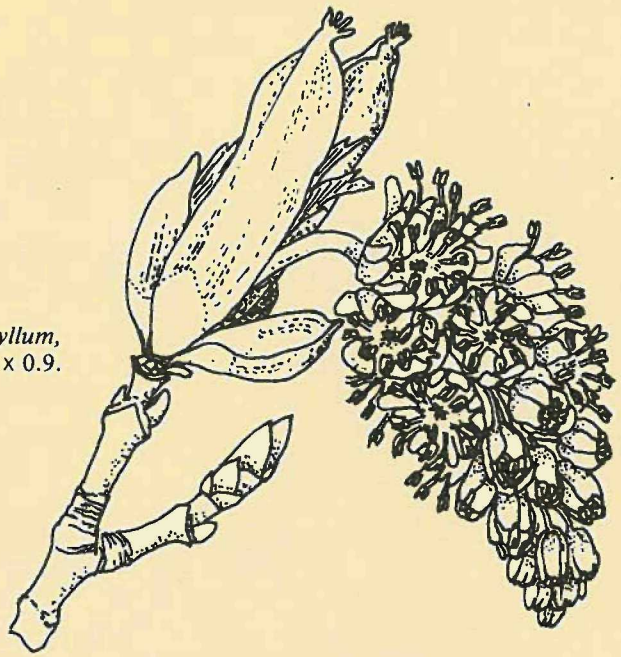
DAVIDSONIA

VOLUME 9 *NUMBER 1* *Spring 1978*

Cover:

Clematis occidentalis subsp. *grosseserrata*,
Western Blue Clematis.



Inflorescence of *Acer macrophyllum*,
Bigleaf Maple, x 0.9.

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Rust Fungi in the British Columbia Flora

D.B.O. SAVILE*

Introduction

Fungi have been treated traditionally as plants. Recent advances, especially in comparative biochemistry and in studies of fine structure with the electron microscope, have shown (see, e.g., Margulis, 1970) that it is more rational to treat living organisms in five kingdoms: Monera (the prokaryotic bacteria and blue-green algae); Protista (a diverse assemblage of simple eukaryotes); Plantae; Animalia; and Fungi. However, many fungi are so intimately associated with plants (as parasites, symbionts or saprophytes) that it is convenient, for ecological purposes, to treat them as part of the flora.

The rust fungi (Uredinales) are peculiar in that heteroecism, the habit of producing the pycnia[1] and aecia[2] on a plant unrelated to that on which the uredinia[3] and telia[4] occur, is very widespread. Nearly all the more primitive rusts are heteroecious[5]; but autoecism[6], coupled with morphological advances and usually a shortened life cycle, has been adopted repeatedly in the more advanced genera. The rusts have generally been placed in two families, Melampsoraceae and Pucciniaceae. Recent studies on the adaptive significance of many structures in the rusts (Savile, 1976b) have shown emphatically that free pedicellate teliospores have arisen in at least three groups. I accordingly recognize five families of rusts: Pucciniastraceae, Melampsoraceae, Pucciniaceae, Phragmidiaceae and Raveneliaceae, whose relationships are shown diagrammatically in Figure 1. Raveneliaceae are mainly tropical, but the other families occur freely in British Columbia.

No fungi have a closer association with vascular plants than the rusts, which make no saprophytic growth in nature. It has been realized since the work of Dietel (1904) that the various rusts and their host plants reflect each others' ages of origin. Thus the rusts with the simplest teliospores occur on ferns and their aecial states are on firs *(Abies)*. Morphological advancement is correlated with increasingly advanced host plants, until finally, especially in the huge genus *Puccinia,* we can trace lineages terminating in very modern herbaceous flowering plants (Savile, 1971a, 1976b). This intuitive view of age relationship was eventually put on a firmer basis by the realization that new species, and even lineages, of rusts often arise by jumps to new hosts when we have evolutionarily young, rapidly evolving parasites and potential hosts growing with a strong ecogeographic overlap, conditions that maximize the chance for compatible genomes to meet (Savile, 1971b).

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[1]Small, usually yellow structures producing: small uninucleate pycniospores that function as sperm cells; receptive hyphae to which the spores fuse; and nectar which attracts insects that effect cross-fertilization.

[2]Yellow, white or tan, often cupulate structures, producing usually hyaline-walled binucleate asexual spores that infect the same or an alternate host.

[3]Generally brown and powdery structures, producing often several generations of binucleate urediniospores reinfecting the same host.

[4]Structures usually succeeding uredinia in late summer, bearing blackish brown binucleate teliospores, in which nuclear fusion and reduction division occur to complete the sexual cycle. The spores produce uninucleate basidiospores in spring, which infect the aecial host to produce pycnia.

[5]With uredinia and telia produced on a plant unrelated to that which produces pycnia and aecia.

[6]With all spore states produced on one host.

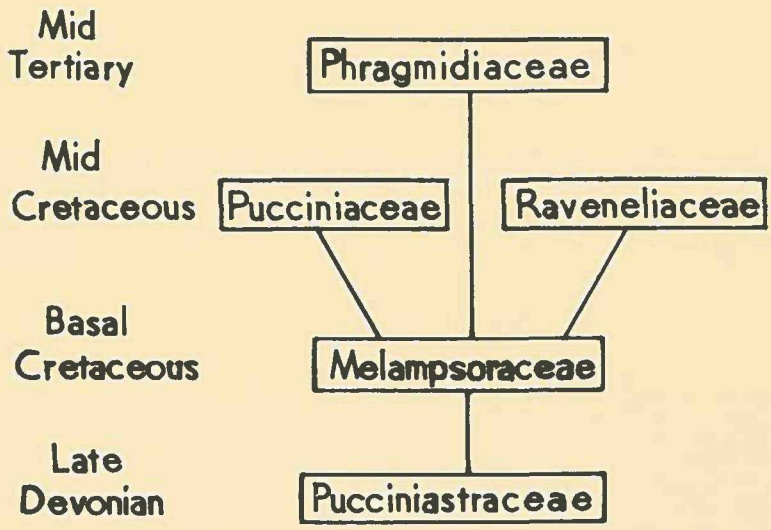

FIGURE 1. Relationships and tentative dates of origin of the families of rust fungi.

Study of the rust fungi could not advance importantly until the development of modern microscopes late in the 19th century. Inevitably, mycologists relied on aid from phanerogamic botany with its longer history, organisms with more obvious and more abundant morphological characters, and a substantial if patchy fossil record, for guidance in classification. In recent years it has become evident that if we study our rusts in sufficient detail, we can sometimes provide clues to the relationships of certain plants; and, more importantly from the viewpoint of developing a phyletic classification, we can often use rust data to indicate the relative ages of plant groups. Some examples of this method of study were given by Savile (1971a).

An Ecological and Biogeographic Approach to Rust Studies

This improved understanding both of the rusts and of their host relationships grew substantially out of an increasingly ecological and biogeographic approach to field study and collecting, which was developed mainly between 1949 and 1962, especially in the subarctic and arctic as well as in and adjacent to British Columbia. What this approach means is that we must do a large proportion of our own field work if we hope to understand what is happening. The great value of British Columbia for studies of this sort lies both in its position on the migration route between North America and Asia; and, especially, in its great climatic diversity over short distances, with habitats ranging from salt marsh or Upper Sonoran desert to high alpine.

I shall try to show, through some examples, how the naturalist can add to our understanding of these interesting and important fungi. Field study of the rusts needs no elaborate equipment and relatively little special knowledge. It does require that we be Curious Naturalists (to borrow Nikolaas Tinbergen's felicitous phrase), that we keep our eyes open and look for the causes of what we see. Rusts seldom occur randomly, but rather in response to characteristics of the physical or biological environment. Nor are their morphological characters mere accidents, but a response to an ecological problem (Savile, 1976b).

A Lodgepole Pine Forest Association

If you drive eastward on Hwy. 3 through Allison Pass, you come suddenly into the moderately dry lodgepole pine forest. A common shrub here and in similar habitats is Soopolallie, *Shepherdia canadensis*. In other associations it may harbor other rusts, but here, as in many similar associations, it harbors the aecia of a biotype of *Puccinia coronata* that alternates only to a tall, caespitose grass, *Calamagrostis rubescens*. Wherever these two plants are abundantly associated we see yellow blotches on the green upper surface of the *Shepherdia* leaves. Turning the leaves over shows the white cluster cups filled with yellow spores. Somewhat later the brown to black uredinia and telia develop on the grass leaves. This rust seems to be an incipient species, probably already practically genetically isolated on these two plants.

A Moist Montane Forest Rust

Now let us visit some moister mountain area provided with a road or trails up to treeline, such as Mount Revelstoke or Glacier. In moist sites, such as the shallow ditch on the uphill side of a trail, we may see a delicate grass, *Agrostis thurberiana,* and a greenish-flowered orchid, *Platanthera stricta,* starting at perhaps 1300 m. Where the plants are within 50 cm of each other we may see conspicuous aecia on the orchid and, in late summer, small inconspicuous uredinia and telia on the grass. By 1500 m we may find that the rust occurs only where the plants are within 15 to 20 cm of each other. Finally, at perhaps 1600 to 1800 m, the rust occurs only when the plants are contiguous. This rust, *Puccinia praegracilis,* was first collected at Glacier by E.W.D. Holway, a retired banker who was a noted alpinist and a tireless collector of rusts. He sent his material to Professor Arthur, and his notes in the type packet state that the grass rust "grew adjacent to the *Habenaria* [*Platanthera*] aecidium, and no where else". Arthur named the rust, but he lacked Holway's alpine experience and did not appreciate that these exclusive associations are as reliable as a controlled inoculation. He later (1934) buried this perfectly good species under *P. coronata* without even citing it in synonymy. We have repeated Holway's observations several times in southern British Columbia and Alberta (Savile, 1976a). The reason for the exclusively close association of the alternate hosts at high elevation (and near arctic tree line) is that the short season allows little time for population build-up by urediniospores. Unless the hosts are adjacent, too few of the randomly scattered spores land on leaves of the alternate hosts to maintain the rust.

