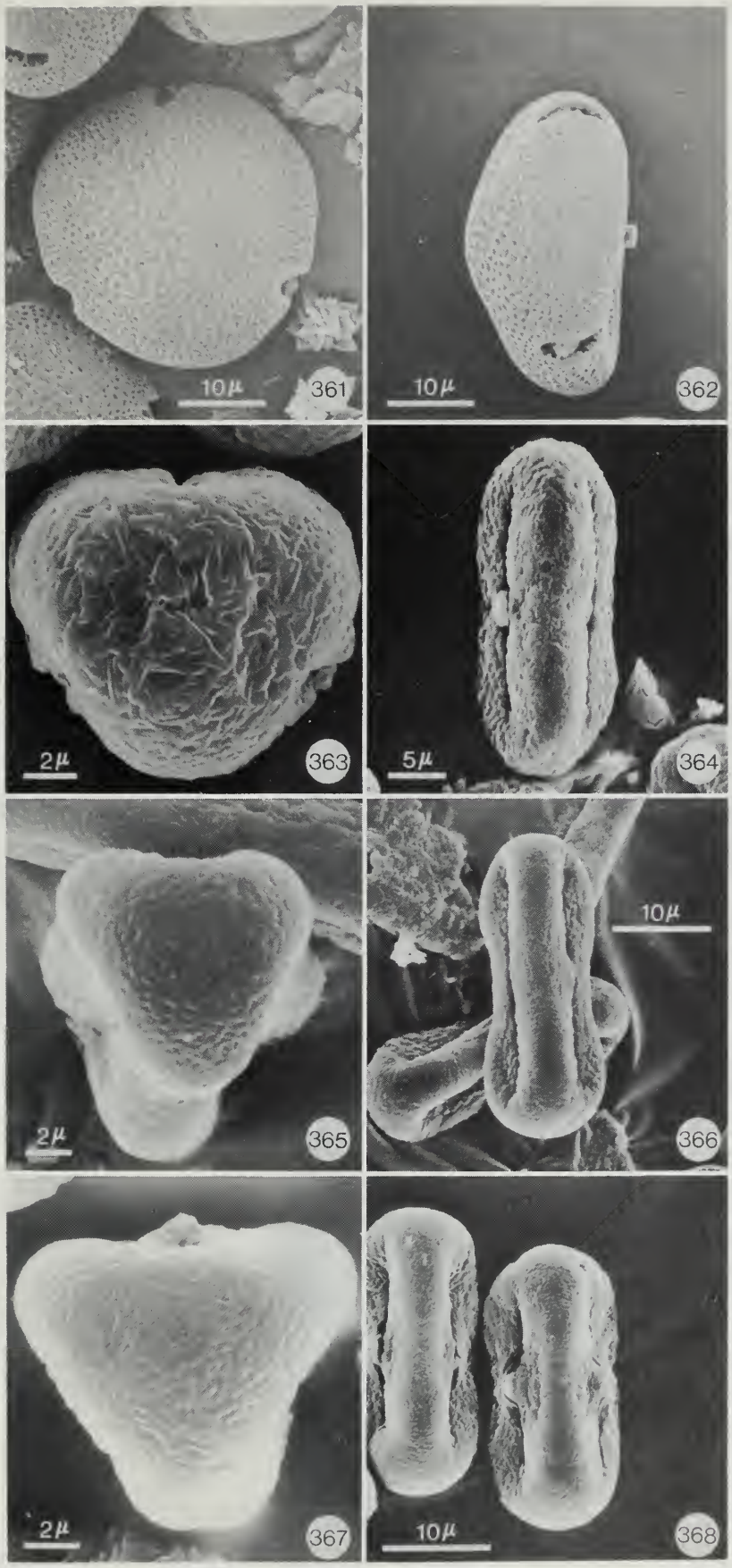

SEM Plate 43 Figs. 337, 338: *Ribes sanguineum*; Figs. 339, 340: *R. triste*; Figs. 341, 342: *Antirrhinum majus*; Figs. 343, 344: *Digitalis purpurea*.



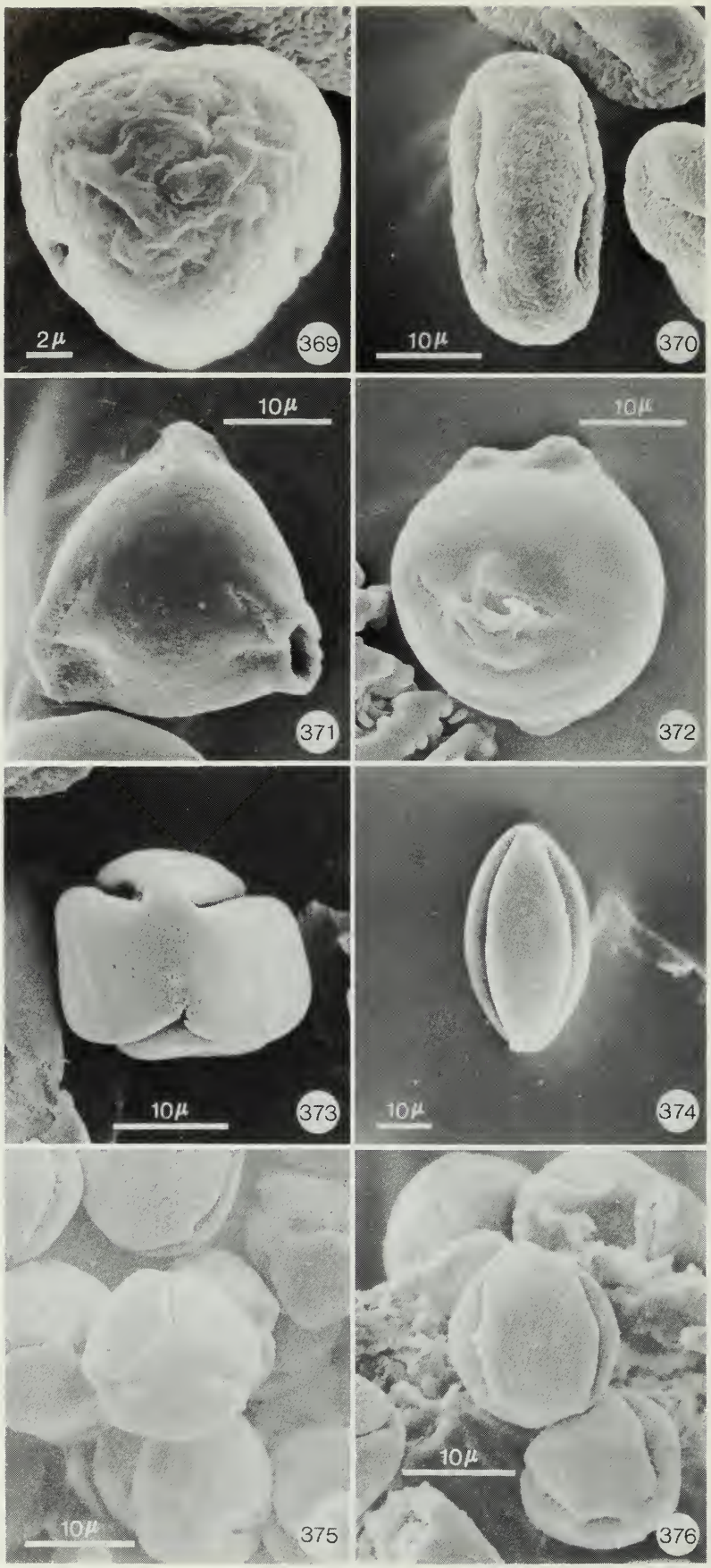

SEM Plate 44 Figs. 345, 346: *Linaria vulgaris*; Figs. 347, 348: *Penstemon gracilis*; Figs. 349, 350: *Ailanthus altissima*; Figs. 351, 352: *Nicotiana tabacum*.




SEM Plate 45 Figs. 353, 354: *Petunia hybrida*; Figs. 355, 356: *Tilia americana*; Figs. 357, 358: *T. cordata*; Figs. 359, 360: *T. xeuropeae*.




SEM Plate 46 Figs. 361, 362: *Tilia platyphyllos*; Figs. 363, 364: *Angelica atropurpurea*; Figs. 365, 366: *Carum carvi*; Figs. 367, 368: *Daucus carota*.

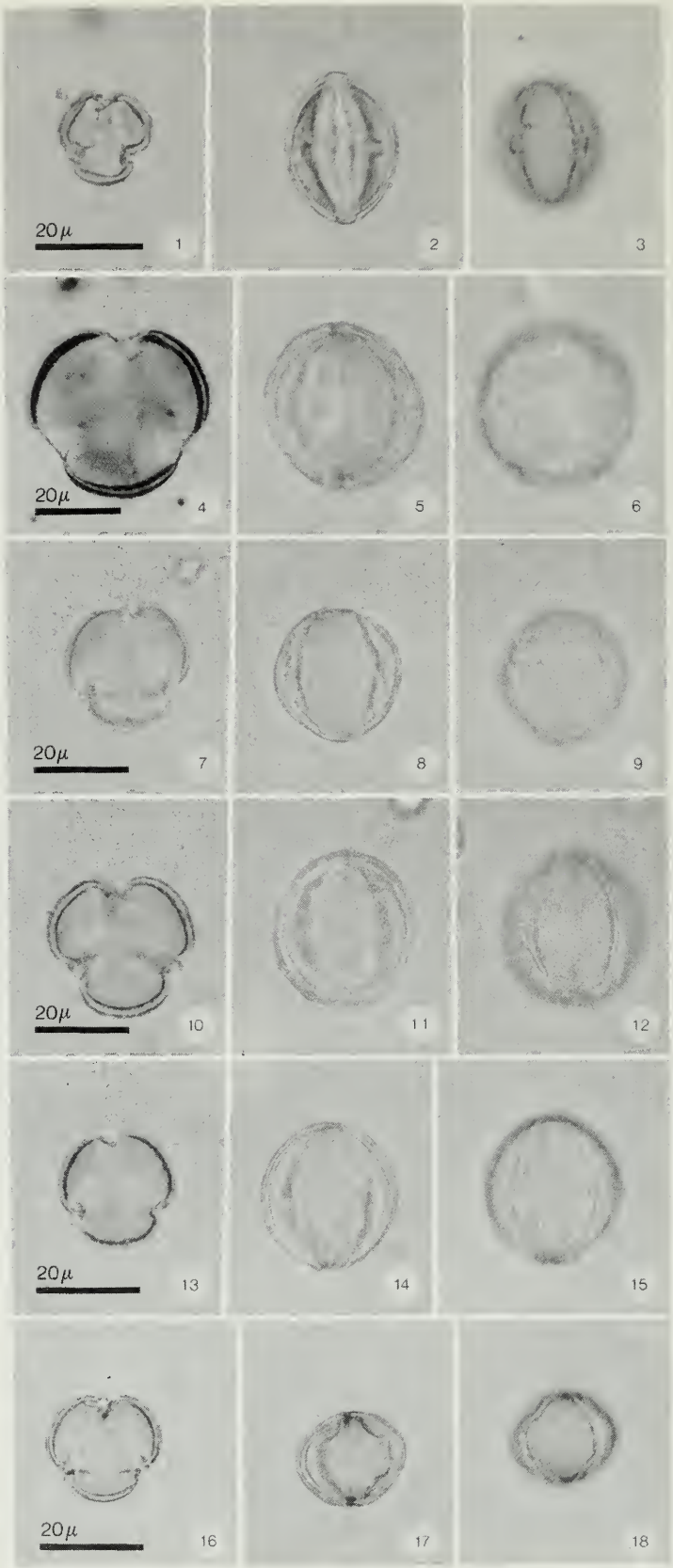



SEM Plate 47 Figs. 369, 370: *Pastinaca sativa*; Figs. 371, 372: *Verbena hastata*; Figs. 373, 374: *Viola palustris*; Figs. 375, 376: *Vitis vinifera*.

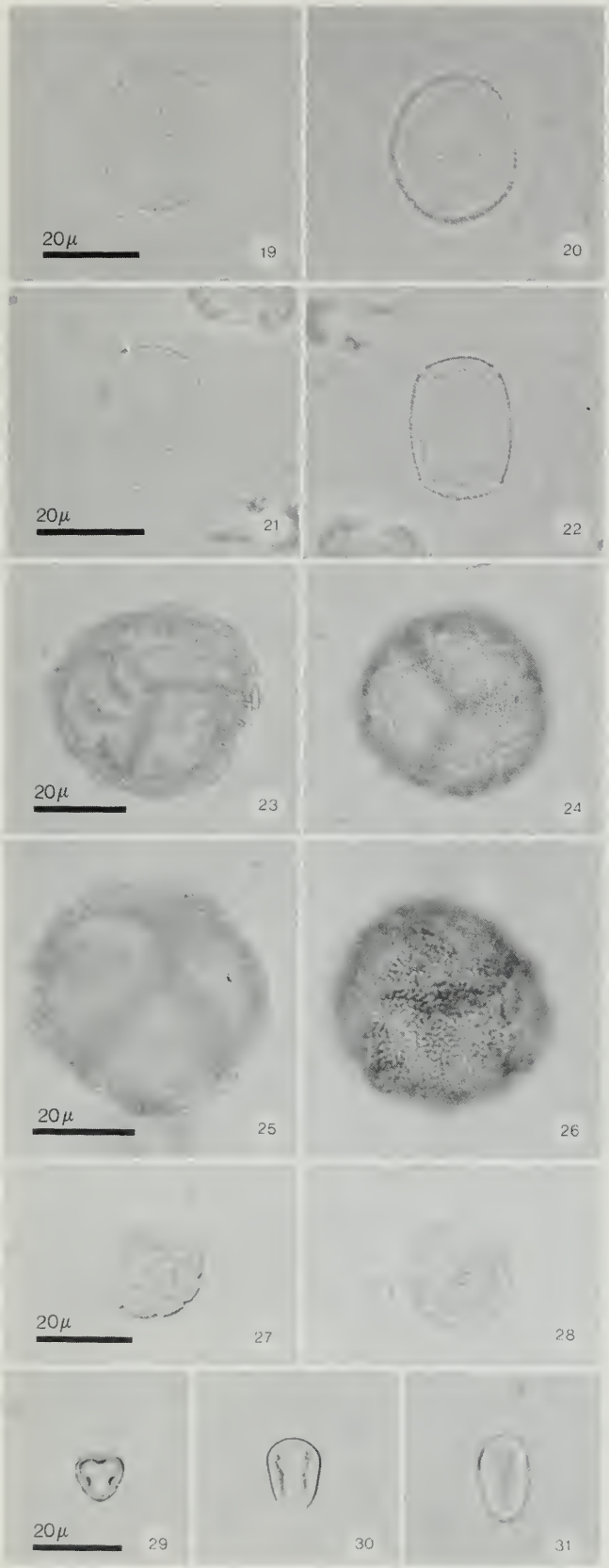
# Plates 1–37: Light microscope (LM) photomicrographs

(Nomarski Interference Contrast)

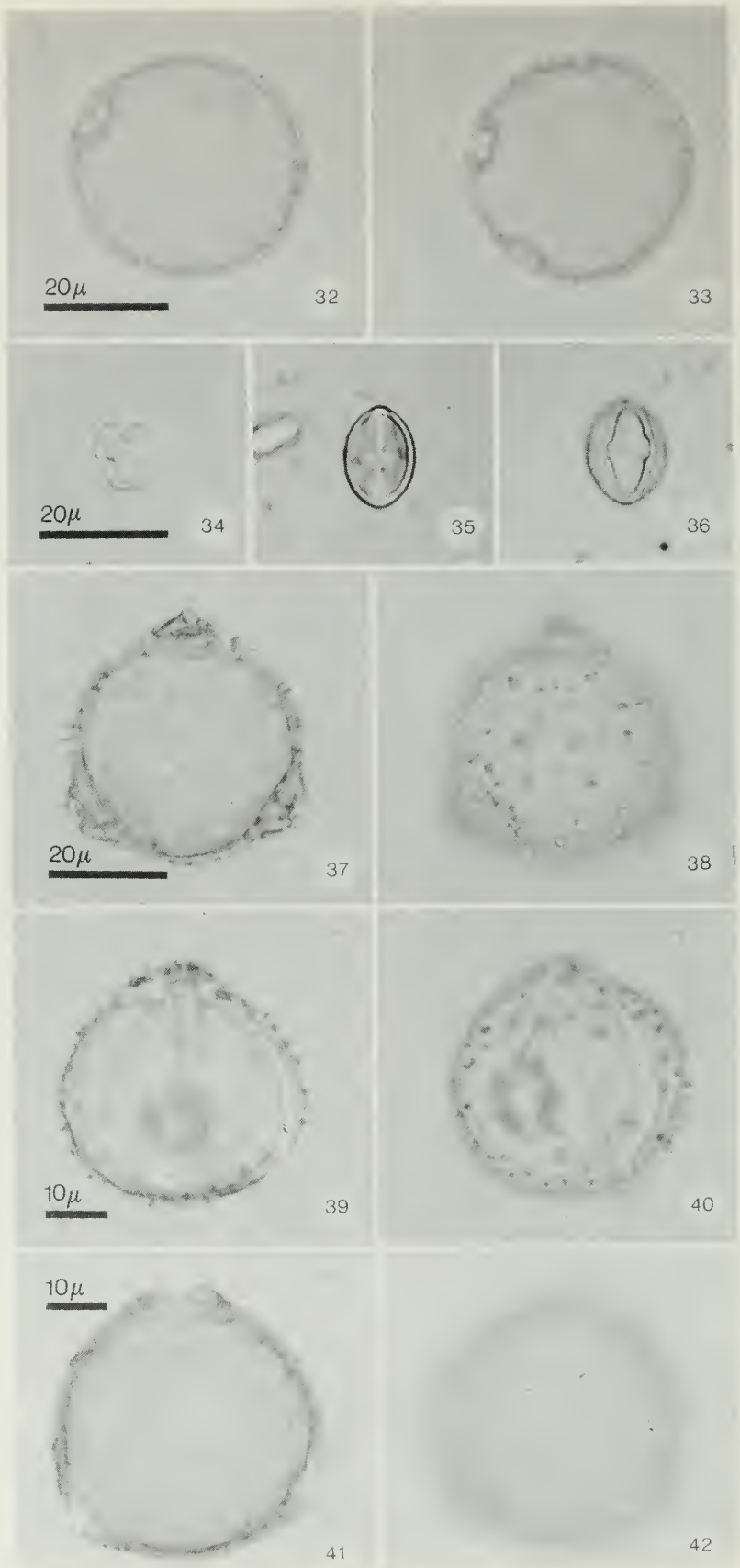
polar = p
equatorial = e
surface = s
polar surface = ps
equatorial surface = es
equatorial bacculae = eb
furrow (colpi) = f