An Alpine Violet Rust

Various rusts of alpine plants accompany their hosts far below tree line along brooks. But another of Holway's rusts from Glacier seems not to occur appreciably below tree line. This is *Puccinia ornatula* on *Viola glabella.* He made three collections all stated to be from alpine meadows. The hosts were variously identified by an eastern botanist, but all are definitely *Viola glabella.* I was puzzled because whenever I had seen it, *V. glabella* petered out just below tree line; and I suspected that the sites might be subalpine meadow openings. For many years only Holway's original collections were known. Then J.A. Calder found a trace infection, again on *V. glabella,* in the Kenai Peninsula, Alaska, in 1951. In 1975 I searched for this rust on various mountain slopes in southwestern British Columbia and Mt. Revelstoke without success; but my wife and I found it on a windswept ridge in the Olympic Mts., partly shaded by scrub trees; the site was at only 1645 m, but was essentially alpine because of its severe wind-sweep. Returning east in mid August we camped at Glacier and I went up Avalanche Crest Trail. *Viola glabella* was abundant from the foot of the trail at 1220 m (as indeed it is near the highway through Rogers Pass), and I checked hundreds of plants without success until the plant dropped out, as usual, somewhat below tree line at ca. 1900 m. I entered the alpine area at ca. 2070 m, and to my delight the plant appeared once more at ca. 2160 m among frost-heaved rocks at the lip of a cirque. Under overhanging rocks and in the shade of taller plants I found a number of rusted specimens. Readers are invited to explain why the rust survives at this site but could not be found below tree line at presumably more benign sites; and why *Viola glabella* here grows above tree line but does not do so at other sites known to me, including Balu Pass just across the highway, and Mt. Revelstoke a short distance to the west.

Dry-Land Adaptations

For a change of scene let us visit the southern part of the Okanagan Valley, at the northern limits of the Upper Sonoran desert, in spring when the grassy slopes are gay with flowers. Here I first saw the exquisite Sagebrush Mariposa Lily, *Calochortus macrocarpus* var. *macrocarpus.* My excitement was doubled by discovery of the aecia of its rust, *Puccinia calochorti.* Finding the telia, which are initiated later in much drier weather, was more difficult, for most of them were in the axils of the clasping leaf bases; but we eventually found the rust nearly throughout the range of *C. macrocarpus* and the more eastern *C. apiculatus.* In this microhabitat moisture from dew or occasional rain persists long enough to allow infection to occur. Nine years later the recollection of this experience led me to the discovery of a new desert-adapted rust in the leaf axils of a high-arctic grass in arid Hazen Valley at nearly 82°N in northern Ellesmere Island.

Other instructive examples of dry-land adaptation are seen in the genus *Gymnosporangium,* whose species nearly all have aecia on pomaceous hosts and telia on *Juniperus* or related genera. In this genus the teliospores are formed in spring, and the aecia in late spring or, usually, mid to late summer. Many species prefer, or at least tolerate dry summers. However, *G. nootkatense* is confined to the humid parts of the Pacific coast and adjacent islands. Its telia are on Yellow Cedar, *Chamaecyparis nootkatensis,* and aecia on the Pacific Crab Apple, *Malus fusca.* In its range the summers are never dry; the aecia are cupulate, and the spores have thin, nearly colorless walls and are forcibly discharged under turgor, just as are those of most *Puccinia* species in spring (Savile, 1976b).

Most species of *Gymnosporangium* occur in climates that are too dry in summer for forcible aeciospore discharge to function reliably. Instead the aecia are roestelioid, i.e. with long cylindric to cornute peridia that do not recurve as in *Puccinia* but develop longitudinal slits. The aeciospores accumulate within the peridia and are shaken out through the slits when the wind is adequate to ensure dispersal. In most species the aeciospores have thick, yellow-brown walls that minimize water loss. Along the dry valleys of southern British Columbia, from the Similkameen River eastward to the Rockies, we find *Gymnosporangium bethelii, G. clavariiforme, G. inconspicuum, G. nelsonii* and *G. nidus-avis* maturing their aecia in late July or August on *Amelanchier, Crataegus* or both. Generally some way up the hillsides, but still subject to quite dry summers, we find *G. cornutum* and *G. tremelloides* with aecia on *Sorbus* (Parmelee, 1971).

This adaptation is not unique to *Gymnosporangium.* A few species of *Puccinia* have repeating aecia, rather than aecia and uredinia. In dry summers the secondary aeciospores are unlikely to be forcibly discharged reliably. One such species is *Puccinia palmeri* which occurs, especially on *Penstemon procerus,* on generally dry hillsides in much of British Columbia; in this species forcible discharge has been dropped, the peridia are roestelioid, and the aeciospores have a yellow wall pigment.

A Study in Host-Parasite Coevolution

To end this brief look at the rusts, let me give an example of a type of study mentioned in the first section of this paper: the use of rust-host relationships to improve our understanding of the host interrelationships. Saxifragaceae, in the restricted sense, serves as my example. This family is pertinent in our context, for most of the genera are represented in our flora, including various sections of the large genus *Saxifraga.* The family is small enough to make detailed studies of it practicable, and we have rusts on a substantial proportion of genera and sections. In 1954 I somewhat prematurely published a study of these rusts which clarified some points in the biogeography and evolutionary trends in the family, but had several puzzling and disturbing aspects.

As the years passed I amassed many more rust specimens on a much wider assortment of host species. Increased familiarity allowed me to correct many errors in host determination among the older specimens. The availability of greatly improved phase-contrast microscope optics allowed more detailed study of spore-wall sculpturings which, with the elimination of host errors and a much longer series of specimens, allowed the recognition of a number of subtly distinct host-limited rusts (Savile, 1973). I was then able to apply the copious

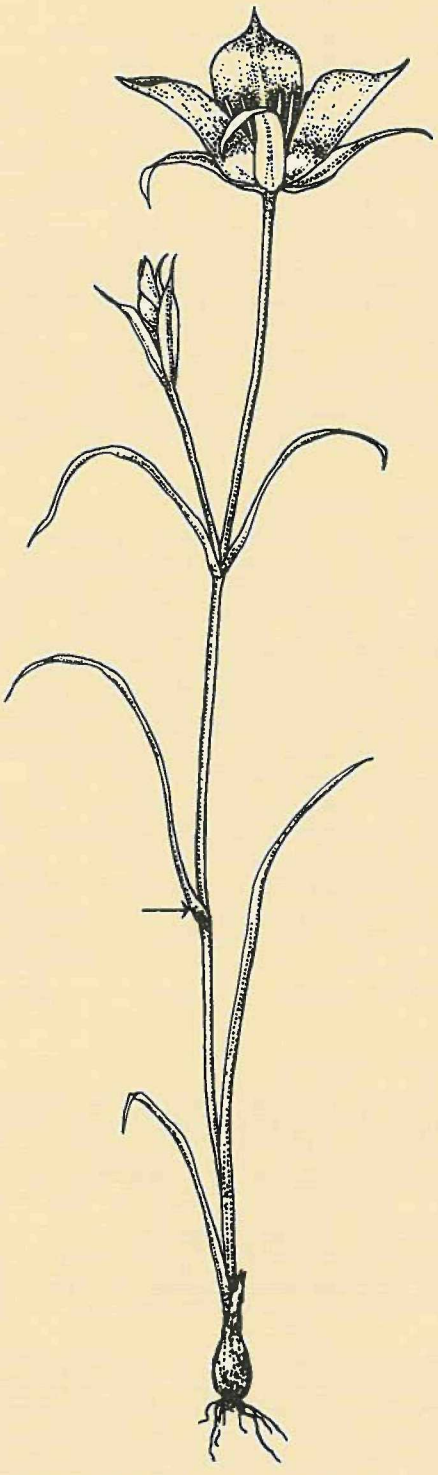

FIGURE 2. *Calochortus macrocarpus* var. *macrocarpus,* X.33, showing leaf bases (arrowed) where the rust fungus *puccinia calochorti* is found.

and detailed rust data to a study of the evolution and biogeography of Saxifragaceae (Savile, 1975). The data help us in two ways: they confirm various relationships; and they tell us the approximate relative ages of many plants. As an example of the first type of aid, the occurrence of three rusts in the assemblage on *Chrysosplenium,* including one that goes to other genera, confirms that this curious genus, adapted to semi-aquatic habitats and to splash pollination and seed dispersal, really belongs in the family.

Using rust morphology as a measure of relative age, we are able to see that the early evolution of the family took place around the North Pacific rim, with periodic crossings of the Bering bridge; and that later radiations occurred in the Himalayas, the North American Cordillera, Beringia and the European mountain systems. Although we have no firm dates, except late Pleistocene for some of the most advanced species of *Saxifraga,* it is clear that the whole family evolved in late Tertiary, after the northern continents reached nearly their present relationships and the uplift of the various Tertiary mountain systems was well advanced.