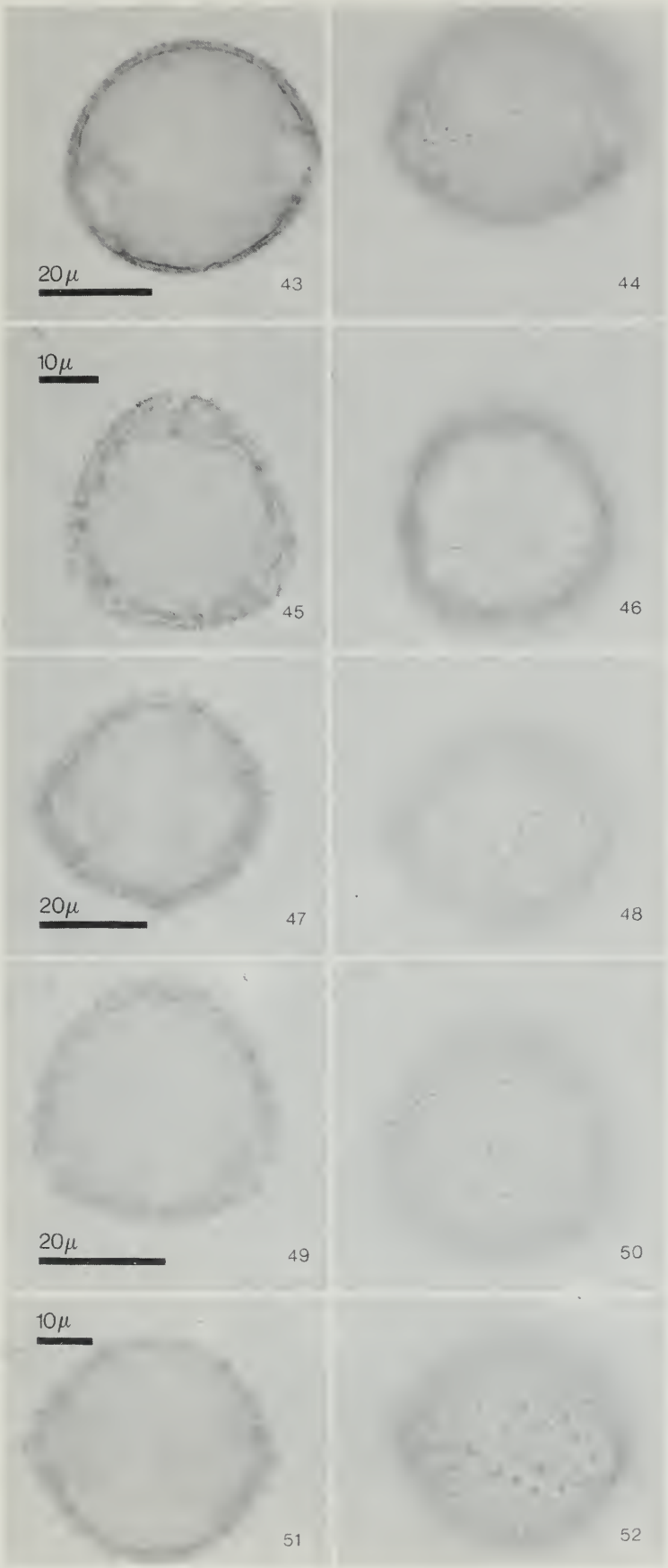

LM Plate 1 Figs. 1–3: *Acer circinatum* (polar, equatorial, surface); Figs. 4–6: *A. macrophyllum* (p, e, s); Figs. 7–9: *A. platanoides* (p, e, s); Figs. 10–12: *A. pseudo-platanus* (p, e, s); Figs. 13–15: *A. rubrum* (p, e, s); Figs. 16–18: *A. tataricum* (p, e, s).



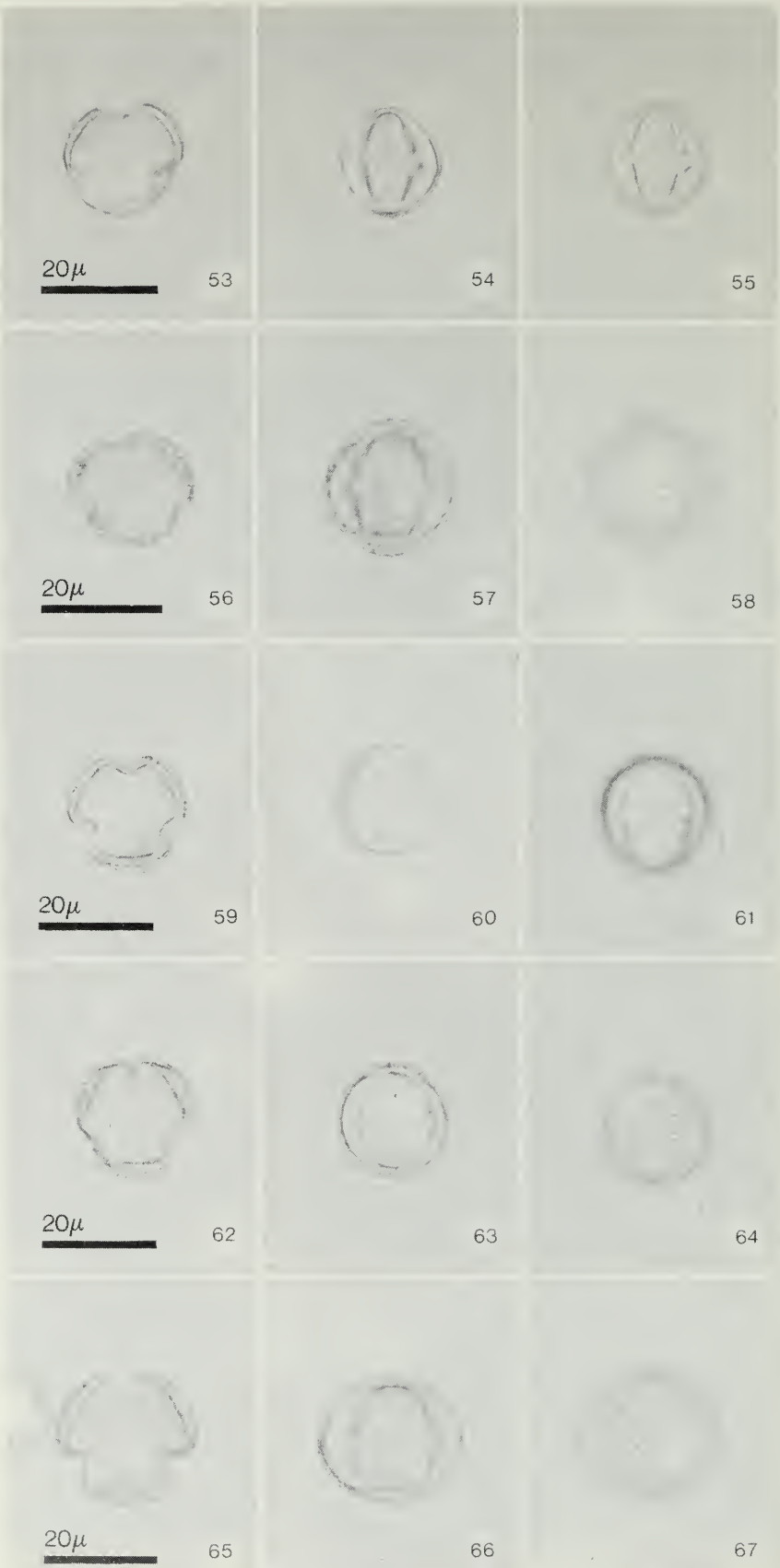

LM Plate 2 Figs. 19, 20: *Impatiens capensis* (p, s); Figs. 21, 22: *I. glandulifera* (p, s); Figs. 23, 24: *Catalpa ovata* (p, s); Figs. 25, 26: *C. speciosa* (p, s); Figs. 27, 28: *Borago officinalis* (p, e); Figs. 29–31: *Echium vulgare* (p, e, s).



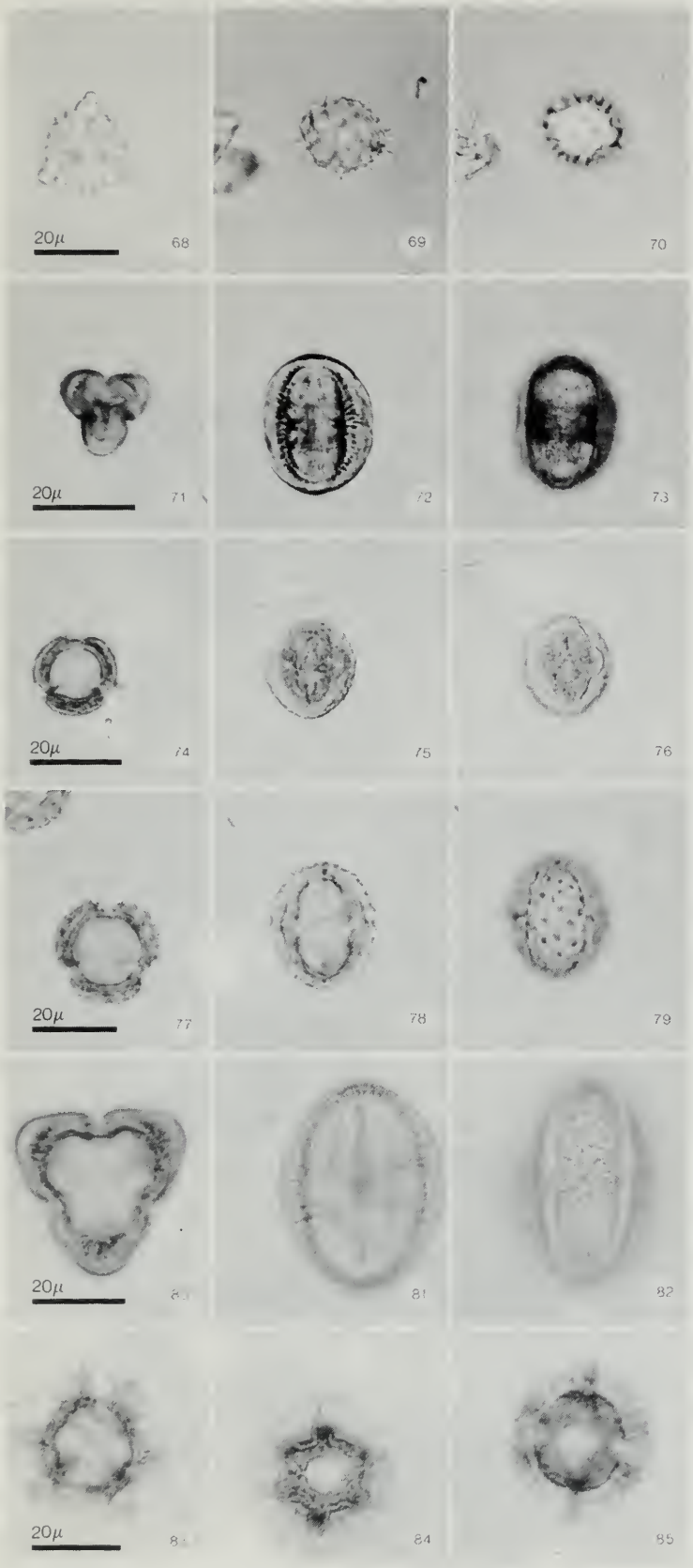

LM Plate 3 Figs. 32, 33: *Campanula rapunculoides* (grain with cell wall and pores); Figs. 34–36: *Cleome serrulata* (p, e, s); Figs. 37–40: *Diervilla lonicera* (p, ps, e, es); Figs. 41, 42: *Lonicera involucrata* (p, ps).



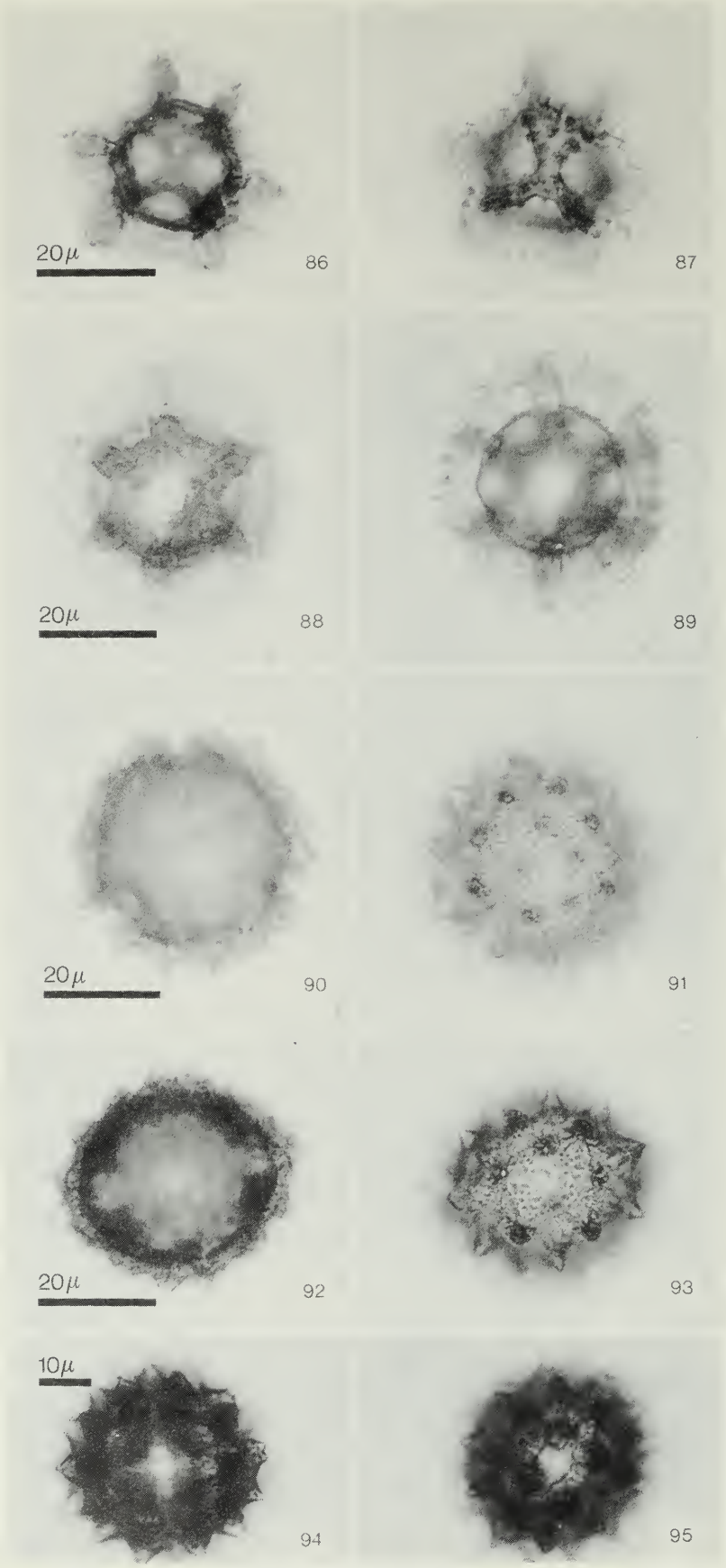

LM Plate 4 Figs. 43, 44: *Lonicera involucrata* (e, es); Figs. 45–48: *L. morrowi* (p, ps, e, es); Figs. 49–52: *L. tatarica* (p, ps, e, es).