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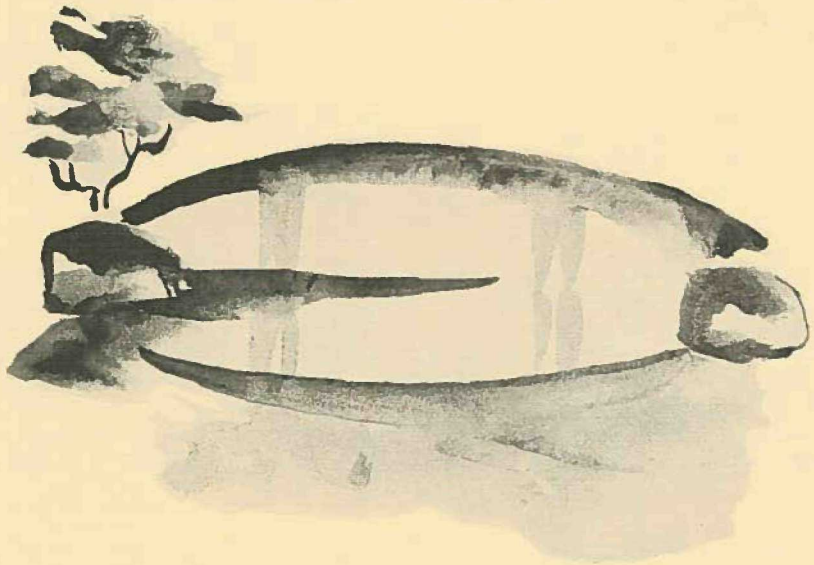

Oenotheras in Cultivation

GERALD B. STRALEY*

The evening-primrose family, Onagraceae, is of world-wide distribution and contains about 20 genera with some 350 species, mostly annuals and herbaceous perennials, and in the tropics a few shrubs and trees. Species diversity is especially rich in Western North America, particularly in California. The family is not an important one from an economic standpoint, but has received much purely scientific study owing to interesting chromosome aberrations found in few other plants, and to the interesting interrelationships of flowers and the insects or other animals which pollinate them. The family contains some very familiar species such as Fireweed *(Epilobium angustifolium);* Clarkias, raised as garden annuals; and Fuchsias, frequent subjects for hanging baskets. The largest genus in the family is *Oenothera* (pronounced E-no-ther-a), the evening-primroses and sun-drops with about 80 species. This and the closely related genera *Camissonia* and *Calylophus*, which are all included within the genus *Oenothera* by some workers, contain some of the showiest annual, biennial and perennial native plants in North America. The flowers are either usually white to pink and open in the evening, hence the name Evening-primrose, or yellow and open during the day, the Sun-drops.

Habit

The biennial and perennial species of *Oenothera* usually produce a flat basal rosette of leaves in their first year and then an elongated flower stalk the following year. The biennial species die after setting seed in the second year, while most of the perennial species die back to the ground each fall to resprout the following spring. Some have flowering stems 2 or more metres tall and others are acaulescent (stemless) forming a mound of foliage and flowers only a few centimetres tall and equally broad. The root system may vary from a simple or branched taproot to fibrous, sometimes with rhizomes forming large clumps.

Flowers and Fruits

All Evening-primrose flowers have four, often showy, petals, four sepals which are reflexed as the flower opens, eight stamens, and a single style with a deeply four-lobed stigma. The petals and sepals are united at the base into a floral tube called a hypanthium. Petals often change color from white to pink, pink to magenta, or yellow to orange as the flower begins to fade. Flower size is quite variable from species to species, but some are as large as 10 cm wide. Pollen grains are triangular, large and visible to the naked eye. They are held together by sticky threads causing them to be shed in masses rather than individually, a condition found in very few other plants. The fruits are four-chambered capsules of variable size, shape, and ornamentation. Some are quite large and showy, as in *Oenothera missouriensis,* in which the golden-brown capsules are up to 7 cm long and have broad wings.

Pollination

The evening-flowering Oenotheras are usually white or pale yellow to pink with a long floral tube and are very fragrant. They are mostly pollinated by hawkmoths whose long tongues can probe to the bottom of the tube for nectar. The day-flowering sun-drops are only very slightly fragrant and they have a much shorter hypanthium. These species are usually visited by bees and butterflies with shorter tongues. There are certain bees which feed only on *Oenothera* pollen and have synchronized distributions with the plants, and flight times in relationship to the time of the day or night when the flowers open. One in eastern North America even changes its feeding habit during the season, flying early in the morning when feeding on the day-flowering species in the late spring and early summer and switching to evening flights later in the summer to forage on the evening-flowering species.

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Uses in the Landscape

Although many of the species are difficult to cultivate, others are easily grown and deserve to be seen much more often than they are. A few nurseries and mail-order companies offer a small number of species for sale, but many of the more desirable species are rarely seen in cultivation, and can be obtained only by collecting the seeds or plants in the wild. Admittedly, the night-flowering ones are best planted near a patio or walkway where their night flowers and fragrances may be best enjoyed. However, on cloudy days the flowers that opened the previous night may remain open for most of the day. The large-flowered, low-growing species fit well into the alpine or rock garden. Most of the taller kinds deserve a place in the perennial flower border, where they will live for many years requiring a minimum of care.

Propagation

The tap-rooted species are often difficult to transplant, so they are best started from seed and left undisturbed. Most of the perennial species may be easily divided once the clump is established, or those with rhizomes may be propagated by transplanting pieces of the rhizome.

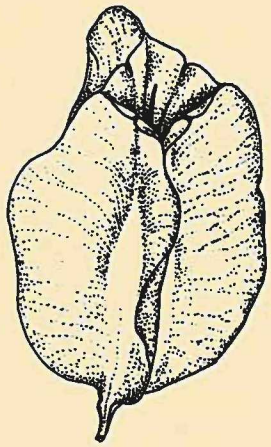

FIGURE 3. Seed capsule of *Oenothera missouriensis*, x0.66.

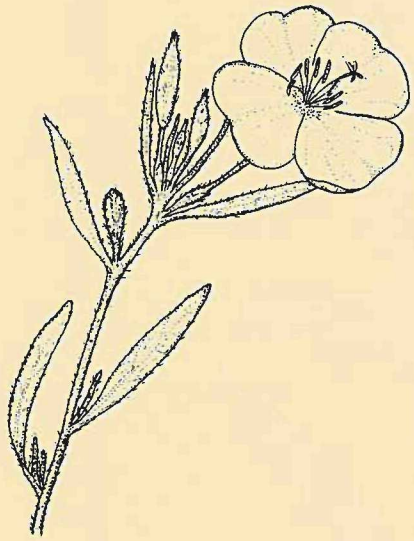

FIGURE 4. Flowering stem of *Oenothera fruticosa* subsp. *fruticosa*, x0.66.

The Kneiffias or Sun-drops

Among the best, but most neglected, species of Oenotheras in cultivation are a group of eastern North American perennial species with bright yellow flowers and four-angled or four-winged seed capsules, in the section (or subgenus) *Kneiffia*. There are five species of Kneiffias, three of which are sometimes cultivated and with great success, giving months of color from about May through September at this latitude. In nature they tend to have a distinctive, shorter flowering season of about a month. However, if the old flowering stems are pruned away during the summer once or twice the plants will continue to flower for months. Older established clumps produce a profusion of flowering stems from the ground, each of which is usually branched, giving a mass of flowers at any one time.

One small species, both in height and flower size, is *Oenothera perennis*. It is native from Newfoundland south through the Appalachian Mountains to South Carolina and westward to southeastern Manitoba and Missouri. There are records from the Vancouver area and Vancouver Island, but these appear to be escapes from cultivation. It is grown in the UBC Botanical

Gardens Alpine Garden and in a few gardens in Vancouver and elsewhere. At flowering the plants are rarely more than 20 cm tall and the flowers are usually not more than 2 cm in diameter. However, there are populations with shorter inflorescences and flowers twice the typical size occurring naturally in northern New England. There has been little or no intentional selection for these in cultivation, but they are certainly more showy than most of the ones now grown.

Two larger species, *Oenothera fruticosa* and *Oenothera pilosella,* each with two subspecies, are seen more frequently in cultivation, including a few named cultivars. *Oenothera fruticosa* is found in a variety of habitats in nature ranging from very near the coast to near the tops of mountains from Nova Scotia to Florida and Oklahoma. There is a subspecies *glauca* with a generally more northern and higher elevational distribution, which typically has broader leaves, larger flowers, and other minor differences. This subspecies has long been considered by many students of *Oenothera* as a distinct species, *Oenothera tetragona.* However, there is a broad overlap in the range of the two, and many intermediate populations occur which are difficult to assign to either species, so it seems best to treat them as subspecies of one large polymorphic species. Some of the showiest populations are found in the higher Southern Appalachian Mountains, with very broad grey (glaucous) leaves and large (to 5 or 6 cm) bright yellow flowers. These populations deserve to be brought into cultivation more than they have been in the past. Due to the wide range of natural habitats from salt marshes to open fields and shaded forest edges, this species seems to be the most adaptable *Oenothera* for cultivation. There are some particularly attractive specimens of it in the UBC Botanical Gardens Perennial Garden.

A similar species is *Oenothera pilosella* found from southern Ontario and Wisconsin southward especially in the Mississippi River Valley to Louisiana. It is most abundant from southern Ohio to Illinois, sometimes forming brilliant yellow masses in open meadows and prairies. Its natural range is difficult to determine definitely because it has been widely planted in, and has escaped from, gardens from southern Quebec, much of New England, and south to Virginia. This species usually has larger flowers than the previous one, has rhizomes, and has longer pubescence on the stems and leaves. The rhizomes allow the plants to form dense colonies in suitable habitats. It is the most tolerant of wet soils in this group of Oenotheras.

Yellow Evening-flowering Species

Another of the large yellow-flowered perennial species is *Oenothera missouriensis,* a native of prairies and open places in the middle United States. It is not infrequently seen in botanic gardens throughout temperate areas. This low-growing species has evening-opening flowers to 10 cm wide, among the largest flowers in the

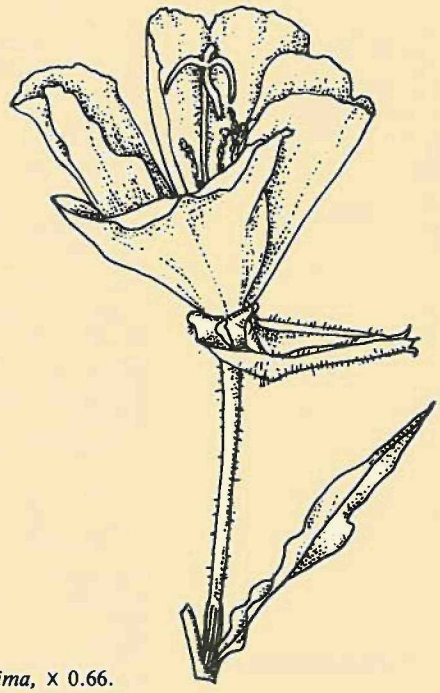

FIGURE 5. Flower of *Oenothera longissima,* x 0.66.

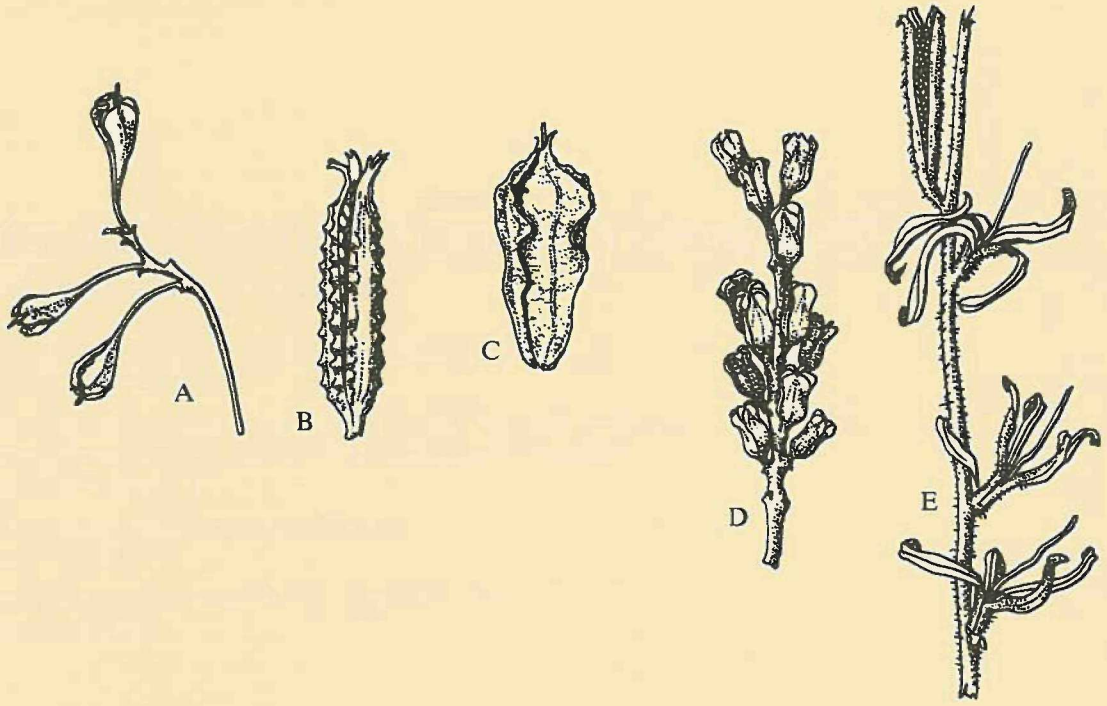

FIGURE 6. Seed capsules of *Oenothera,* x 0.66. A. *O. fruticosa* subsp. *fruticosa,* B. *O. caespitosa,* C. *O. acaulis,* D. *O. fruticosa* subsp. *glauca,* E. *O. longissima.*

genus, in addition to the largest seed capsules.

Among the other evening-primroses with yellow flowers are some of the weediest Oenotheras, native to most of North America, but now established throughout most of the world. These include *Oenothera biennis, O. parviflora,* and *O. villosa.* There are also some larger flowered desirable species for cultivation in this group including *Oenothera hookeri, O. erythrosepala, O. grandiflora,* and *O. longissima.* These are mostly biennial or short-lived perennials, producing a rosette of leaves the first year and a flowering stem a metre or more tall the following year. The origin of *Oenothera erythrosepala* is not known but it is thought to be a garden hybrid originating in Europe during the 1800's. It is one of the showiest and the most frequently grown evening-primrose in Vancouver, and is often seen as a roadside escape. A very similar species native to the western United States, and especially common in California, is *Oenothera hookeri.* Flowers of both of these species are bright yellow and about 10 cm wide.

White-flowered Species

In the UBC Botanical Gardens Alpine Garden there are two choice white-flowered, evening-opening species, *Oenothera caespitosa,* a native western North American species, and *Oenothera acaulis,* a native of Chile. Both have a deep taproot and are stemless or nearly so. The large white flowers (to 10 cm) fade to pink at maturity. Their compact habit and large flowers make them very desirable species for the rock garden. A third white-flowered species is *Oenothera pallida,* a native of the dry interior of B.C. southward. It is a taller species (to 30 cm) with slightly smaller flowers to 6 cm wide. A well-drained location is essential for these three, especially here on the wet coast.

Pink-flowered Species

Probably the best of the pink-flowered species are *Oenothera rosea* and a dark form of *Oenothera speciosa. Oenothera rosea* is a low-spreading perennial native from Texas to Peru, but naturalized in many parts of the world. The rose to red-violet flowers are about 2 cm wide. The larger-flowered *Oenothera speciosa* is found from Kansas and Missouri to Texas, but has escaped from cultivation and become naturalized in most of the eastern and southern United States. The wild form typically has white flowers to 8 cm broad, often flushed with pink. However, the form most commonly seen in cultivation is bright pink, and this is the form usually seen in profusion along roadsides from April to June in the southeastern United States. These, especially the latter, are good subjects for the perennial border.

The Genus *Clematis* in British Columbia

Member of the Family Ranunculaceae

CLEMATIS LIGUSTICIFOLIA Nuttall in Torrey & Gray
Western White Clematis

CLEMATIS OCCIDENTALIS (Hornemann) A.P. de Candolle
subsp. GROSSESERRATA (Rydberg) Taylor & MacBryde
Western Blue Clematis

CLEMATIS ALPINA (Linnaeus) P. Miller
Alpine Clematis

CLEMATIS TANGUTICA (Maximowicz) Korshinsky
Golden Clematis

The members of the genus *Clematis* in British Columbia are deciduous, perennial, semi-woody to woody vines, with opposite pinnately compound leaves. The petioles are long, curved and sensitive to contact on the lower side, thus aiding in climbing. They become thickened and lignified by the fall and are persistent, with the leaf blades only abscissing. The flowers are solitary or in paniculate cymes, dioecious to perfect, and are showy. The sepals are petaloid, either white, blue or yellow, and spreading to closed. The petals are absent in all members of the genus, although they are sometimes simulated by enlarged outer stamens or staminodia. There are numerous stamens and styles. The fruit is a head of 1-seeded achenes, each with a silky or plumose elongated style persistent at one end.

There are over 200 species of wide geographical distribution in the Northern Temperate regions, many of which are much prized ornamentals.

Key to the British Columbian species:

Flowers numerous in terminal or axillary corymbose panicles, dioecious, fragrant, white to creamy-white, in May to September; sepals 0.6-1.2(-1.5) cm long; leaves pinnately (3)5-7-foliolate; leaflets (2)3-6(-8) cm long. Native. ..... *Clematis ligusticifolia*

Flowers solitary, perfect, nodding, blue or yellow, in April to September; sepals 2.5-6 cm long; leaves pinnately 3-foliolate or biternate; leaflets 2-21 cm long.

Flowers blue, in April to July; sepals more or less spreading; leaflets 2-11 cm long.