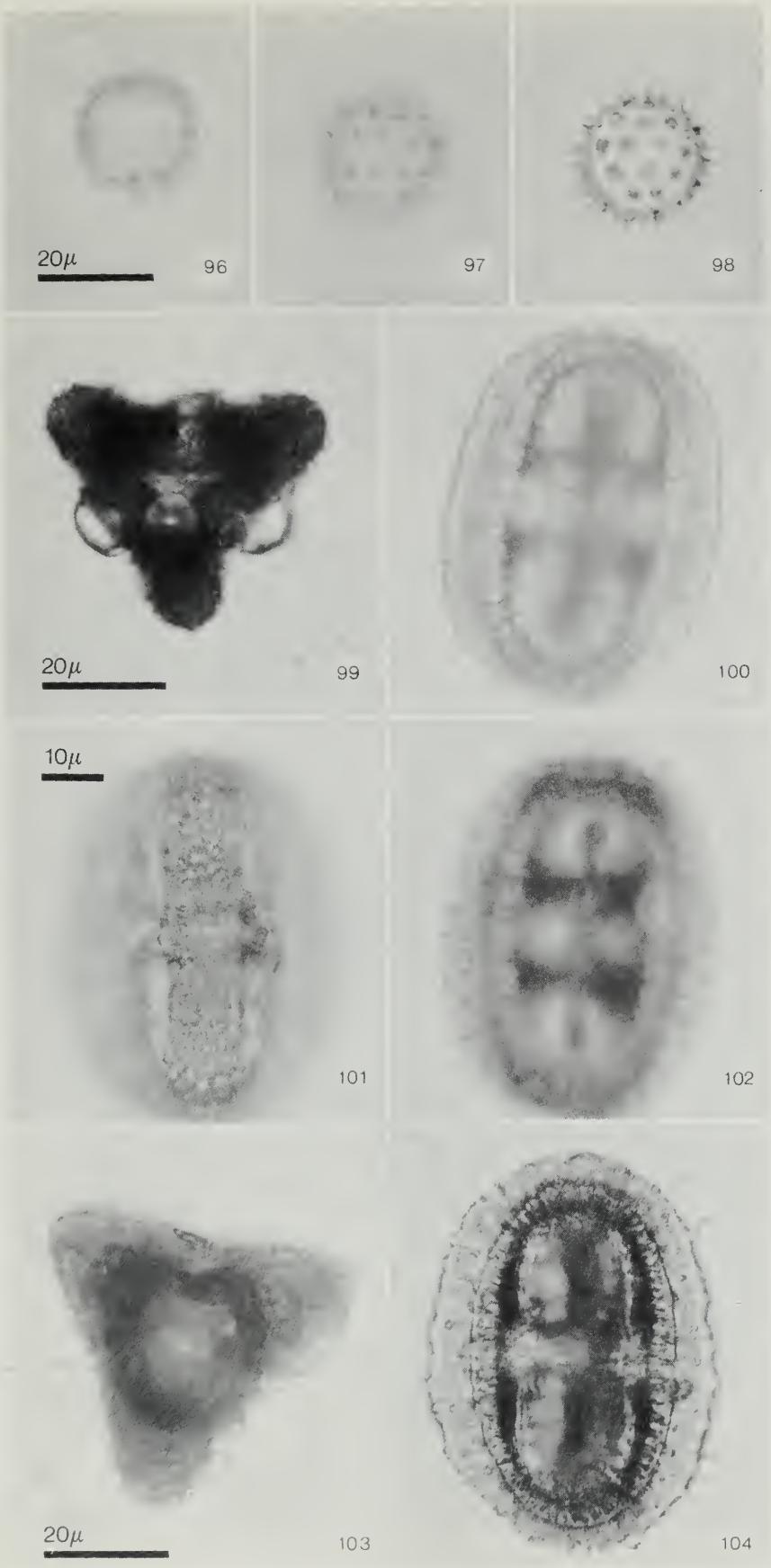

LM Plate 5 Figs. 53–55: *Sambucus canadensis* (p, e, s); Figs. 56–58: *Viburnum lentago* (p, e, s); Figs. 59–61: *V. opulus* (p, e, s); Figs. 62–64: *V. plicatum* (p, e, s); Figs. 65–67: *V. prunifolium* (p, e, s).



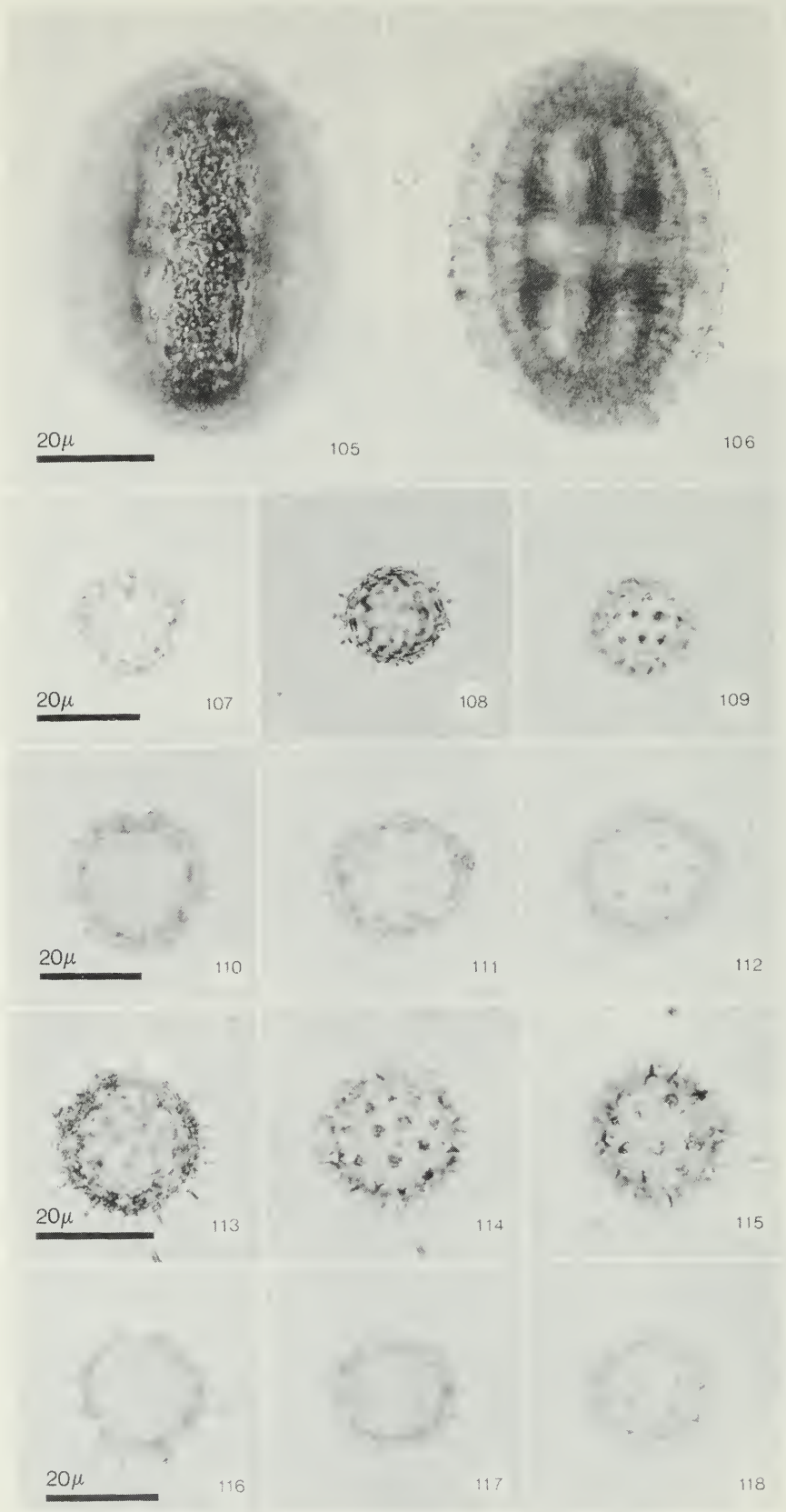

LM Plate 6 Figs. 68–70: *Aster novae-angliae* (p, e, s); Figs. 71–73: *Centaurea cyanus* (p, e, s); Figs. 74–76: *C. diffusa* (p, e, s); Figs. 77–79: *C. maculosa* (p, e, s); Figs. 80–82: *C. montana* (p, e, s); Figs. 83–85: *Cichorium endiva* (p, e, s).



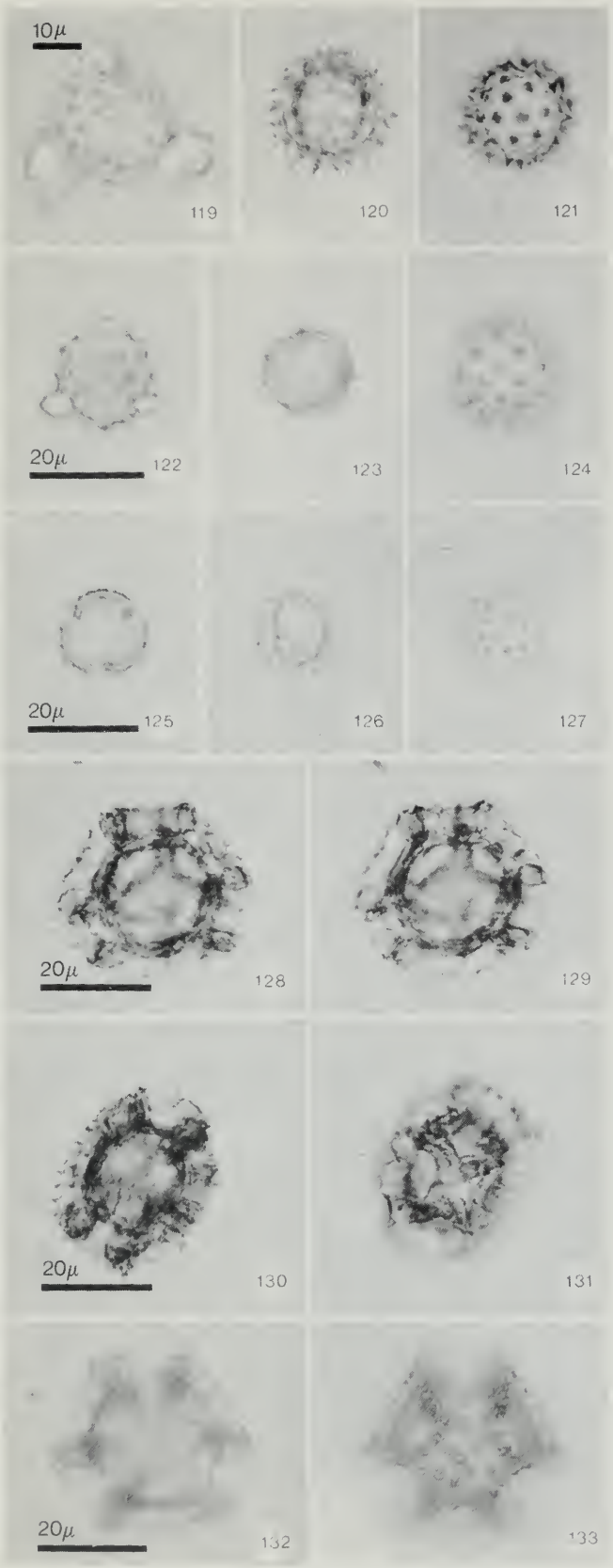

LM Plate 7 Figs. 86–89: *Cichorium intybus* (p, ps, e, es); Figs. 90–93: *Cirsium muticum* (p, ps, e, es); Figs. 94, 95: *C. vulgare* (e, es).



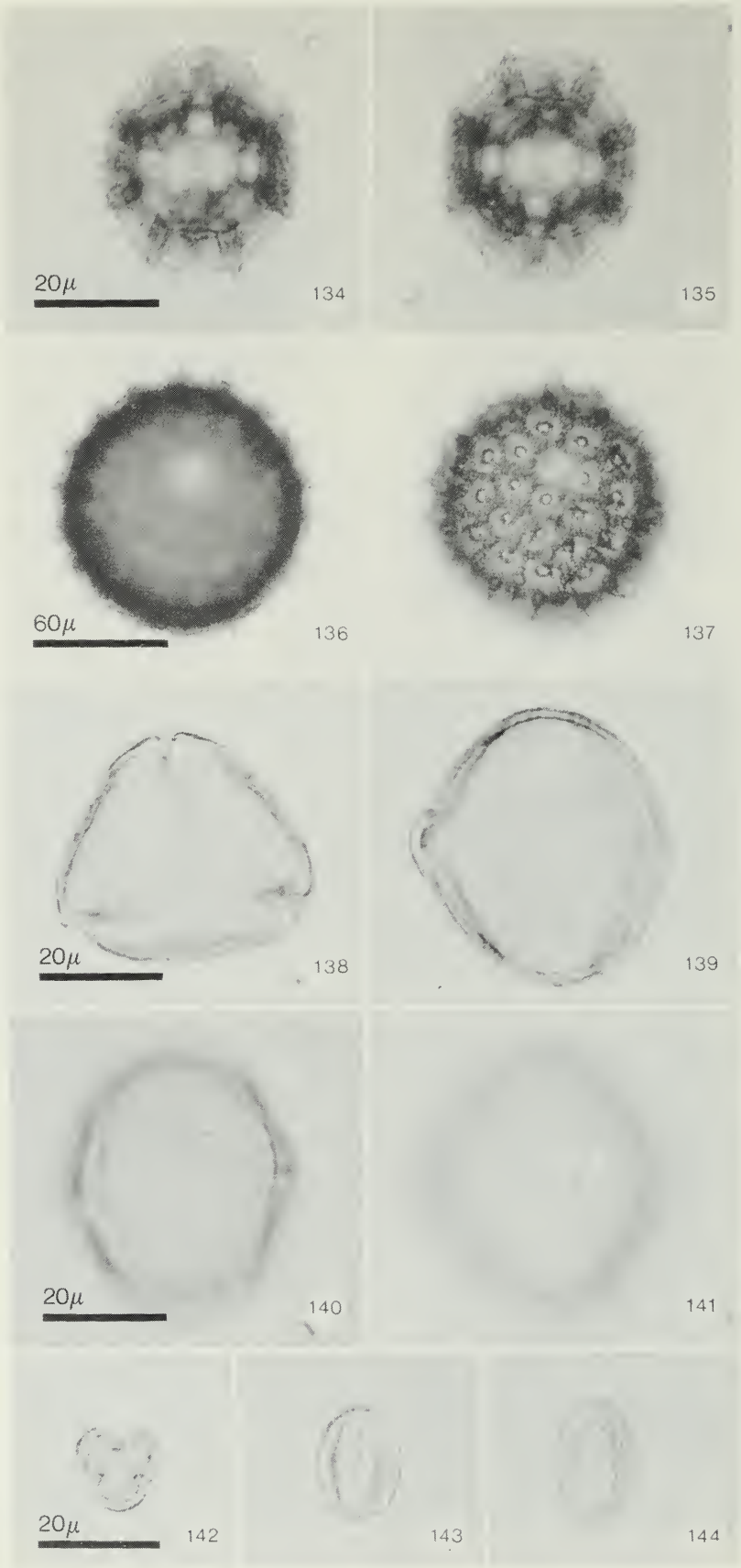

LM Plate 8 Figs. 96–98: *Cosmos bipinnatus* (p, e, s); Figs. 99–102: *Echinops exaltatus* (p, e, es, eb); Figs. 103, 104: *E. sphaerocephalus* (p, e).



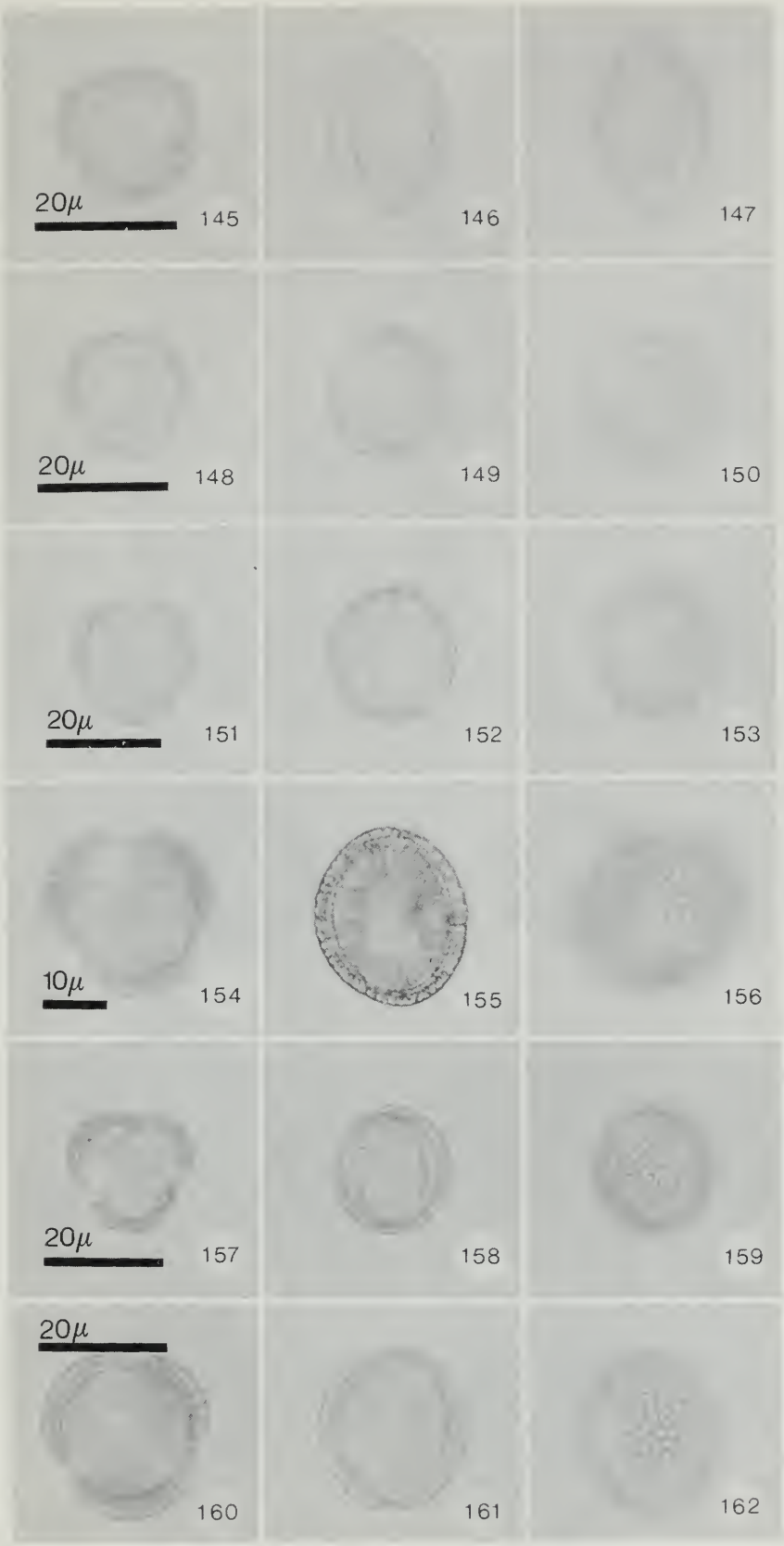

LM Plate 9 Figs. 105, 106: *Echinops sphaerocephalus* (s, eb); Figs. 107–109: *Eupatorium perfoliatum* (p, ps, e); Figs. 110–112: *Helianthus annuus* (p, e, es); Figs. 113–115: *H. petiolaris* (p, e, es); Figs. 116–118: *H. salicifolius* (p, e, es).



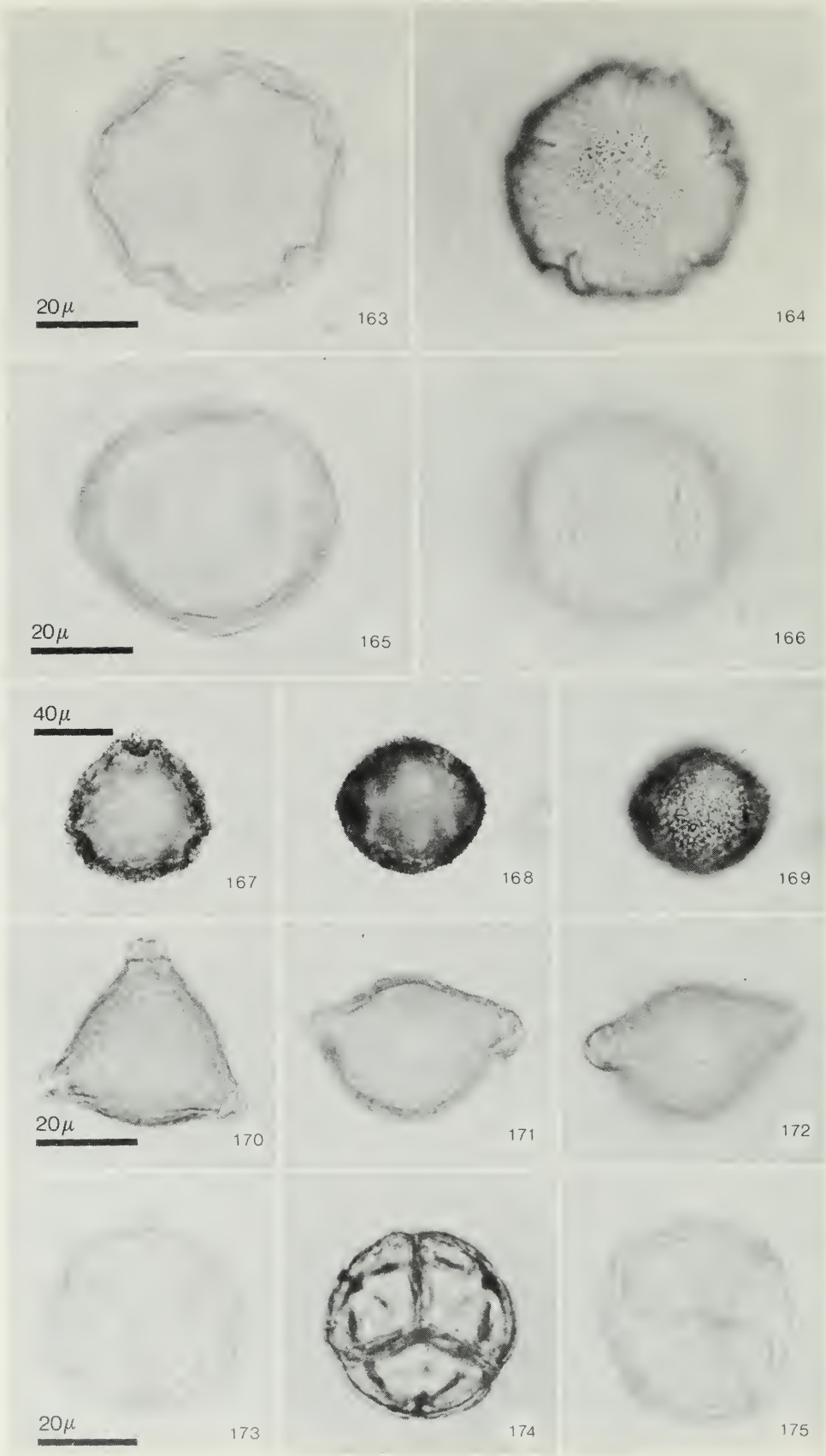

LM Plate 10 Figs. 119–121: *Liatris cylindracea* (p, e, es); Figs. 122–124: *Rudbeckia hirta* (p, e, es); Figs. 125–127: *Solidago canadensis* (p, e, s); Figs. 128–131: *Taraxacum officinale* (p, ps, e, es); Figs. 132, 133: *Tragopogon dubius* (p, ps).



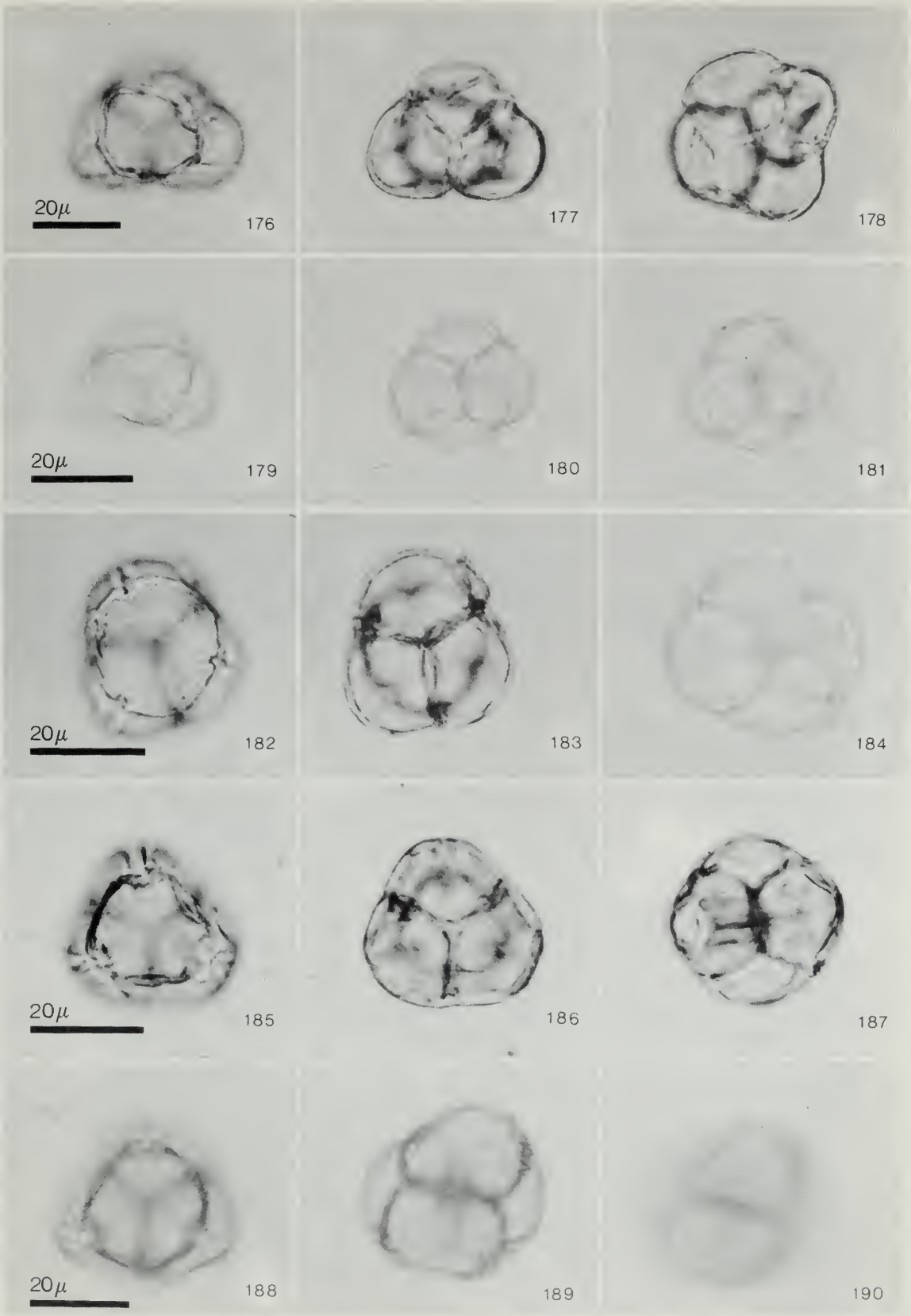

LM Plate 11 Figs. 134, 135: *Tragopogon dubius* (e, es); Figs. 136, 137: *Ipomoea purpurea* (e, s); Figs. 138–141: *Cornus stolonifera* (p, e, es, f); Figs. 142–144: *Alyssum saxatile* (p, e, s).



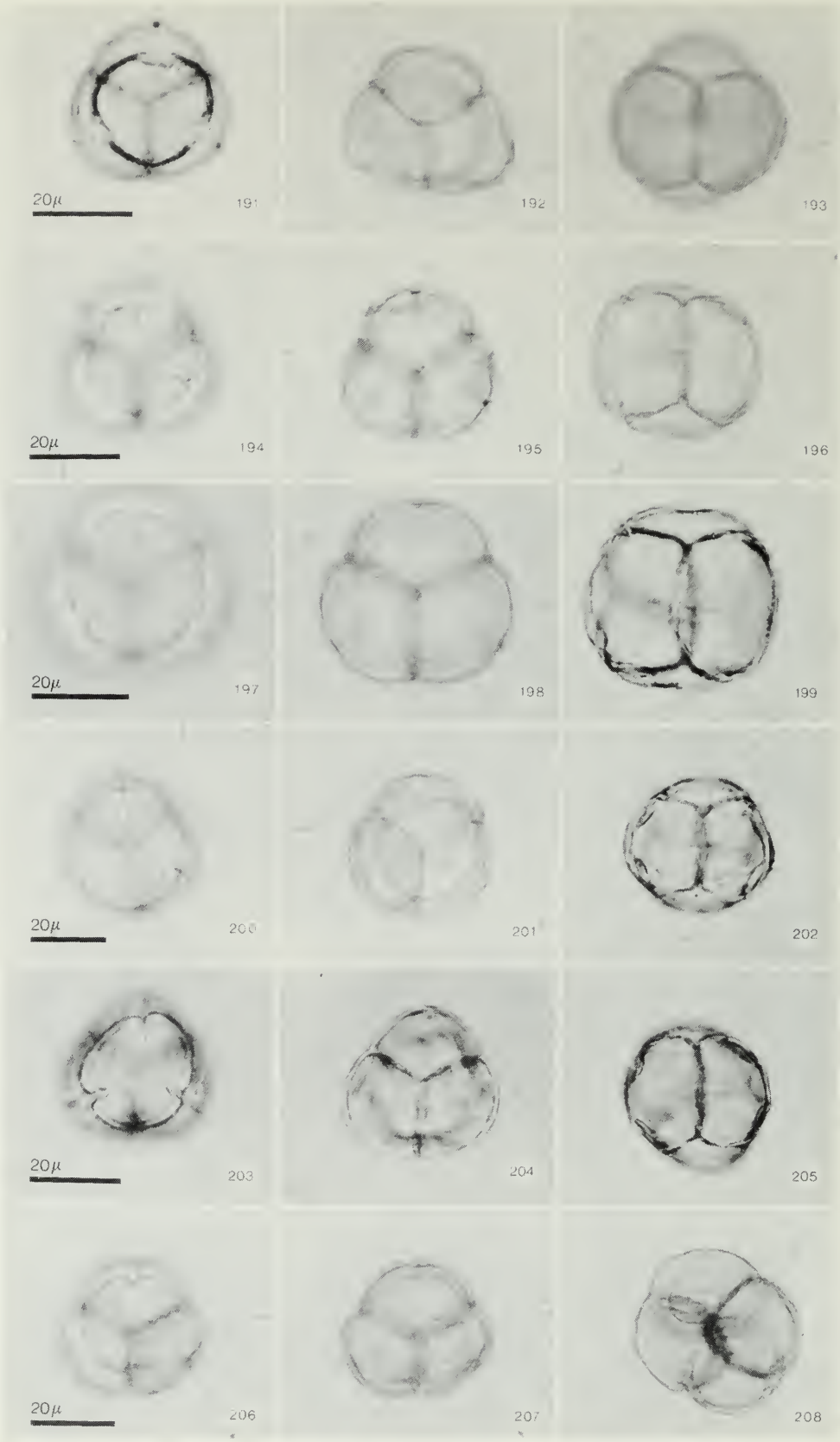

LM Plate 12 Figs. 145–147: *Brassica napus* (p, e, s); Figs. 148–150: *B. nigra* (p, e, s); Figs. 151–153: *B. rapa* (p, e, s); Figs. 154–156: *Diplotaxis tenuifolia* (p, e, s); Figs. 157–159: *Raphanus raphanistrum* (p, e, s); Figs. 160–162: *Sinapis alba* (p, e, s).



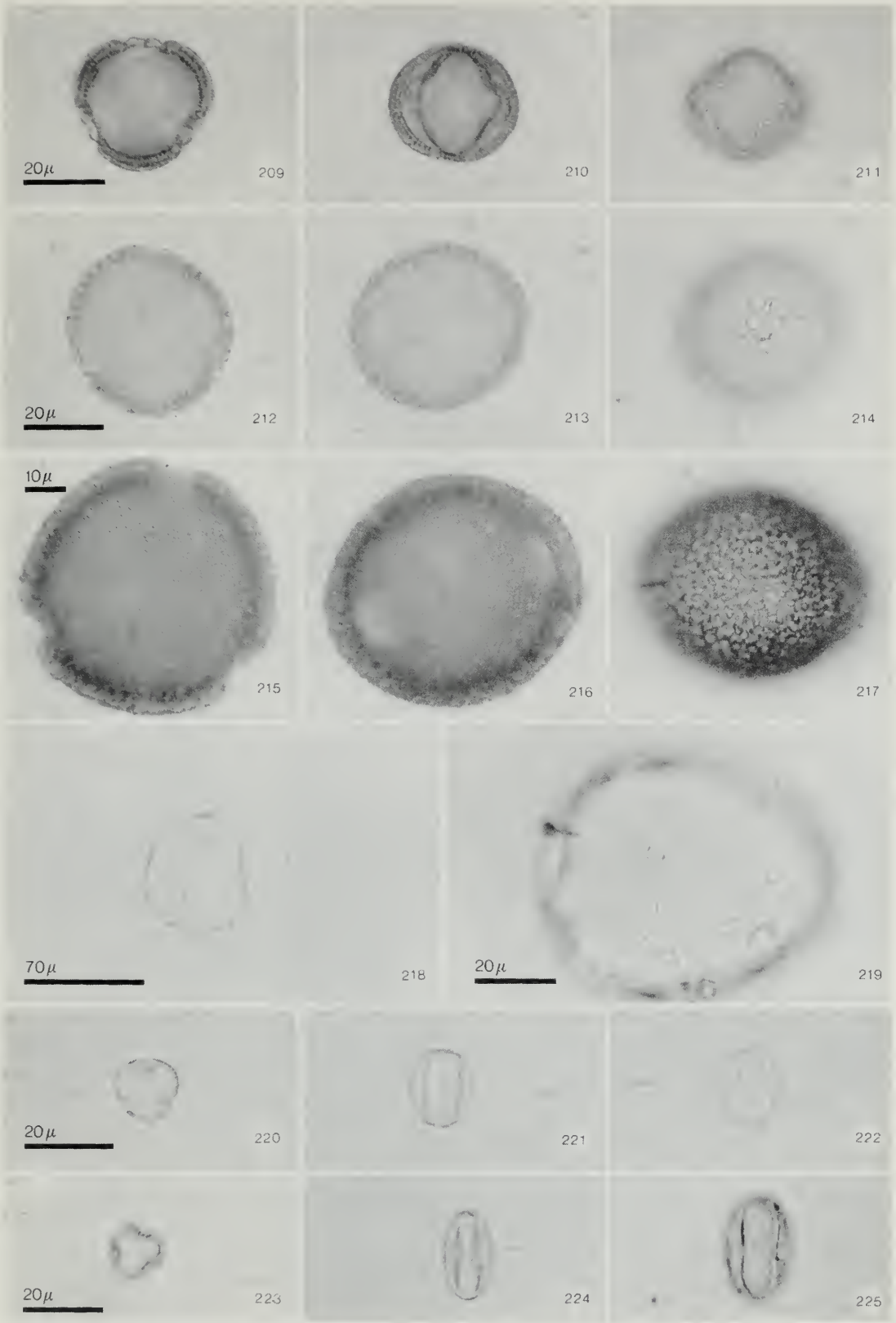

LM Plate 13 Figs. 163–166: *Echinocystis lobata* (p, ps, e, es); Figs. 167–169: *Dipsacus sylvestris* (p, e, s); Figs. 170–172: *Elaeagnus commutata* (p, e, s); Figs. 173–175: *Arctostaphylos uva-ursi* (ps, p, s).




LM Plate 14 Figs. 176–178: *Calluna vulgaris* (ps, p, e); Figs. 179–181: *Kalmia angustifolia* (ps, p, e); Figs. 182–184: *K. latifolia* (ps, p, e); Figs. 185–187: *Ledum groenlandicum* (ps, p, e); Figs. 188–190: *Rhododendron canadense* (ps, e, es).