Flowers violet-blue to deep bluish-purple (rarely white), in May to July; petaloid staminodia absent; leaves pinnately 3-foliolate. Native. ..... *Clematis occidentalis* subsp. *grosseserrata*

Flowers blue or lavender-blue, in April and May; white petaloid staminodia present; leaflets biternate (9 in 3 triplets). Adventive. ..... *Clematis alpina*

Flowers yellow and campanulate-like, in July and September; sepals 4-5 cm long and semi-closed; leaves pinnately 3-foliolate; leaflets 3-21 cm long. Adventive. ..... *Clematis tangutica*

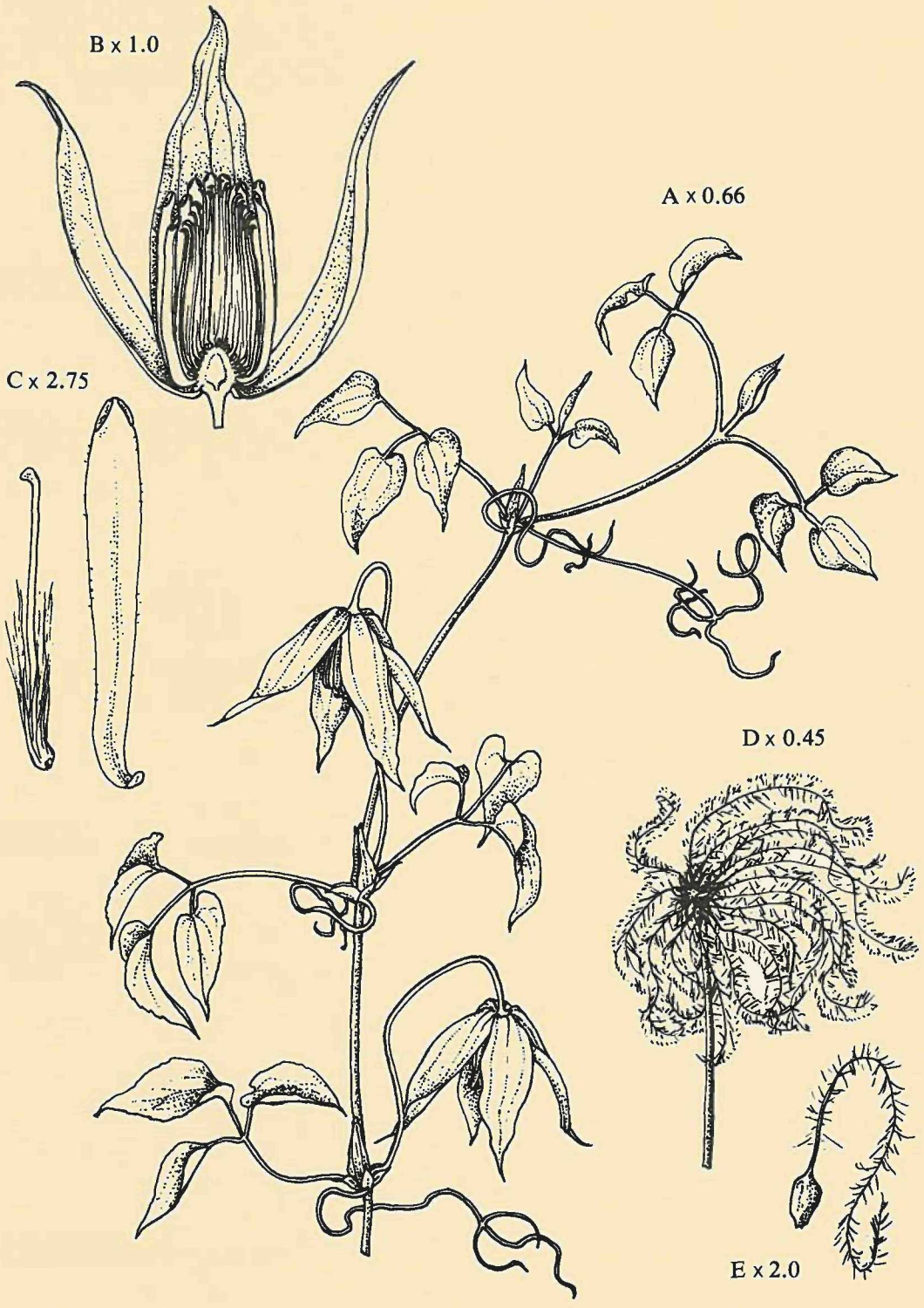

FIGURE 7. *Clematis occidentalis* subsp. *grosseserrata*. A. Section of stem showing flowers, leaves and tendrils, B. section through a flower showing the arrangement of the parts, C. single sepal and style, D. fruiting head, E. single fruit with elongated feathery style.

The Native Species

Natural Distribution

Clematis occidentalis subsp. *grosseserrata* is a widespread but rarely abundant species present from the mountains of southern Colorado north to southwestern Saskatchewan (the Cypress Hills) and the Peace River region of Alberta and southwestern Yukon, and west to the east side of the Cascades in northeastern Oregon, Washington, and British Columbia. In British Columbia the species occurs east of the Cascade Range, but the range is divided into two segments, apparently depending on the underlying rocks. The two areas are near the Rocky and Purcell Mountains on folded and faulted sedimentary rocks, and on the Interior Plateau on areas of flatlying and gently dipping lava flows. It has been collected at Nickel Plate Mountain, Penticton Creek, Creston, Adams Lake, Quesnel, the Windermere Valley, and Fort St. James.

Clematis ligusticifolia occurs from British Columbia south on the east side of the Cascade Mountains to the Columbia River Gorge in Washington, then south along both sides of the Cascades in Oregon to southern California, and east to the Dakotas and New Mexico. In British Columbia the species is abundant in the Dry Interior Zone from Princeton to Keremeos, Osoyoos to Kaleden, Lytton to Kamloops, and near Lillooet and Cranbrook. It is also found on Vancouver Island, where it occasionally climbs to over 15 m in conifer trees.

Habitat

Clematis occidentalis subsp. *grosseserrata* occurs at middle elevations in moist to dry areas in dense to open woods, often on talus slopes. It is virtually restricted to rocky sites but in pockets of good soil between the rocks, and is associated with a wide range of non-granitic rocks. The sites are all at least partially shaded, and it is rarely found in areas exposed to full sun. The plant is present in many different communities throughout the range, such as Aspen, Lodgepole Pine-Aspen, Lodgepole Pine-White Spruce, Engelmann Spruce, and Douglas Fir. In British Columbia it occupies a wide altitudinal range on shady mountain slopes and valley bottoms.

Clematis ligusticifolia is found growing over bushes on streambanks and in woods and thickets, and is common on roadside fences. In British Columbia it prefers good soils in rocky areas. It is usually associated with Ponderosa Pine, Black Cottonwood, and Chokecherry.

Description

Clematis occidentalis subsp. *grosseserrata* (previously known as *C. columbiana*) is a half-woody climber, with slender vines which are either scandent or occasionally trailing. The vines are 0.25-2.5(-4) m long, and are somewhat pilose to sparsely lanate, becoming glabrate with age. *Clematis ligusticifolia* is a variable species in size. It is a strong, dioecious (separate male and female plants), woody climber. The vines are 3-15(-20) m long with a base diameter up to 0.1 m, and are nearly glabrous to rather densely strigose or villous.

The shoots branch from the vines in a very symmetrical fashion, are 6(-12) angled, and straw-colored to brown. The young growth is pilose, soft and brittle, becoming glabrate and woody by the first fall. The pith is star-shaped, continuous and white. There are no stipules, stipule scars, or leaf scars.

The root system is fibrous and may be shallow to rather deep depending on the soil.

The leaves are cauline, exstipulate and in opposite pairs at each node. They are pinnately foliolate (divided into leaflets), and the leaflets are sometimes lobed in both species. The leaves are pilose when young, becoming glabrous to sparsely hairy, especially beneath, with age. The petiolules (leaflet stalks) are slender and may become lignified and persistent. Both species show much variation in leaflet shape on the same plant, and *Clematis ligusticifolia* also shows great variation in the number of leaflets. The leaves of *Clematis occidentalis* subsp. *grosseserrata* are pinnately 3-foliolate. The leaflets are green, thin, (2)3-6(-11) cm long, and narrowly ovate to ovate, deltoid or nearly orbicular. They have entire to rather sharply or coarsely toothed margins. The apex is acuminate, and the base is rounded to obliquely cordate. The lateral leaflets may be oblique and unsymmetrical. The petiolules are 0.7-2 cm long. The leaves of *C. ligusticifolia* are pinnately (3)5-7-foliolate. The leaflets are bright green, thickish, firm-textured, (2)3-6(-8) cm long, 1.5-4 cm broad, and coarsely few-toothed. They are narrowly to broadly ovate, with an acuminate apex and a rounded to cordate or somewhat cuneate base. The terminal leaflet may be deeply 3-lobed, or occasionally 3-foliolate.

The flowers of *Clematis occidentalis* subsp. *grosseserrata* are produced from April to July (to August) throughout the range, although there is sometimes a second flowering in late summer at the end of leafy branches of the current season's growth. The flowers are formed at the end of short axillary branches on the distal portions of stems of the previous season's growth, and are usually subtended by 1 or 2 pairs of leaves. They are solitary, perfect, nodding and 5-10 cm across. The sepals are usually 4, thin, delicate, violet-blue to

bluish purple (rarely white) with darker veining, and (2.5)3-6 cm long. They are narrowly ovate to narrowly elliptic, separate, and spreading from the base (occasionally widely spreading). The apex is slightly to strongly acuminate (rarely attenuate), and the sepals may be cleft almost to the base. They are densely villous along the margins, and sparsely villous on the dorsal surface. Occasionally flowers are found in some populations which have 6-10 narrowly lanceolate to linear, long-attenuate sepals, some of which are also deeply cleft. There are 35-50 stamens which are erect to spreading, and spirally arranged. The filaments are pubescent, flat, and somewhat enlarged. The outer stamens are usually oblanceolate to narrowly spatulate (rarely broader), and usually bear at least rudimentary functional anthers. Very occasionally, they are replaced by sterile staminodia. The anthers are yellow, short, blunt, and adnate to the filaments. The pollen is white. There are numerous yellow styles which are silky or plumose along their length and persistent on the fruit. There are 45-175 (average 90) carpels, each containing 1 ovule. The pedicel is 5-15 cm long, and bractless.