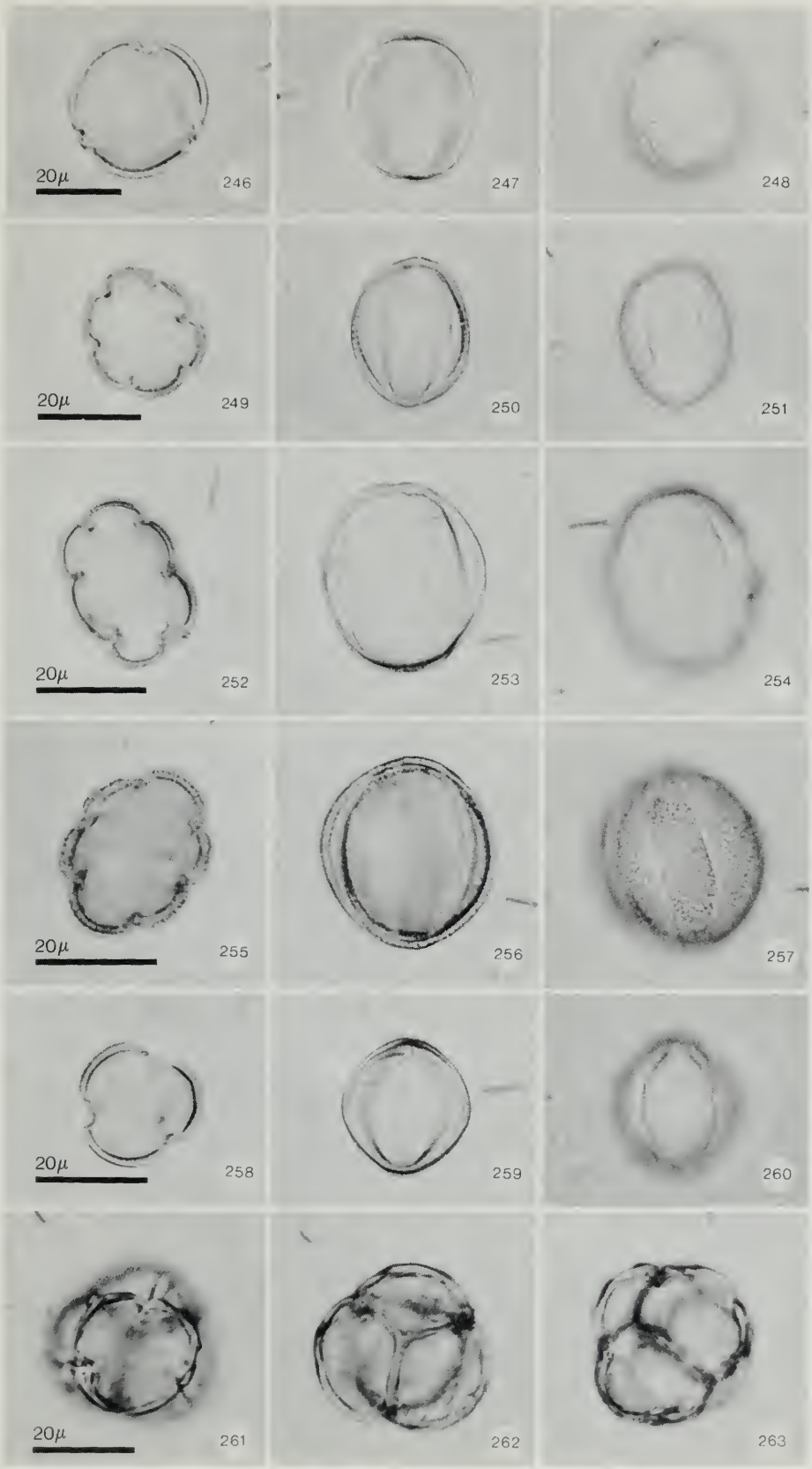



LM Plate 15 Figs. 191–193: *Vaccinium angustifolium* (ps, p, e); Figs. 194–196: *V. arboreum* (ps, p, e); Figs. 197–199: *V. corymbosum* (ps, p, e); Figs. 200–202: *V. macrocarpon* (ps, p, e); Figs. 203–205: *V. myrtilloides* (ps, p, e); Figs. 206–208: *V. vitis-idaea* (ps, p, e).



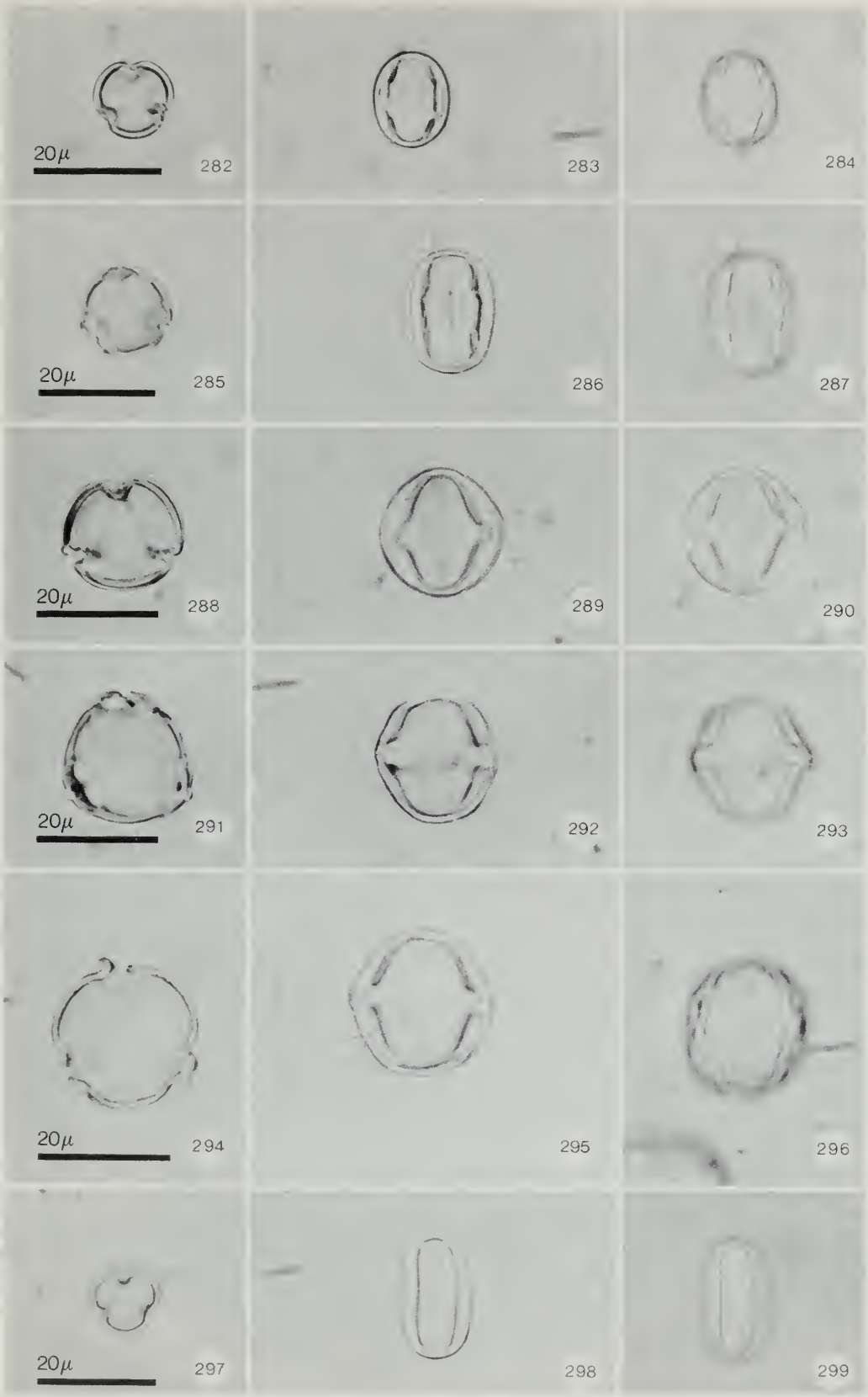

LM Plate 16 Figs. 209–211: *Euphorbia esula* (p, e, s); Figs. 212–214: *Gentianella crinata* (p, e, s); Figs. 215–217: *Geranium bicknellii* (p, e, s); Figs. 218, 219: *Zea mays* (grain 40×, grain 100×); Figs. 220–222: *Hamamelis virginiana* (p, e, s); Figs. 223–225: *Aesculus hippocastaneum* (p, e, s).


LM Plate 17 Figs. 226–228: *Phacelia linearis* (p, e, s); Figs. 229–231: *Hypericum perforatum* (p, e, s); Figs. 232, 233: *Iris versicolor* (s, surface showing furrow); Figs. 234–236: *Ajuga reptans* (p, e, s); Figs. 237–239: *Dracocephalum parviflorum* (p, e, s); Figs. 240–242: *Leonurus cardiaca* (p, e, s); Figs. 243–245: *Mentha spicata* (p, e, s).

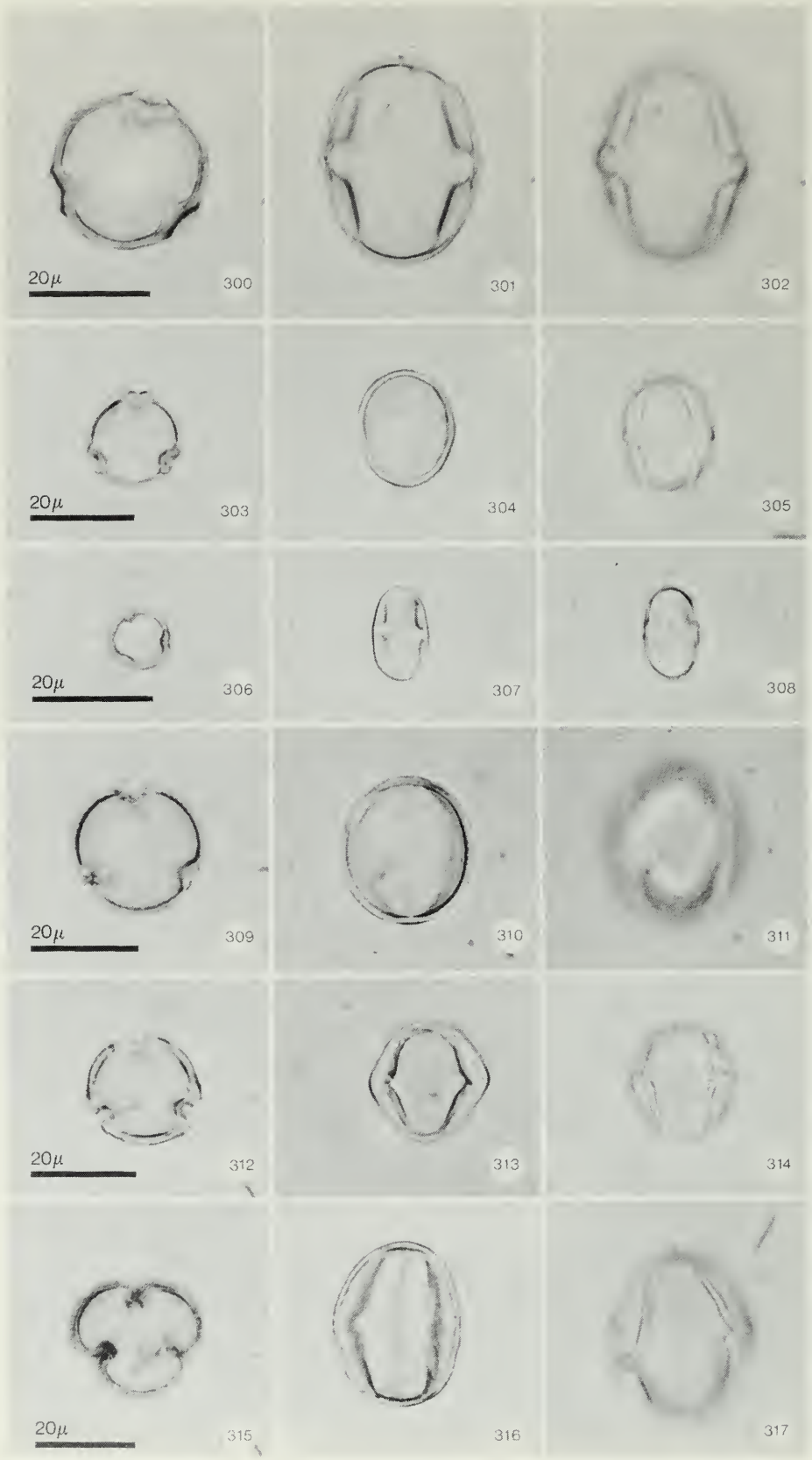



LM Plate 18 Figs. 246–248: *Monarda fistulosa* (p, e, s); Figs. 249–251: *Nepeta cataria* (p, e, s); Figs. 252–254: *Prunella vulgaris* (p, e, s); Figs. 255–257: *Salvia officinalis* (p, e, s); Figs. 258–260: *Stachys palustris* (p, e, s); Figs. 261–263: *Loiseleuria procumbens* (ps, p, e).


LM Plate 19 Figs. 264–266: *Amorpha fruticosa* (p, e, s); Figs. 267–269: *Anthyllis vulneraria* (p, e, s); Figs. 270–272: *Astragalus alpinus* (p, e, s); Figs. 273–275: *A. cicer* (p, e, s); Figs. 276–278: *A. striatus* (p, e, s); Figs. 279–281: *Baptisia australis* (p, e, s).

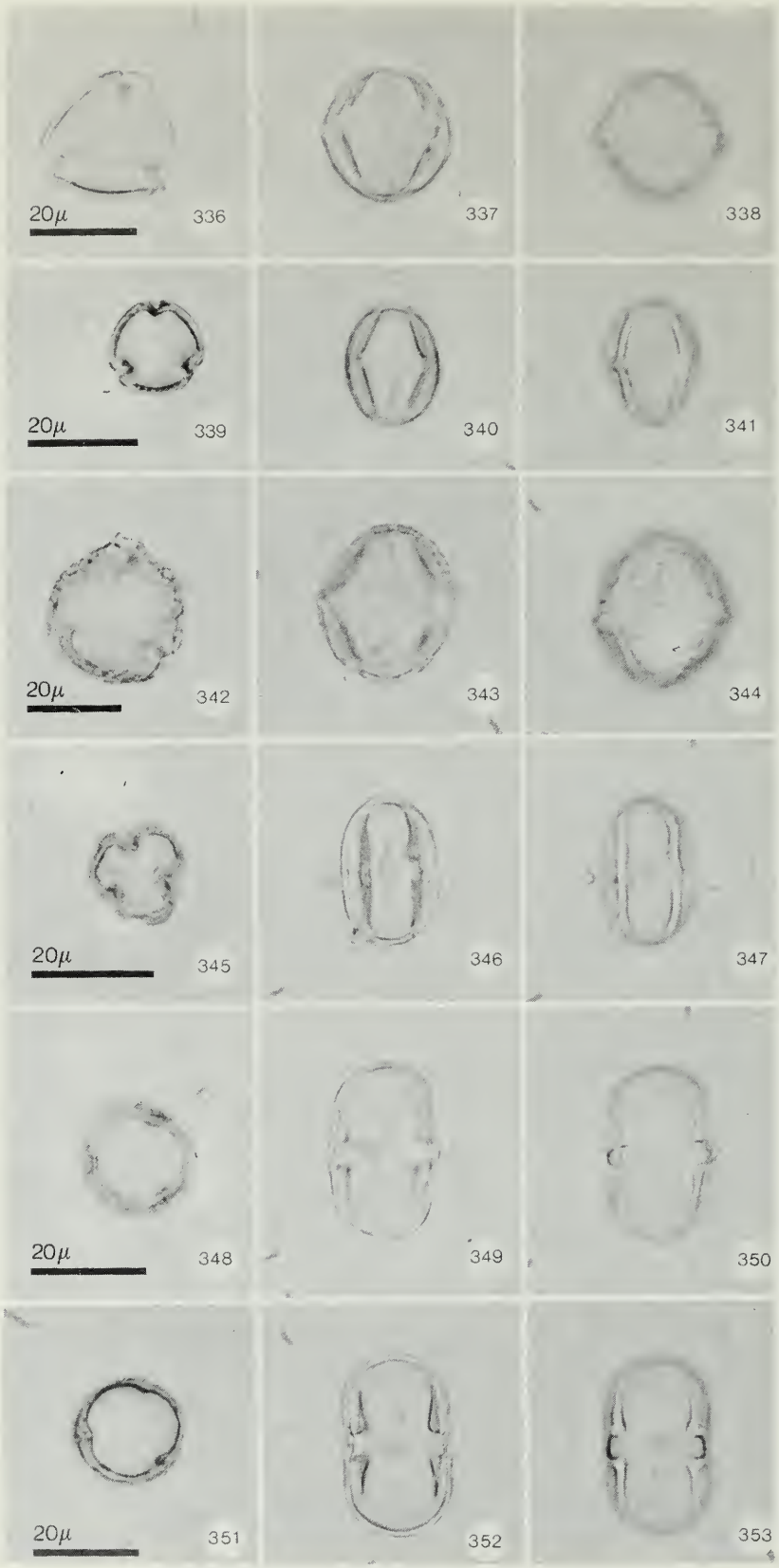



LM Plate 20 Figs. 282–284: *Baptisia tinctoria* (p, e, s); Figs. 285–287: *Caragana arborescens* (p, e, s); Figs. 288–290: *Cercis canadensis* (p, e, s); Figs. 291–293: *Coronilla varia* (p, e, s); Figs. 294–296: *Cytisus scoparius* (p, e, s); Figs. 297–299: *Hedysarum boreale* (p, e, s).

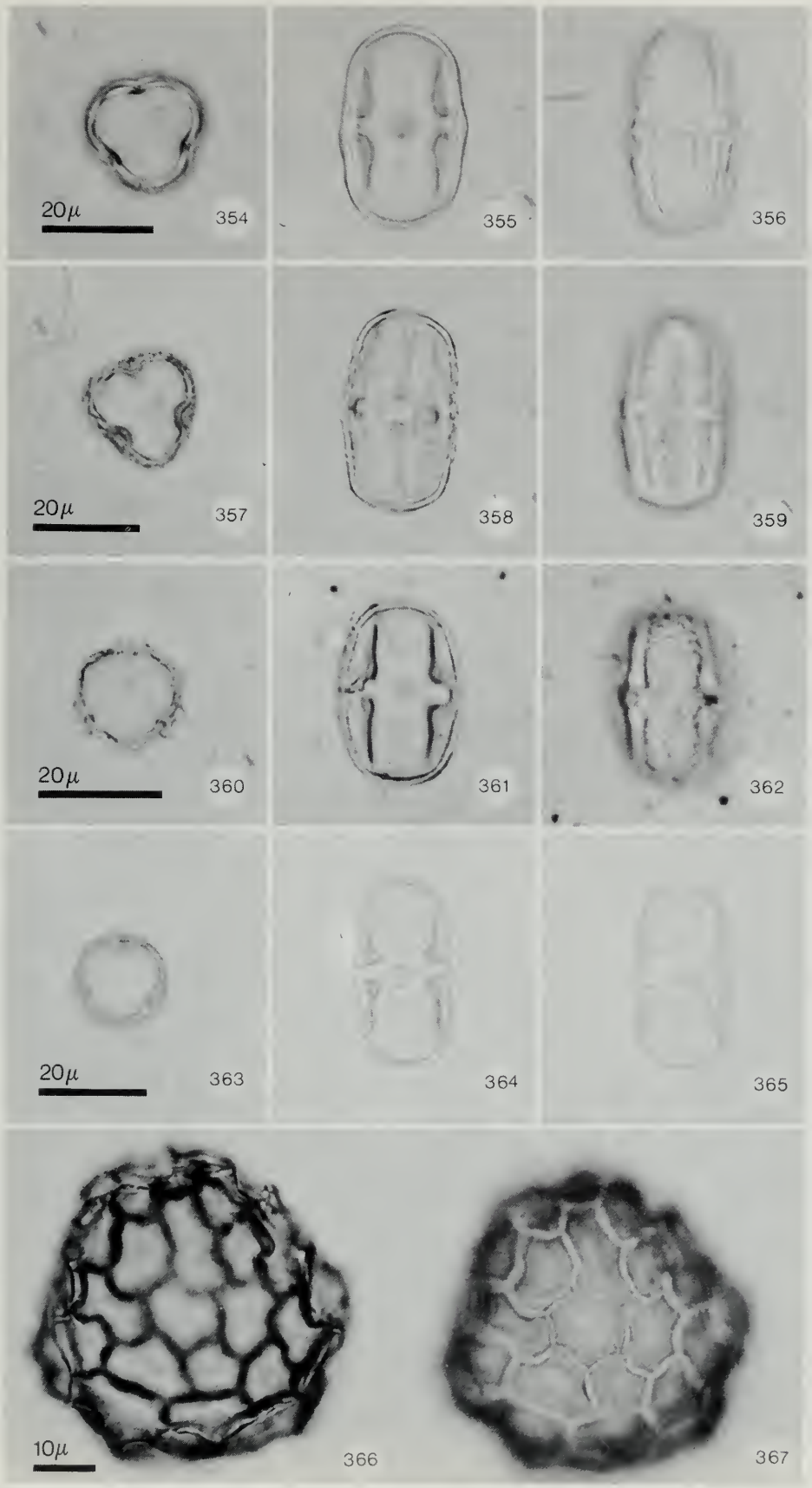



LM Plate 21 Figs. 300–302: *Lathyrus tuberosus* (p, e, s); Figs. 303–305: *Lespedeza bicolor* (p, e, s); Figs. 306–308: *Lotus corniculatus* (p, e, s); Figs. 309–311: *Lupinus argenteus* (p, e, s); Figs. 312–314: *Medicago lupulina* (p, e, s); Figs. 315–317: *M. sativa* (p, e, s).

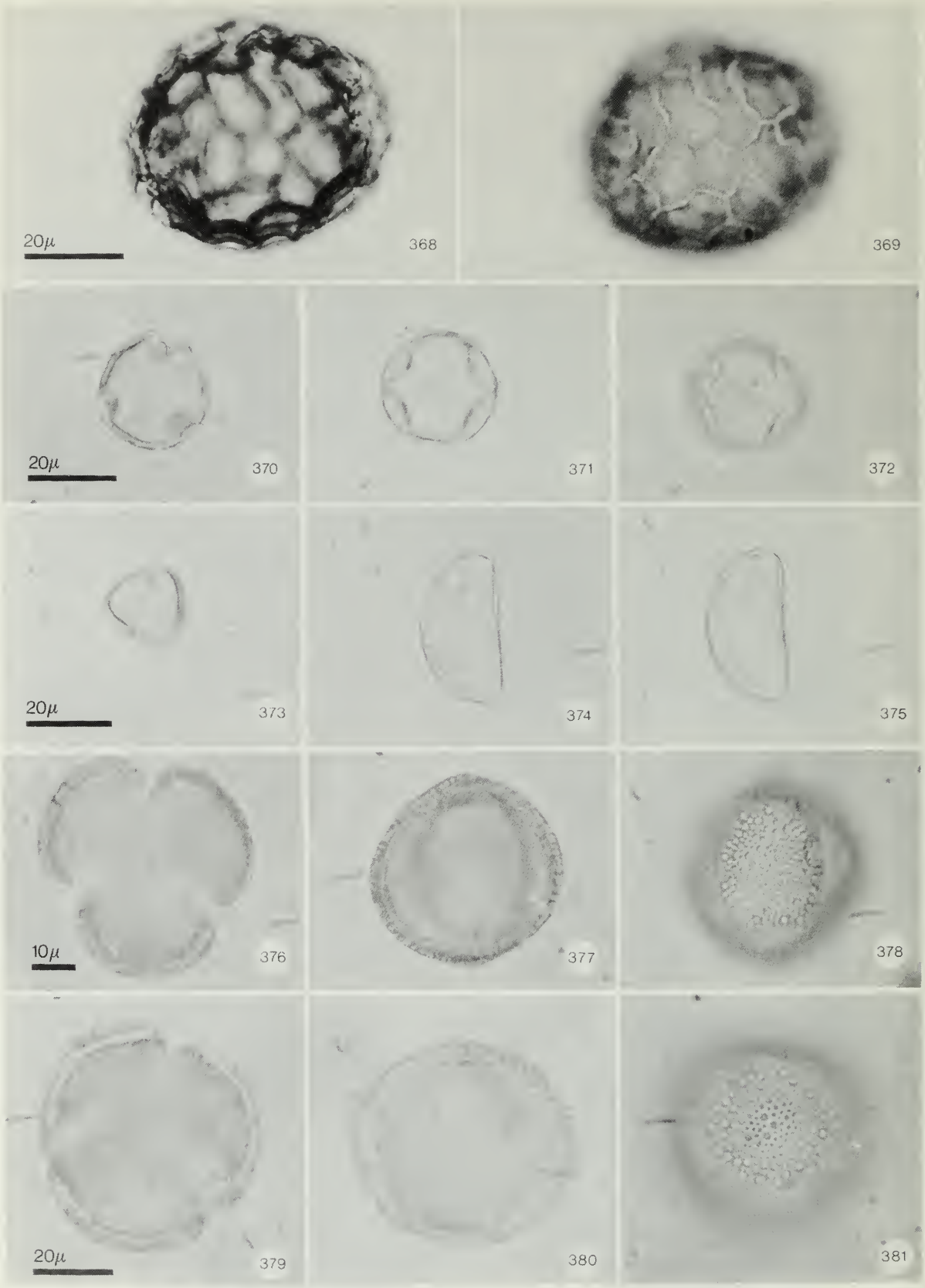

LM Plate 22 Figs. 318–320: *Melilotus alba* (p, e, s); Figs. 321–323: *M. indica* (p, e, s); Figs. 324–326: *M. officinalis* (p, e, s); Figs. 327–329: *Onobrychis viciaefolia* (p, e, s); Figs. 330–332: *Phaseolus coccineus* (p, e, s); Figs. 333–335: *P. vulgaris* (p, e, s).



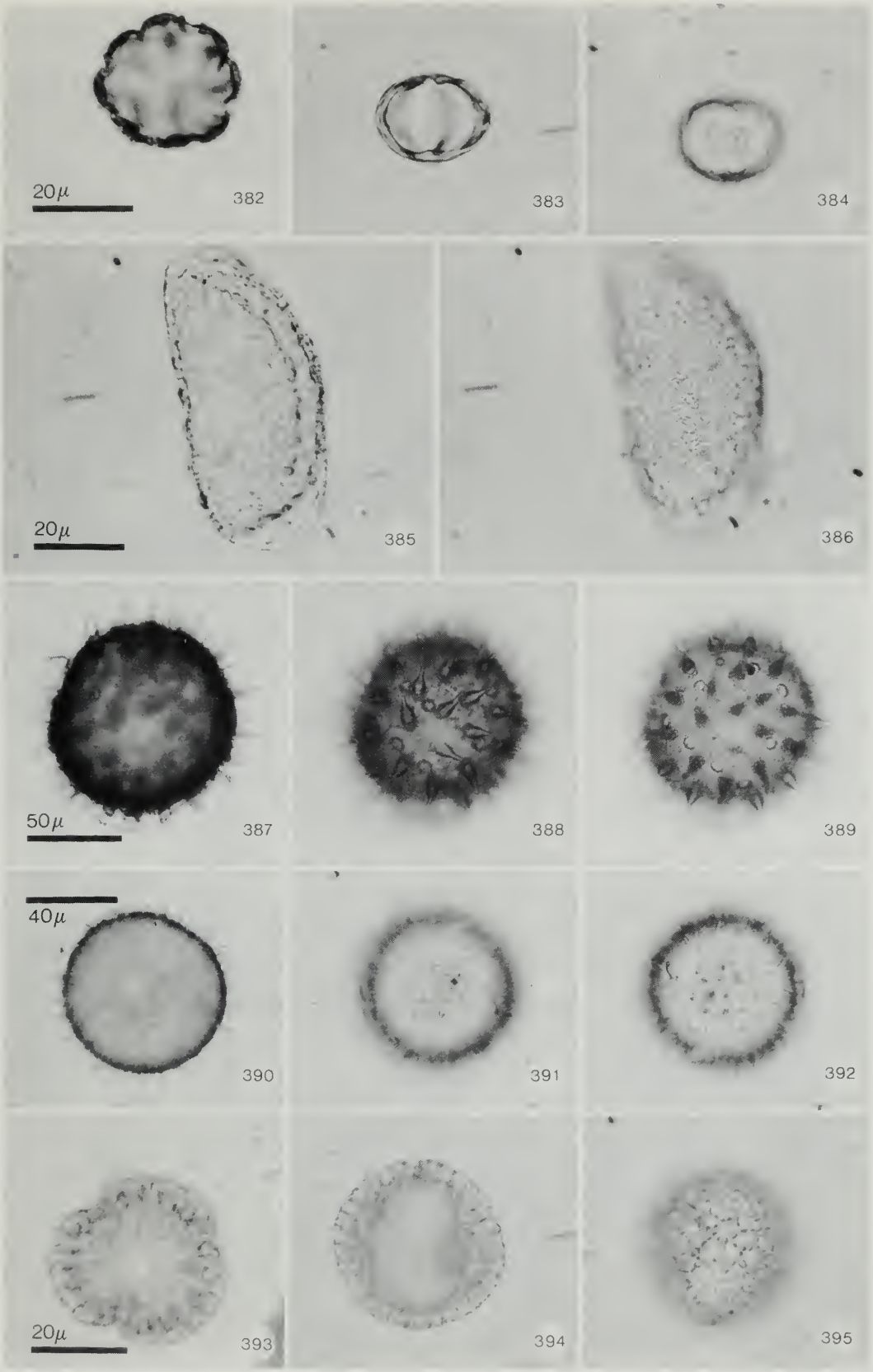

LM Plate 23 Figs. 336–338: *Robinia pseudo-acacia* (p, e, s); Figs. 339–341: *Trifolium hybridum* (p, e, s); Figs. 342–344: *T. pratense* (p, e, s); Figs. 345–347: *T. repens* (p, e, s); Figs. 348–350: *Vicia angustifolia* (p, e, s); Figs. 351–353: *V. americana* (p, e, s).



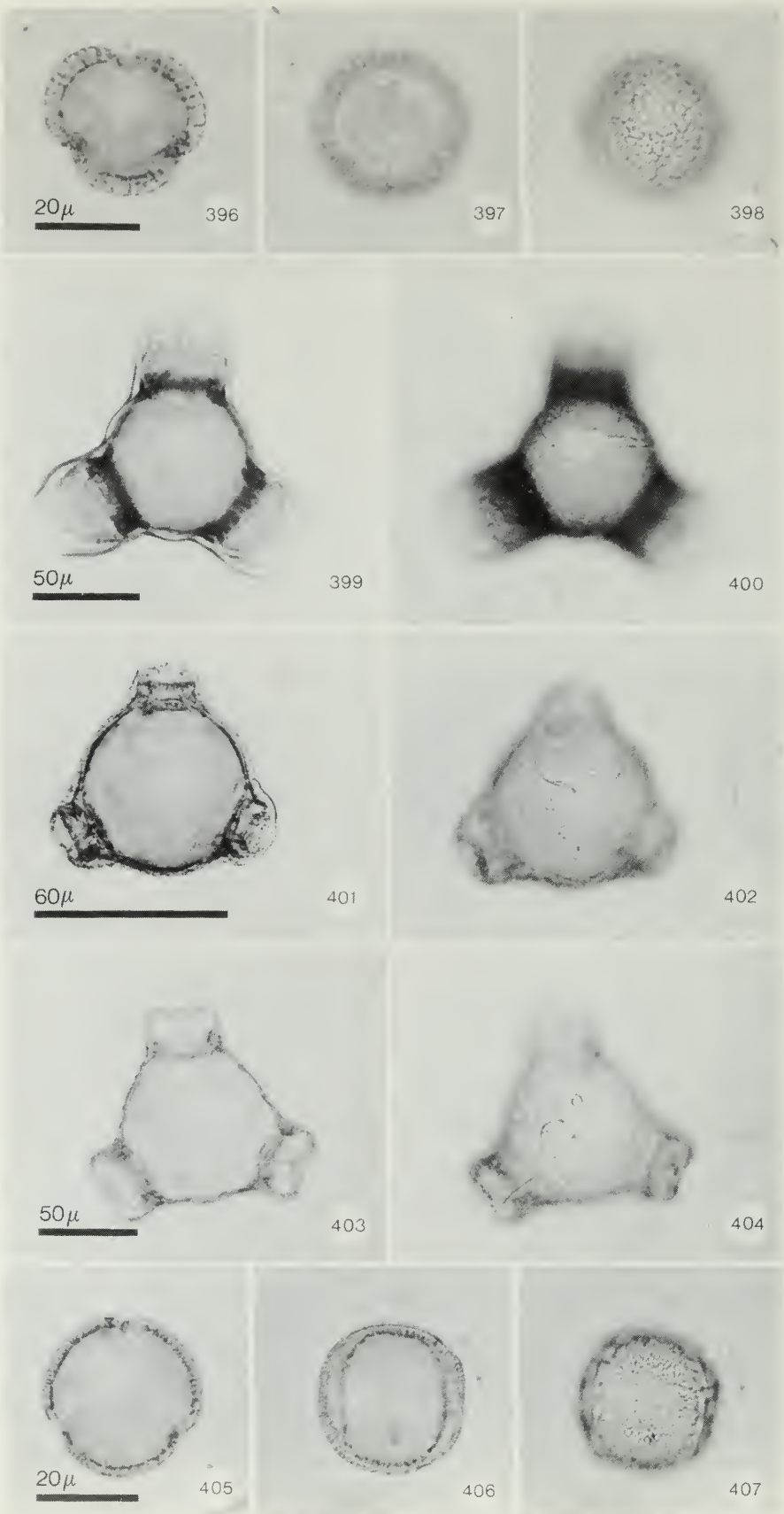

LM Plate 24 Figs. 354–356: *Vicia cracca* (p, e, s); Figs. 357–359: *V. faba* (p, e, s); Figs. 360–362: *V. sativa* (p, e, s); Figs. 363–365: *V. villosa* (p, e, s); Figs. 366, 367: *Vigna sinensis* (p, ps).



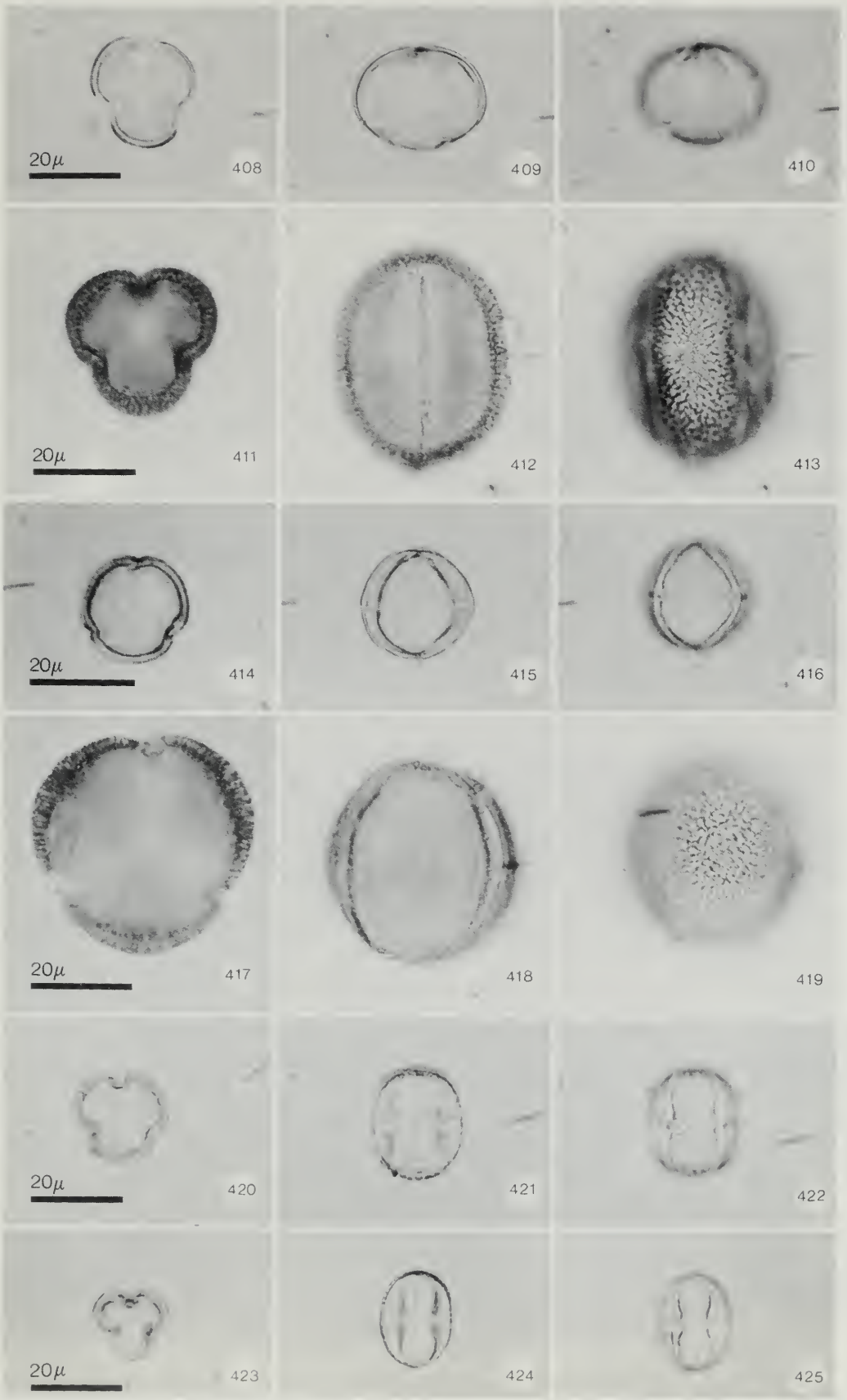

LM Plate 25 Figs. 368, 369: *Vigna sinensis* (e, s); Figs. 370–372: *Wisteria floribunda* (p, e, s); Figs. 373–375: *Allium cernuum* (p, e, s); Figs. 376–378: *Linum flavum* (p, e, s); Figs. 379–381: *L. perenne* (p, e, s).