The flowers of *Clematis ligusticifolia* are produced in May to September in British Columbia, sometimes as early as March in the southern parts of the range. The inflorescence is a corymbose panicle containing numerous flowers, which forms on short stems arising from the leaf axils of the current year's growth. The branches of the panicle are bracteate and nearly erect. The flowers are imperfect, 1.9 cm across, fragrant, and the sexes are on separate plants (dioecious). The sepals are white to creamy-white, spreading to somewhat reflexed, narrowly-ovate, and 0.6-1.2(-1.5) cm long. The staminate flowers contain numerous spreading stamens with linear, filiform filaments. The anthers are 0.6-1.5 mm long. There are no styles in these flowers. The pistillate flowers usually contain numerous, somewhat broader and dilated, sterile stamens. The styles are numerous, long, and plumose. The ovary is villous.

The fruit is a dry 1-seeded achene, occurring in globose heads of up to 175 individuals. The styles are persistent in fruit and become greatly elongated and plumose from the base to the tip, giving a "feathery" appearance to the head. The achenes are dispersed by wind during the late summer and early fall. The achene of *Clematis occidentalis* subsp. *grosseserrata* is elliptic to wedge-shaped, pilose at least on the upper half, about 5 mm long, and is brown when mature. The style elongates to 3-6(-7) cm long. The seed is small (1-5 mm long), and is somewhat oily. The achene of *C. ligusticifolia* is obovate, pilose, and drab to pale-brown. The style is greyish and elongates to 2.5-5 cm long. The fruits ripen from (May) August to November (December) over the range, and may be present with the flowers on the same vine in late summer and fall.

Cultivation of the genus Clematis

> *"Clematis are as hardy as the oak.... come early into flower and only cease with the approach of winter, of few other flowers can this be said."*
>
> (William Robinson, from Coats, 1970)

> *Clematis, these most rewarding climbers, are as tough and hardy as the British oak. They thrive anywhere in the temperate regions of the world."*
>
> (Fisk, 1975)

Propagation

The genus is considered to be easy to propagate. Seed from the species (but not hybrids and cultivars) may be sown immediately after it is ripe in the fall, or in the spring after stratification. It should be stratified at 0.5-5°C in moist sand, peat, or a mixture of the two, for 40 days. Sow in sand at temperatures of 20°C (night) and 30°C (day), and germination should occur in 40-60 days, although seed of *Clematis ligusticifolia* may take up to 200 days with as little as 1% success. The seed may be stored dry in airtight containers in a cool place for up to 1 year.

Layering is the easiest method of propagation as all *Clematis* root readily from stem nodes. The best time for layering is August, although it can be done throughout the summer. Choose a well-established vine with several stems from the base. Fill a plant pot (12 cm diameter) with good compost and insert to above the rim in the soil at the point at which the selected shoot touches the soil when bent. Using a sharp knife, cut off a thin sliver of bark, 2.5 cm long, from the stem where it can easily be pressed into the soil. Dust the cut with hormone rooting

powder, press the stem into the compost, and hold in position with a U-shaped piece of wire. Cover the pot with soil, and place a stone or brick on top to hold the layer down. Keep moist and undisturbed for at least 1 year before severing from the parent plant.

Cuttings of soft or half-ripe wood may be taken either early in the year or in July and August with good success. Use one node with a pair of leaves and a piece of stem, preferably taken from the middle part of the stem. Plant in a mixture of equal parts of sharp sand and peat in a warm shady place in the greenhouse, and water frequently. Rooting should occur in 4-6 weeks, after which the cutting can be repotted into good compost. Keep in a cool greenhouse during the winter and plant out in the spring.

Unusual cultivars and hybrids are often grafted, with 2-year old rootstocks of *Clematis vitalba* as the stock. At the final planting, the graft is put well below the soil surface. The scion then forms its own roots from the part of the stem below the ground, and by the end of the year the rootstock is no longer needed and eventually dies.

Transplantation

Clematis species do not transplant readily and should be left undisturbed once planted. It is usual to buy them potted from the nurseries.

Conditions for Cultivation

The members of the genus *Clematis* are hardy vines, in many cases to well below -18°C, and are considered to be easy to grow provided there is an ample supply of water and food. They prefer a retentive but well-drained, fairly rich, friable, calcareous, loamy soil, but will succeed in any kind of soil, especially if great care has been taken to prepare the area before planting. Clematis are sun lovers and will grow and flower in all aspects except in moderate to heavy shade. The roots and lower parts of the main stem, however, should be in the shade. This can be achieved by planting a dwarf shrub near the base of the plant.

Clematis are normally planted in the fall or before growth starts in the early spring, but if purchased in pots they can be planted at any time of the year except when the ground is frozen or excessively wet. Dig the hole about twice the width and depth of the pot to ensure an ample quantity of good soil around the roots. Carefully remove the plant from the pot and disentangle any roots which are wound round the root ball. Be sure to plant the top of the root ball at least 2.5 cm below soil level. Fill in the hole, firm the soil, and water well. At the time of planting it is advisable to put a stake or bamboo cane from the root to the intended support to act as a guide for the new shoots. An annual spring application of a balanced fertilizer and the addition of 2.5 cm of mulch together with an adequate supply of water in dry weather will ensure satisfactory growth and flowering.

The vines may be trained over any suitable support, such as strong shrubs, trees, stumps, or pergolas. A wire or iron frame or trellis should be placed about 1.5 cm away from walls and the Clematis trained up this. Wood used as supports for Clematis (either trellises or pergolas) should not be creosoted as the fumes linger for months and will kill the young and tender shoots.

Clematis occidentalis subsp. *grosseserrata* belongs to the group which flowers on the previous year's wood. Very little pruning is required for this group, except for tidying up, or cutting out old dead wood. If the allotted space has been filled, the vine may be cut back hard to the old woody stems, particularly if the plant has become top heavy and a tangled mass of growth has developed. It should be pruned as soon as possible after flowering, but with extreme caution as the stems are very brittle. Vigorous shoots may be pinched during the early spring growth to encourage branching.

Clematis ligusticifolia flowers later in the year on the current year's wood. It should therefore be pruned annually every spring to encourage new growth and flowering display. The wood should be pruned hard to the lowest breaks as soon as new growth starts.

Landscape Value

All the Clematis are valuable ornamentals with attractive relatively large flowers followed by the handsome large feathery seed heads in late summer and early fall. They provide some of the most beautiful effects in gardens during these periods. Unfortunately, *Clematis occidentalis* subsp. *grosseserrata* does not seem to survive the wet winters on the Coast for long, although it is an excellent garden plant east of the Cascades. *Clematis ligusticifolia* has smaller flowers during the late summer and fall, followed by magnificent seed heads which are amongst the largest in the genus. Like the Western Blue Clematis, it is a better plant for gardens east of the Cascades.

Clematis may be trained to grow over strong shrubs and trees; on frames against a wall, fence or balcony; over pergolas; or on tripods or poles at the back of herbaceous borders. They may also be allowed to scramble over the ground as a permanent ground cover, preferably on a frame raised 2-3 cm above the ground. Four to six plants in a 2.4 m diameter round bed can be trained together to hide the bare lower parts. Bulbs planted permanently in the same bed will give added color in the spring before the Clematis grows. The vines may also be grown in tubs on a terrace or by the front door, provided that they are never allowed to dry out. In a wild garden, they should be allowed to ramble freely through the trees without pruning.

Availability

The large-flowered hybrids and *Clematis tangutica* are readily available from nurseries, but the native species are apparently not available from North American suppliers.

Varieties and Ornamental Cultivars

There is much variation within *Clematis occidentalis* subsp. *grosseserrata* involving length, shape, and degree of spreading of the sepals. These variations may be of horticultural significance, but the forms have never been taxonomically recognized. A form with white sepals has been reported from the Rocky Mountains in the United States, but is apparently known only from the original site.

The sepals of the section Atragene, to which this species belongs, are exposed long before anthesis and begin to separate before they are fully expanded. Specimens collected with such immature flowers have been recognized as new taxa in the past.

Plants have been collected from a few localities in Montana and Colorado which appear to be hybrids between *Clematis occidentalis* subsp. *grosseserrata* and *C. columbiana* var. *tenuiloba*. The leaves are once-ternate with deeply incised leaflets, or are occasionally bi-ternate. The sepals are blue-violet. They are very similar to the extreme forms of *Clematis occidentalis* var. *dissecta* (A. Gray) Pringle, except for the sepal color. This variety intergrades with the subsp. *grosseserrata* where the ranges overlap in Washington. The eastern subsp. *occidentalis* and the cordilleran subsp. *grosseserrata* can apparently be hybridized in cultivation, although their ranges do not overlap in nature.

Two varieties of *Clematis ligusticifolia* have been named, although they may represent merely geographic races. The variety *brevifolia* Nuttall in Torrey & Gray is the common form of eastern Washington and Oregon. It has ovate, usually cordate leaflets which are nearly or quite glabrous, and the inflorescence branches are more spreading and shorter than in the species. The sepals are somewhat spatulate. The variety *californica* S. Watson is the common form in southern California, and has leaflets which are more or less densely silky canescent at least on the lower surface.

Some plants have been collected which seem to be intermediate between *Clematis drummondii* Torrey & Gray and *C. ligusticifolia,* and may therefore represent hybridization between these species.

No ornamental cultivars seem to have been named in either of the species, despite their long history of cultivation.

Other uses

The flowers of all Clematis may be cut and floated in a bowl as an indoor decoration. They will last longer if the cut end of the stem is burnt with a match.

The Thompson Indians of British Columbia used a mild decoction of the "plants" as a headwash, and for scabs and eczema, although *Clematis ligusticifolia* was considered to be the more effective of the two species. Despite the poisonous nature of the species, a decoction of *Clematis ligusticifolia* was also used as a tonic or remedy for a general disorder or "out-of-sorts" feeling.