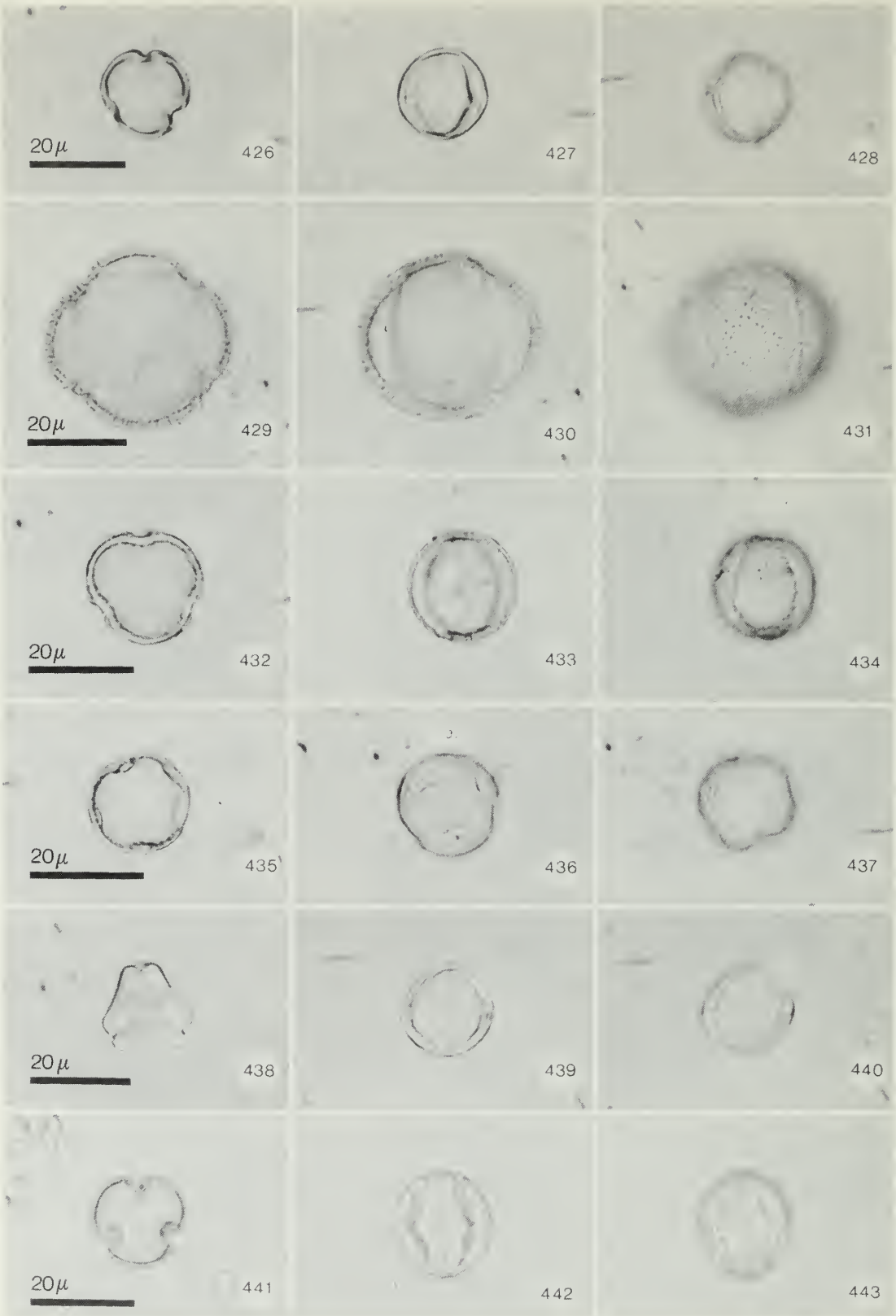

LM Plate 26 Figs. 382–384: *Lythrum salicaria* (p, e, s); Figs. 385, 386: *Liriodendron tulipifera* (e, s); Figs. 387–389: *Hibiscus trionum* (e, s, s); Figs. 390–392: *Malva moschata* (e, s, s); Figs. 393–395: *Ligustrum japonicum* (p, e, s).



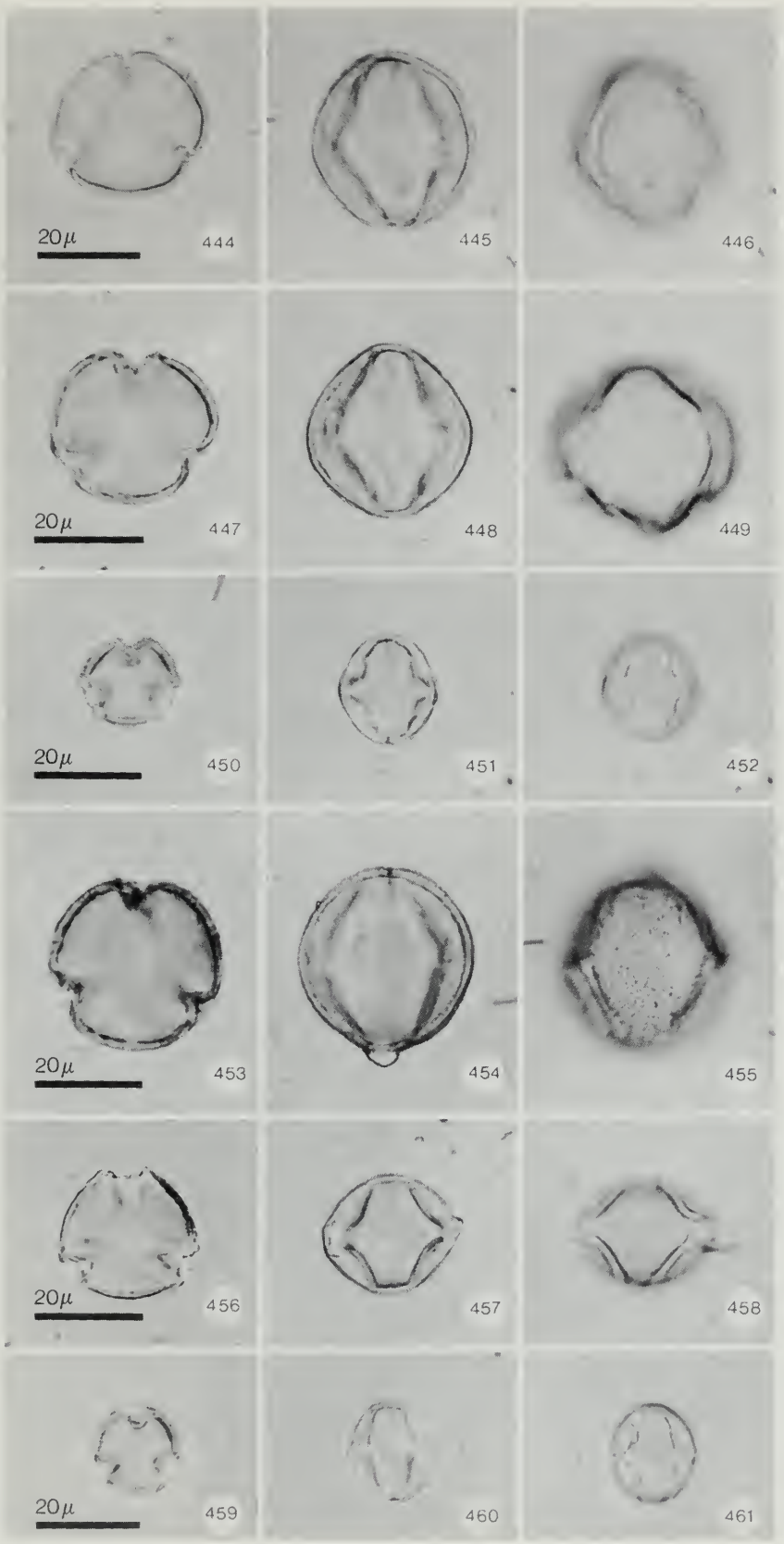

LM Plate 27 Figs. 396–398: *Ligustrum vulgare* (p, e, s); Figs. 399, 400: *Clarkia* sp. (p, ps); Figs. 401, 402: *Epilobium angustifolium* (p, ps); Figs. 403, 404: *Oenothera biennis* (p, ps); Figs. 405–407: *Oxalis stricta* (p, e, s).



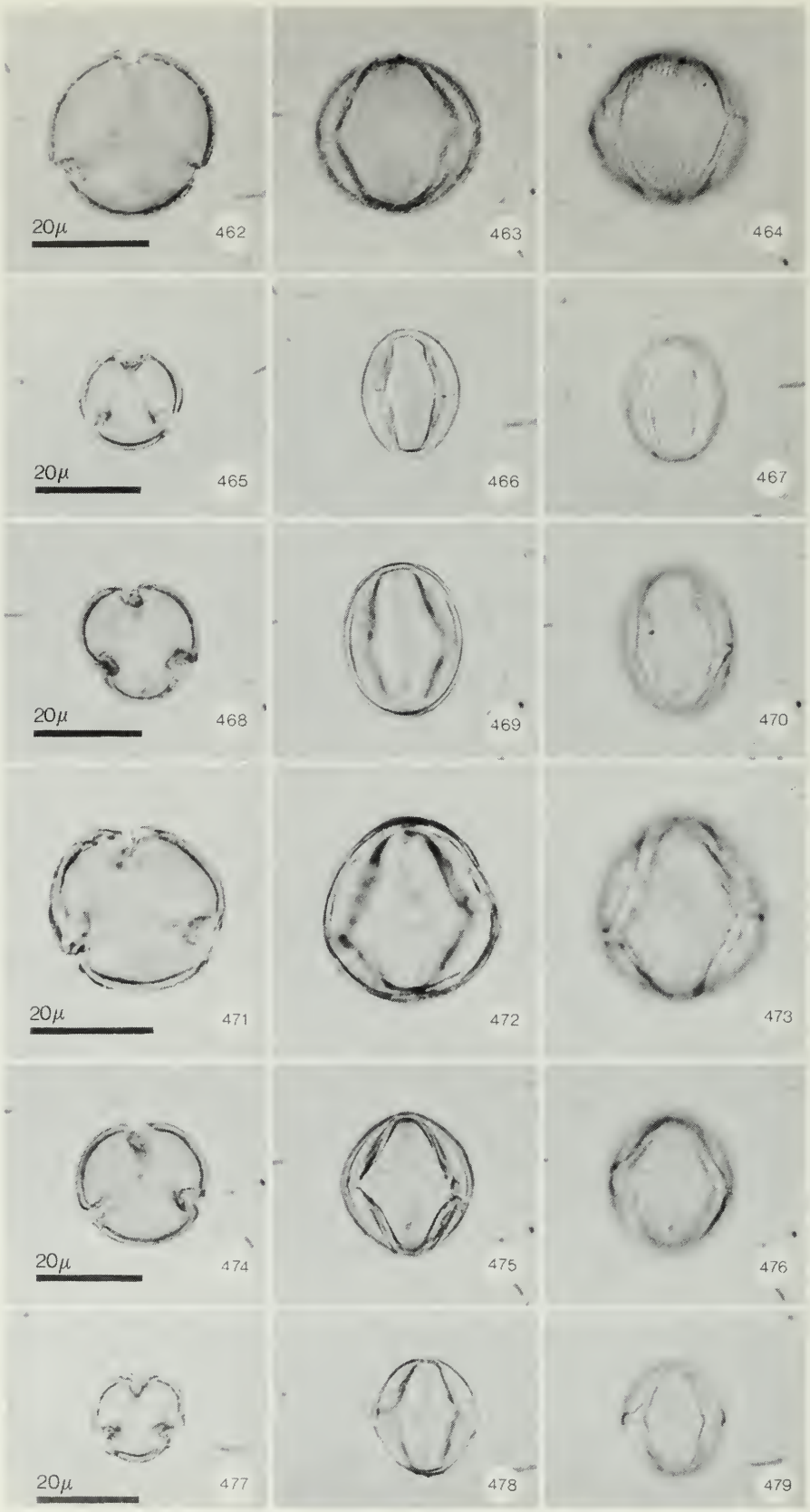

LM Plate 28 Figs. 408–410: *Phryma leptostachya* (p, e, s); Figs. 411–413: *Fagopyrum esculentum* (p, e, s); Figs. 414–416: *Polygonum cilinode* (p, e, s); Figs. 417–419: *Claytonia virginica* (p, e, s); Figs. 420–422: *Lysimachia punctata* (p, e, s); Figs. 423–425: *L. terrestris* (p, e, s).



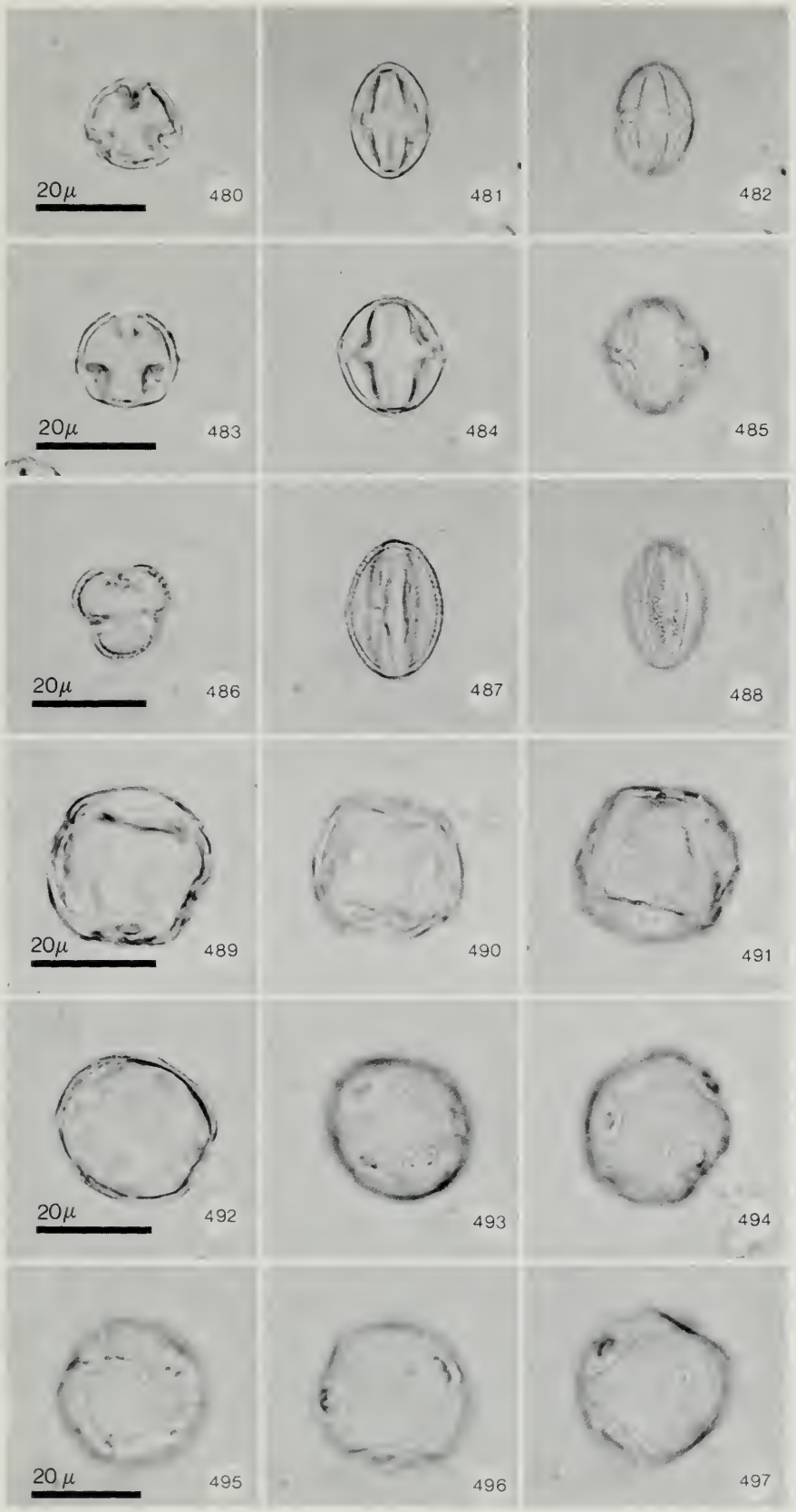

LM Plate 29 Figs. 426–428: *Lysimachia thrysiflora* (p, e, s); Figs. 429–431: *Anemone patens* (p, e, s); Figs. 432–434: *Clematis virginiana* (p, e, s); Figs. 435–437: *Thalictrum occidentale* (whole grain, s, s); Figs. 438–440: *Rhamnus alnifolia* (p, e, s); Figs. 441–443: Amelanchier alnifolia (p, e, s).