Diseases and Problems of Cultivation

The young shoots of all Clematis are soft and brittle, and will easily break. The young growth may be damaged by late spring frosts. Slugs eat the young shoots, and earwigs the leaves, flowers, and tips of the shoots. Shortage of water may cause bad wilting of the plant. Powdery mildew is frequently a problem on the Coast during spells of hot dry days and cool nights.

The species occurring in British Columbia are all poisonous to humans and livestock, and they also contain an acrid juice which can cause dermatitis in some people.

The genus is relatively trouble-free, and is affected by few diseases and insects. The 'Clematis Borer', the larva of a Clearwing Moth, feeds on the roots of several species seriously damaging the vines. The borers may be cut out and killed, or a suitable insecticide used in midsummer when the moths and larvae are active. *Coccus hesperidium,* 'Brown Soft Scale', attacks a wide range of greenhouse, indoor, and ornamental plants (including Clematis) in coastal British Columbia. The adult is soft, greenish-brown or yellowish-green with a ridge across the back, oval, flat and 0.3 cm long. It is associated with a blackish sooty fungus (probably *Meliola camelliae* Cath.) which develops in the honeydew secreted by the insect.

Leaf spots caused by *Cercospora squalidula* and *Didymaria clematidis* and Rust caused by *Puccinia recondita* have been reported on *Clematis ligusticifolia* in the Interior of British Columbia.

All the species seem to be tolerant to the fungus *Ascochyta clematidina* which causes Clematis Wilt virtually overnight, especially in the large-flowered hybrids. If it does occur, cut the affected stems right back to ground level and burn.

The Adventive Species

Two other species of *Clematis* have been reported as adventive in British Columbia, that is, they have escaped from cultivation and have persisted in the wild for some time.

Clematis alpina (Linnaeus) P. Miller, 'Alpine Clematis', from Europe and Asia, has been reported from the Ponderosa Pine Zone in the Province. This species has scandent stems which grow to about 2.5 m, with biternate leaves 7.5-15 cm long. The 9 leaflets are arranged in 3 triplets, and are 2.5-5 cm long, and ovate to narrowly ovate. It bears abundant, beautiful, nodding, solitary flowers which are 7-10 cm long, and appear in April and May. The sepals are satiny, blue or lavender-blue, 3.5-6 cm long, 0.8-1.3 cm broad, and there are conspicuous white staminodia present. The seed head is a globular gray tuft, 5 cm or more across. This species is a popular garden plant with three varieties and many forms. The flowers are produced from axillary buds on the previous year's growth, and therefore it should be pruned after flowering, if necessary.

Clematis tangutica (Maximowicz) Korshinsky, 'Golden Clematis', from China, has been reported for southern British Columbia. It is a dense-growing climber to 4.5 m, with gray-green, finely-divided, 3-foliolate leaves. The leaflets are 3-21 cm long, usually narrowly ovate with serrate margins, and are sometimes 2- or 3-lobed. The solitary, nodding, yellow flowers are campanulate, 4-5 cm long and up to 10 cm across. The sepals are nearly 5 cm long, and are narrowly ovate with long slender points at the apex. The pedicel is 7-10 cm long, and the flowers are produced from July to September on the current year's growth. The flowers are followed by attractive, silvery, round seed heads. This is probably the handsomest yellow-flowered Clematis for gardens, with one variety and one cultivar available. The plants should be pruned back to about 1 m tall in the spring, depending on where the strongest new growths are breaking out from the old wood. The fruiting head can be used for dried and preserved flower arrangements.

Clematis vitalba Linnaeus, 'Traveller's Joy', from Europe and North Africa, has been reported from herbarium specimens in the UBC herbarium (Dr. Fred R. Ganders, personal communication). The specimens were collected 50-80 years ago in New Westminster and Burnaby and misidentified as *Clematis ligusticifolia.* This species is known to occur as a garden escape in the Puget Sound area of Washington, and may also be found in the Lower Mainland of British Columbia. It is very similar to *C. ligusticifolia,* except that the leaflets are usually entire (or the upper one may be 3-lobed), and the flowers are perfect.

Origin of the Name

The generic name *Clematis* is derived from the Greek *klema* (or *clema*) meaning 'shoot', 'vine-branch', or 'tendril', because of the climbing habit. The name was apparently first used by Dioscorides for a climbing plant with long, lithe branches. The specific epithet *occidentalis* means 'western', and the subspecific *grosseserrata* means 'with large saw-teeth'. The specific name *ligusticifolia* means 'lovage-leaved', because the foliage reminded Nuttall of the compound leaves of the genus *Ligusticum* (Apiaceae). The specific epithet *alpina* means 'alpine', and *tangutica* commemorates the Tangut people of the Kansu region in northwestern China where the plant was collected.

The type locality for *Clematis occidentalis* subsp. *grosseserrata* (as *Atragene grosseserrata* Rydberg) is "in the Palouse Country and about Lake Coeur d'Alene", where it was collected in 1892 by G.B. Aiton. The type locality for *C. ligusticifolia* is "Plains of the Rocky Mountains" where it was collected by Thomas Nuttall.

Clematis occidentalis has a long history of cultivation in North America and Europe, seed being sent to the English nurseryman Conrad Loddiges by an American correspondent sometime before 1806. By 1806 the species was being grown in the Botanic Garden at Copenhagen. These specimens, however, were probably the eastern subspecies, although the subspecies *grossesserrata* is now the most popular form of the species in cultivation. It is, however, more popular in and near the natural range. It is often listed erroneously as *Clematis columbiana* in nursery lists and references.

Clematis ligusticifolia was introduced to cultivation in Great Britain in 1880, while *C. alpina* was introduced about 1792 from Europe. *Clematis tangutica* was introduced about 1898 from St. Petersburg, although all the plants presently grown are derived from a later introduction in 1911 from west Kansu in China.

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Climatological Summary*

Data 1978	JANUARY	FEBRUARY	MARCH
Average maximum temperature	5.8°C	8.4°C	9.9°C
Average minimum temperature	2.0°C	3.1°C	4.6°C
Highest maximum temperature	9.5°C	12.9°C	14.7°C
Lowest minimum temperature	-6.0°C	-2.0°C	-1.7°C
Lowest grass minimum temperature	-10.6°C	-7.2°C	-7.5°C
Rainfall/no. days with rain	97.2 mm/25	83.1 mm/19	94.5 mm/16
Total rainfall since January 1, 1978	97.2 mm	180.3 mm	274.8 mm
Snowfall/no. days with snowfall	25.7 cm/4	13.0 cm/2	0
Total snowfall since October 1, 1977	28.1 cm	41.1 cm	41.1 cm
Hours bright sunshine/possible	36.3/265.3	77.7/278.2	120.4/361.1
Ave. daily sunshine/no. days total overcast	1.2 hr/18	2.8 hr/11	3.9 hr/6

**Site: The University of British Columbia, Vancouver, B.C., Canada*
Position: lat. 49° 15'29" N; long. 123° 14'58" W. Elevation: 104.4 m

FIGURE 8. David Tarrant of the Botanical Garden staff explains potting techniques to a group of people during the Vancouver Home and Garden Show, held from February 24 to March 5, 1978. The greenhouse was the prototype for the octagonal greenhouse recently constructed at the Botanical Garden and described in detail on page 19.

Botanical Garden News and Notes

Horticulture as Therapy Symposium — The joint Botanical Garden and Division of Continuing Education in Rehabilitation Medicine Symposium on "Horticulture as Therapy" using gardening in therapy was successfully completed on March 9th and 10th. The proceedings of the symposium will be published and made available to parties interested in using plants as therapy. An announcement will be made of the release of these proceedings in a future issue of Davidsonia.

New Technical Bulletin — Technical Bulletin No. 5 on Gardening as Therapy (Spring Season), a new book designed to provide basic information for people interested in using plants within a therapy program during the Spring, was published in early March 1978. This publication has resulted from the dedication of the members of the 'Friends of the Garden' "Horticulture as Therapy" project and their efforts were co-ordinated by Margaret Coxon, a member of the U.B.C. Botanical Garden staff. The illustrations were completed by Lea Price-Bickford. The publication costs $4.25 plus postage and is available from the Botanical Garden Office. Three further resource manuals to cover the Summer, Fall and Winter seasons are expected to be published.

Dedication of New Garden Components — On April 24th, the President and the Chancellor of the University of British Columbia will participate in the dedication of two major components in our new garden development, the Alpine Garden and the B.C. Native Garden. The Alpine Garden will be named "The E.H. Lohbrunner Alpine Garden" in honor of Mr. E.H. Lohbrunner of Victoria, whose outstanding devotion to the collection, study and propagation of alpine plant materials has made him an internationally recognized world expert in this special group. Many of the foundation plants within the Alpine Garden came from Mr. Lohbrunner's nursery, and it is a great pleasure for the Garden to be able to honor Ed and Ethel Lohbrunner in this way.

The second component, "The B.C. Native Garden", will be dedicated to the memory of Professor John Davidson, the first director of the Botanical Garden and a pioneer in the study of native plants in British Columbia. He was not only responsible for the development of the gardens on the University campus when it was first developed on Point Grey, but he was also the founder of the Vancouver Natural History Society. It is appropriate that he should be honored in this way as he had a great love and compassion for the plants of British Columbia. Professor William T. Stearn, a recently retired Senior Research Scientist with the British Museum (Natural History) in London, will officiate at the dedication and will present an evening lecture at the Faculty Club following the ceremony.