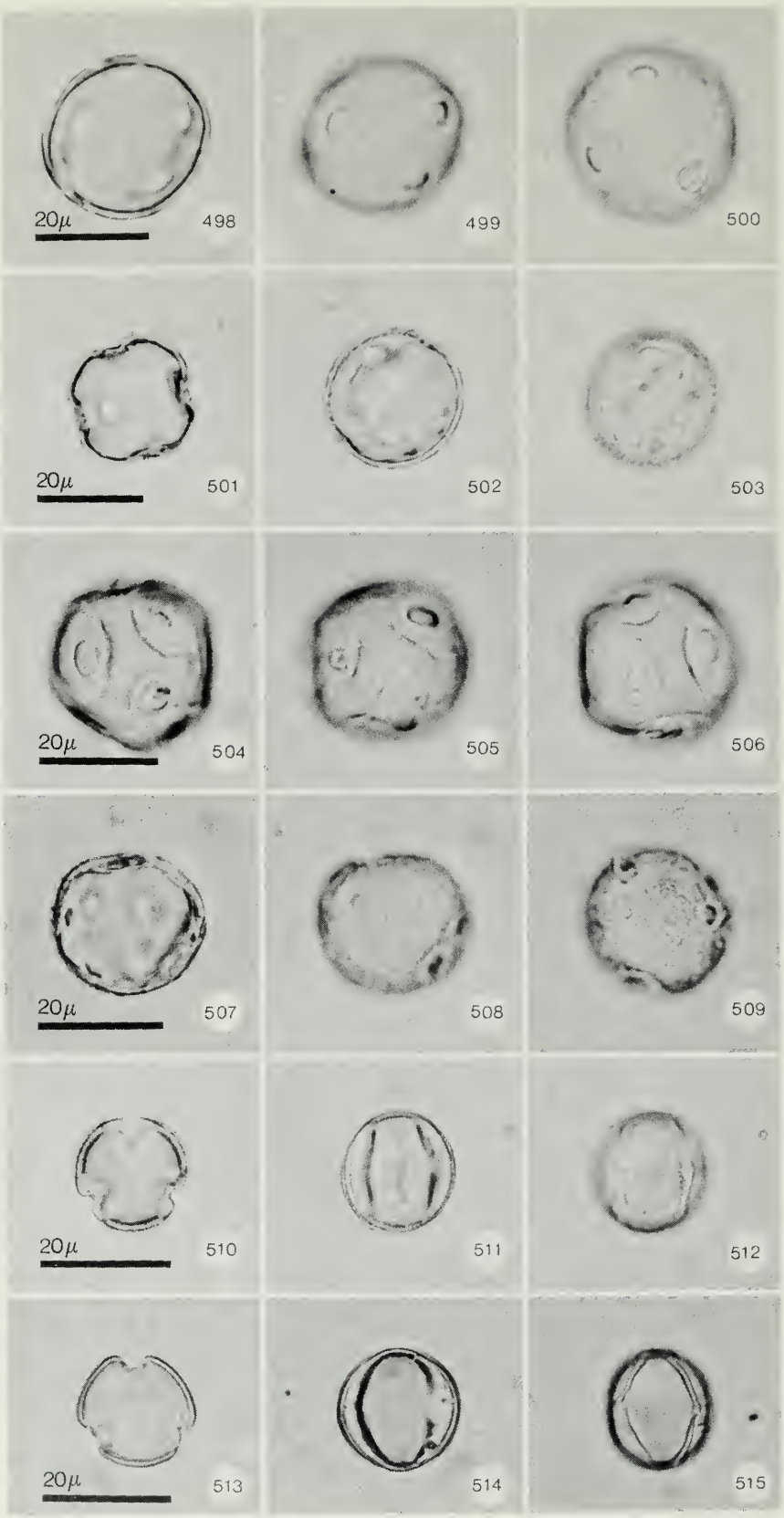

LM Plate 30 Figs. 444–446: *Crataegus crus-galli* (p, e, s); Figs. 447–449: *C. monogyna* (p, e, s); Figs. 450–452: *Fragaria virginiana* (p, e, s); Figs. 453–455: *Prunus domestica* (p, e, s); Figs. 456–458: *P. pensylvanica* (p, e, s); Figs. 459–461: *P. serotina* (p, e, s).



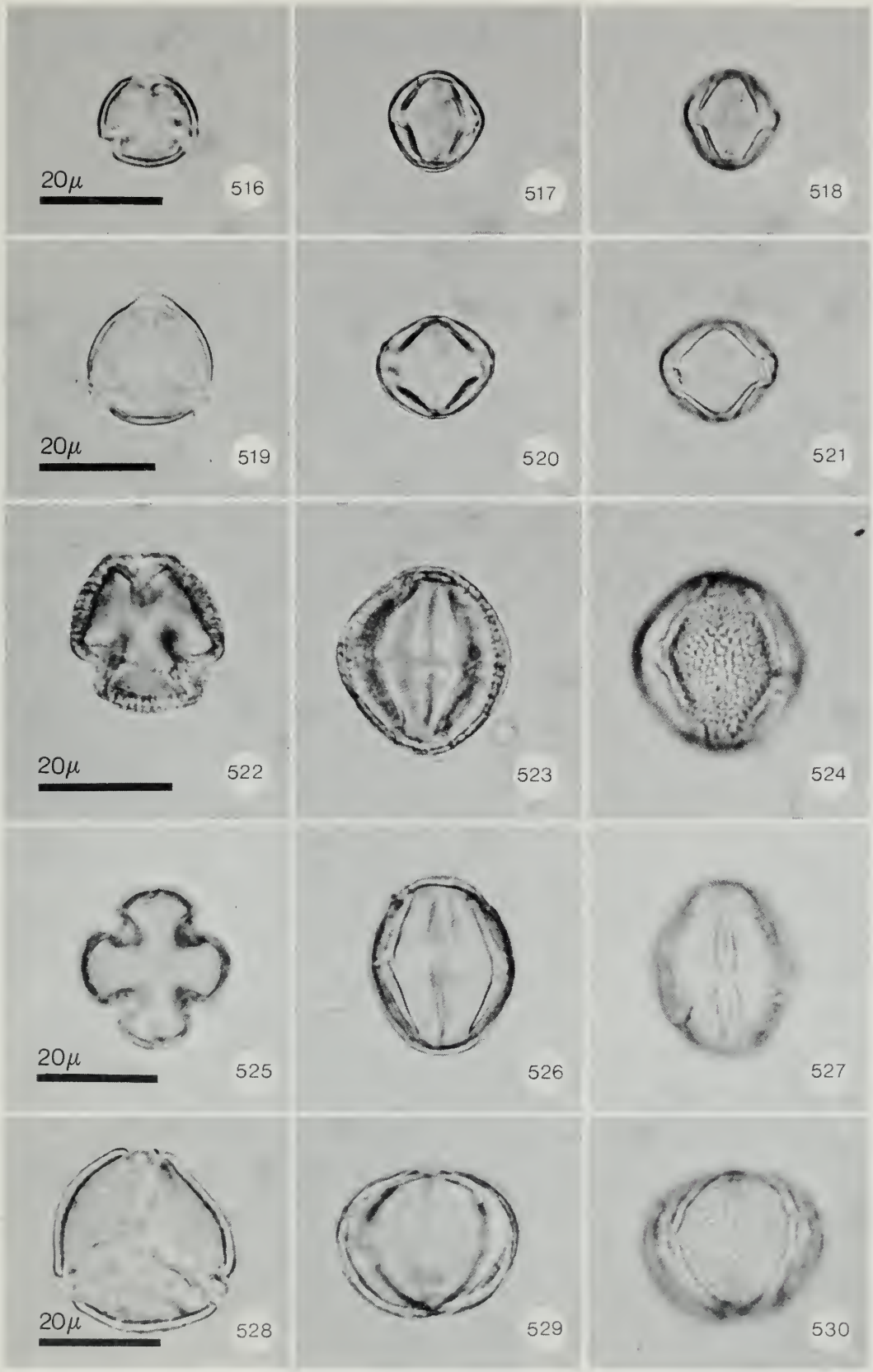

LM Plate 31 Figs. 462–464: *Prunus serrulata* (p, e, s); Figs. 465–467: *Pyrus aucuparia* (p, e, s); Figs. 468–470: *P. communis* (p, e, s); Figs. 471–473: *P. coronaria* (p, e, s); Figs. 474–476: *P. malus* (p, e, s); Figs. 477–479: *Rosa multiflora* (p, e, s).



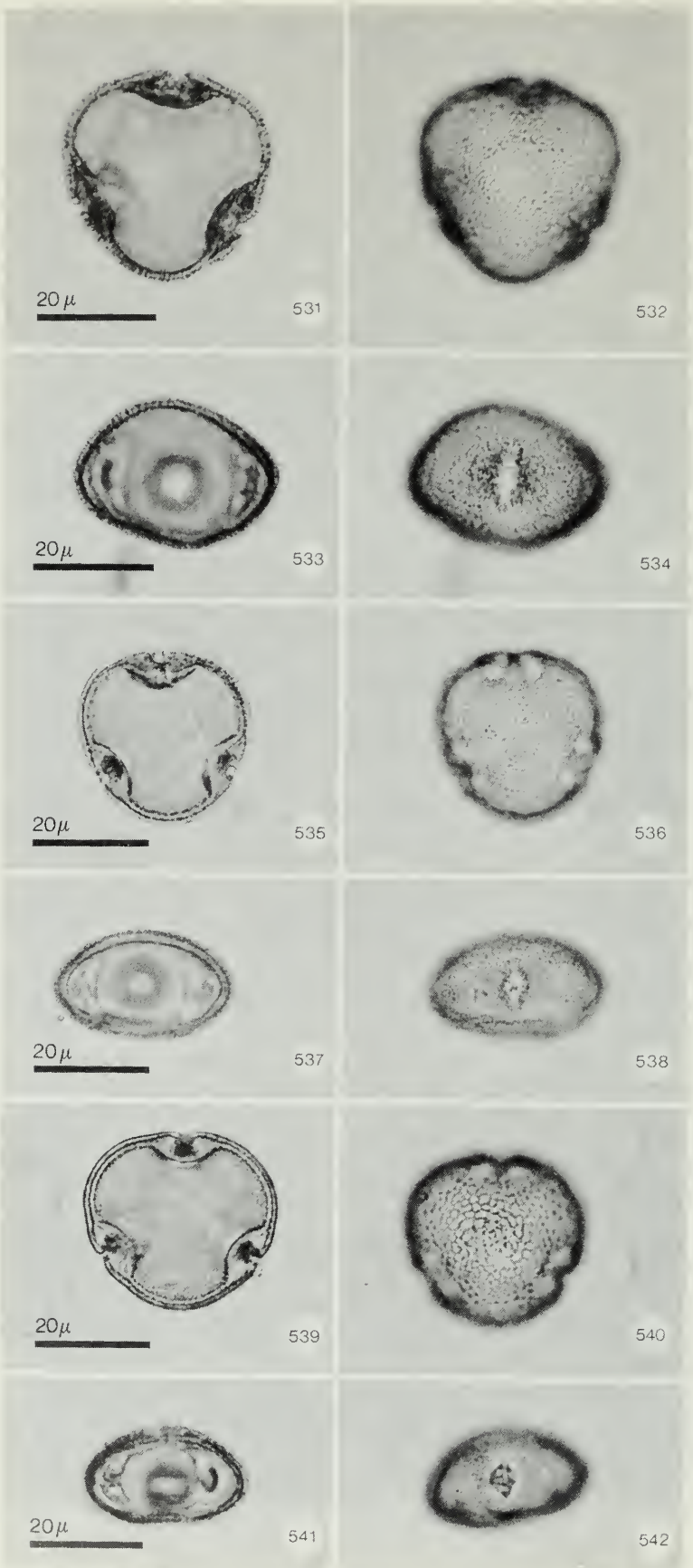

LM Plate 32 Figs. 480–482: *Rubus idaeus* (p, e, s); Figs. 483–485: *R. odoratus* (p, e, s); Figs. 486–488: *Salix discolor* (p, e, s); Figs. 489–491: *Ribes americanum* (e, s, s); Figs. 492–494: *R. aureum* (e, s, s); Figs. 495–497: *R. glutinosum* (s, s, s).




LM Plate 33 Figs. 498–500: *Ribes odoratum* (e, s, s); Figs. 501–503: *R. oxycanthoides* (e, s, s); Figs. 504–506: *R. sanguineum* (s, s, s); Figs. 507–509: *R. triste* (e, s, s); Figs. 510–512: *Antirrhinum majus* (p, e, s); Figs. 513–515: *Digitalis purpurea* (p, e, s).

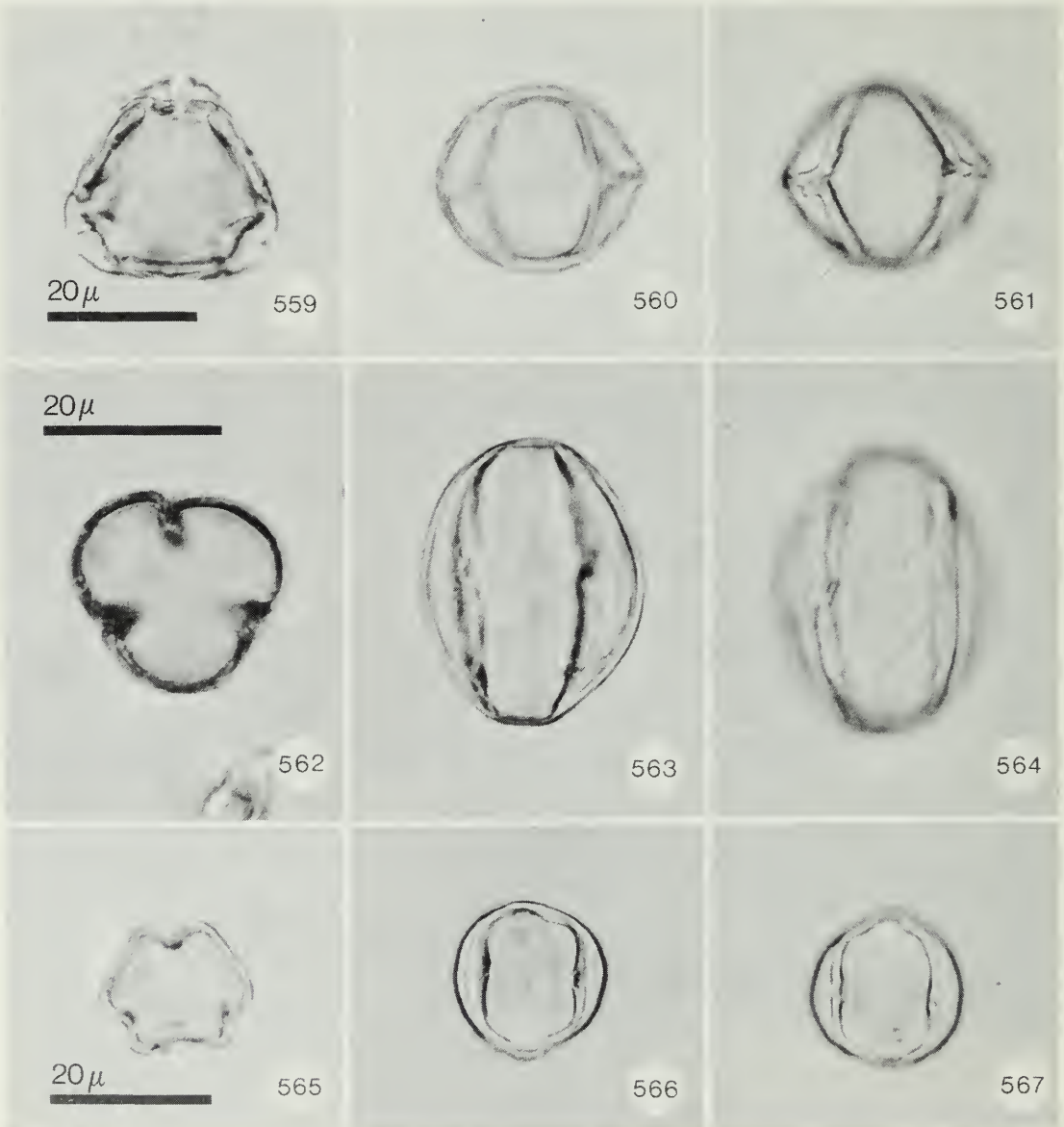



LM Plate 34 Figs. 516–518: *Linaria vulgaris* (p, e, s); Figs. 519–521: *Penstemon gracilis* (p, e, s); Figs. 522–524: *Ailanthus altissima* (p, e, s); Figs. 525–527: *Nicotiana tabacum* (p, e, s); Figs. 528–530: *Petunia hybrida* (p, e, s).




LM Plate 35 Figs. 531–534: *Tilia americana* (p, ps, e, s); Figs. 535–538: *T. cordata* (p, ps, e, s); Figs. 539–542: *T. xeuropaea* (p, ps, e, s).


LM Plate 36 Figs. 543–546: *Tilia platyphyllos* (p, ps, e, s); Figs. 547–549: *Angelica atropurpurea* (p, e, s); Figs. 550–552: *Carum carvi* (p, e, s); Figs. 553–555: *Daucus carota* (p, e, s); Figs. 556–558: *Pastinaca sativa* (p, e, s).




LM Plate 37 Figs. 559–561: *Verbena hastata* (p, e, s); Figs. 562–564: *Viola palustris* (p, e, s); Figs. 565–567: *Vitis vinifera* (p, e, s).

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