The dedication ceremonies will take place at 2:30 p.m. on Monday, April 24, 1978, with the dinner and evening lecture by Professor Stearn at the Faculty Club at 7:30 p.m.

A Field Day at The Botanical Garden by the B.C. Nursery Trades Association and the B.C. Society of Landscape Architects — June 20th, the third Tuesday in June, has been set as the special day for visiting the Botanical Garden to see new plant material that may be of interest to the horticulture industry. All members of the BCNTA and BCSLA are invited to participate in this program. Details will be forwarded to the memberships. This program is a follow-up to last year's August field day and the subsequent development of the Botanical Garden Plant Introduction Advisory Council which was established to provide direction for the introduction of new plant materials to the trade in British Columbia.

New Horticulture Greenhouse — March saw the completion of a newly designed glass greenhouse for the extension of horticulture to the handicapped (see Figure 9). The structure, octagonal in shape and with a concrete floor, consists of eight aluminum framed glass side walls 2.1 m tall. The peaked roof, 3 m tall, is made of eight triangular sections corresponding to the side walls. The greenhouse is 4.5 m across at the centre of the wall panels. The benches are 61 cm deep, are installed only around the perimeter, and are attached at the back to grooved aluminum corner members with diagonal braces from the bench front to the floor at the rear. Some adjustment in height is possible before their use. This design allows wheelchair users full access to the benches.

One 2.4 m long section of the bench has been constructed to allow the direct growing of plants in soil, while the remaining sections are of slatted cedar wood for container growing. The house is ventilated by a thermostatically controlled exhaust fan with two louvers located on the opposite wall. Five hand-operated glass ouvers have been installed in each of the other walls for additional or replacement ventilation. Electrical services have been supplied to provide tubular perimeter heating, service lighting, and outlets for the use of supplementary lighting and other normal greenhouse equipment as required. Access to the house is facilitated by a wide surfaced entrance area, a wider than usual door with adaptations to permit easy opening and closing by handicapped users, and the absence of a door sill. Consideration is currently being given to the replacement of the present outward opening door by a sliding door. A wooden bumper, near the base of the glass wall adjacent to the door outside and around the total perimeter inside, will help to decrease accidental damage to the glazing by wheelchairs.

The addition of this special greenhouse to the UBC Botanical Garden has been made possible through the donation of $5,000 by The Garden Club of Vancouver. The Garden Club has continued to support the activities of the Botanical Garden over the past several years, and this generous gift will provide new leadership for horticulture as therapy in the Vancouver area.

The greenhouse, like the new facility recently opened at Wisley in England (R.H.S. Journal 102:266-267, 1977) will give workers with hospital, extended care and handicapped patients an opportunity to observe rehabilitation and therapy through horticulture. Hopefully, research ideas generated by the use of this facility will provide new ideas for institutions and homeowners who may wish to incorporate either the entire structure or individual components into new building programs.

The greenhouse was designed by Mr. Ken Wilson of the Botanical Garden and Mr. Henry Heinen of B.C. Greenhouses Ltd., and the construction and erection was completed by B.C. Greenhouses Ltd., Burnaby, B.C.

VanDusen Botanical Display Garden Plant Sale — The VanDusen Garden will be holding a public sale of plants on Sunday, April 30, 1978, from 10:00 a.m. to 6:00 p.m. The proceeds are to benefit the Garden.

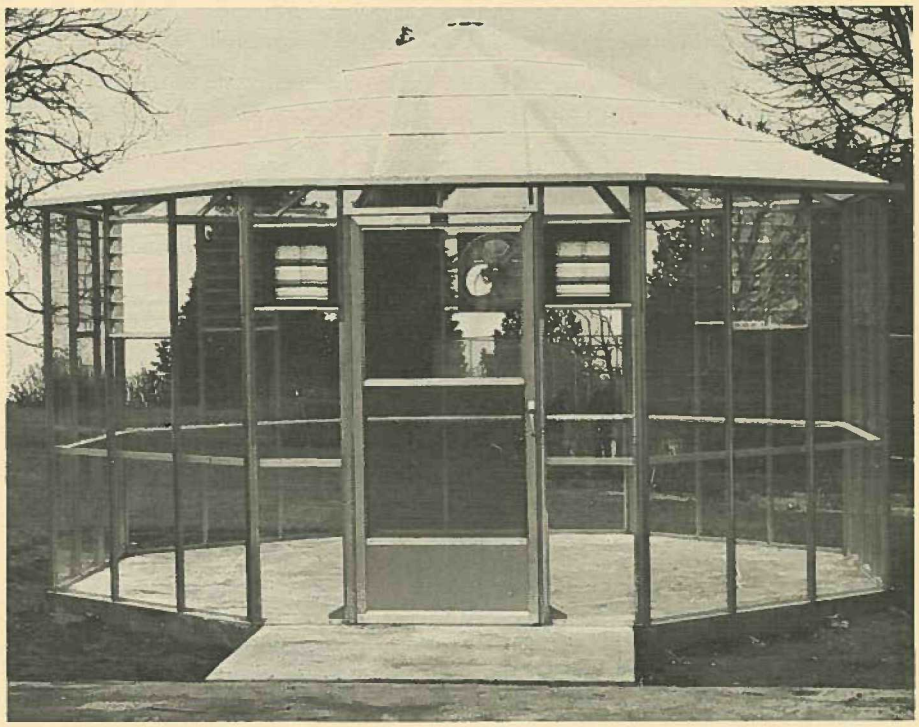
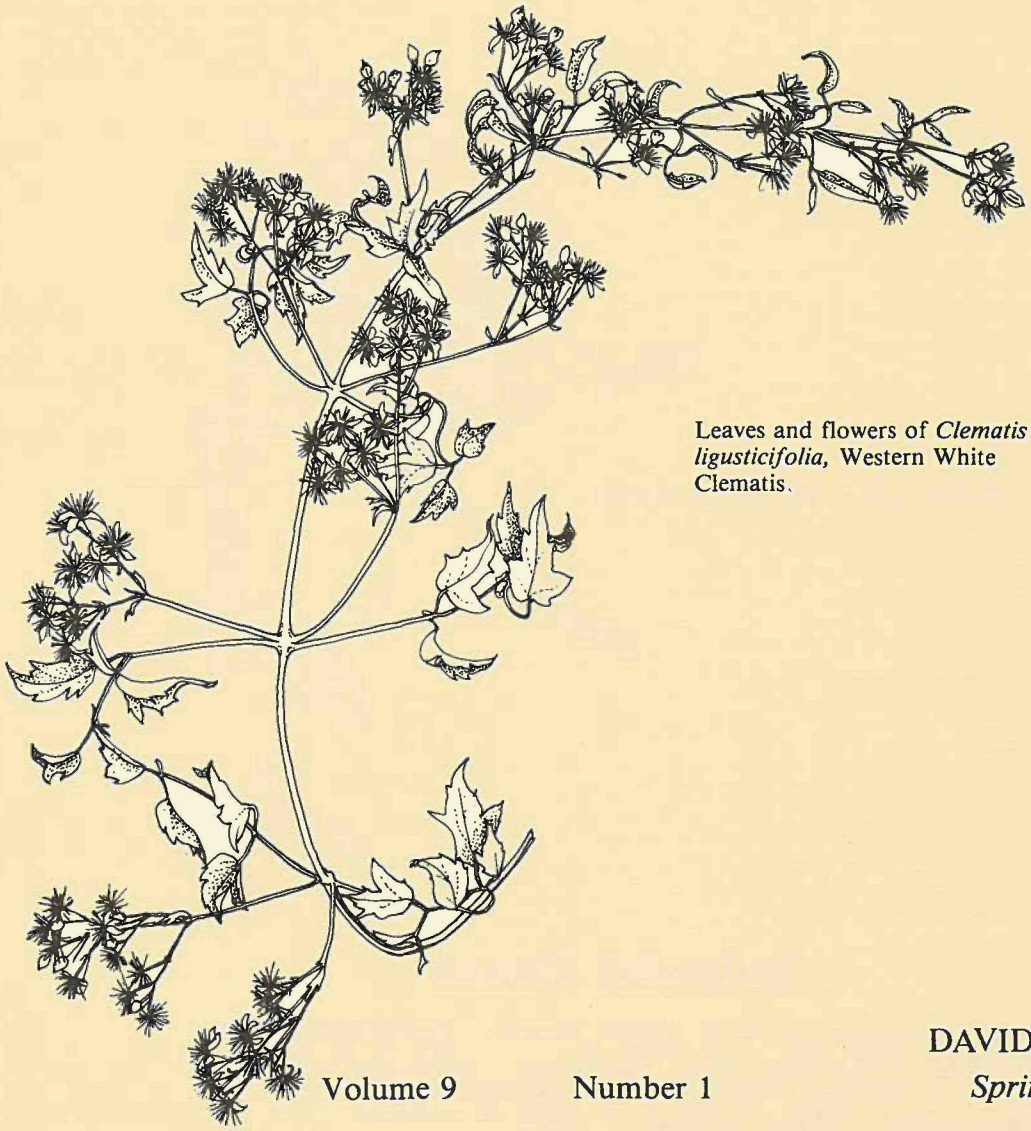


FIGURE 9. The new octagonal greenhouse for use in horticultural therapy programs at the Botanical Garden.

Fruiting head of *Clematis ligusticifolia.*

Editorial Board



Leaves and flowers of *Clematis ligusticifolia,* Western White Clematis.

DAVIDSONIA

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