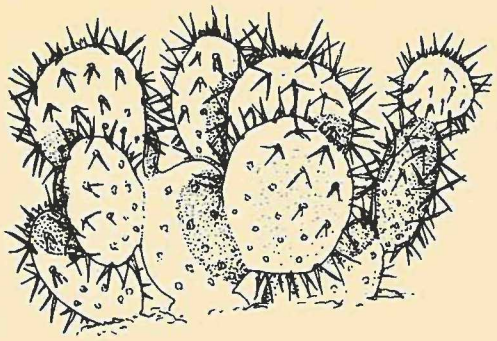
DAVIDSONIA

VOLUME 7 *NUMBER 3* *Fall 1976*

Cover:

A desert hillside dotted with Saguaro *(Carnegiea gigantea)*, chollas and prickly-pears (*Opuntia* spp.), and Ocotillo (*Fouquieria splendens*).



Opuntia engelmannii, Engelmann's Prickly-pear. This cactus is common in northern Mexico and the southwestern United States, and is sometimes a pest on cattle ranges.

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Cacti and Succulents from Mexico

MARGARET COXON

The major part of the xerophyte collection at the U.B.C. Botanical Garden was donated by Mr. and Mrs. C. Brown of Vancouver, and is the result of numerous collecting trips to Mexico as well as many years of devoted care and maintenance. An assortment of cacti and succulents from this special collection is presented here. Since these plants derive much of their interest from their unusual growth form, a number of the rarer and more distinctive members of the cactus family have been included.

The plants found in the dry deserts of Mexico display a fascinating assortment of life forms. These desert plants all face the common problem of a dry, hot and windy climate, and they have overcome this problem in various ways. Among the best-known of desert plants are the cacti and succulents, which have adapted to their native regions by developing thickened stems or leaves for storing water. These plants do well in the dry sunny plateaus of Mexico, and show remarkable tolerance of the harsh growing conditions. The conditions vary from one part of the country to another, and for each species whose range is known, the provinces in which it grows are mentioned here.

Cacti are a unique group of plants with thick, often jointed stems and no leaves. Most of them have spines. Their flowers, though usually short-lived, are often large and showy. The cactus family is native to the New World, and in Mexico there are more than 700 native species of cactus — a larger number than in any other part of the Western Hemisphere.

Mexico also has a wealth of plant species which, though not members of the cactus family, resemble these plants in many ways and often live in similar habitats. These are the succulents, and they belong to a number of different plant families (including the lily, stonecrop, aster and milkweed families).

Hobby growing of xerophytes (desert plants) is fast becoming a very popular pursuit. Growing these plants in cultivation is not difficult, but there are a number of factors that must be considered. Most cacti and succulents need good light for healthy growth, and particularly for flowering. Summer conditions, during the growing season, should be bright and hot; winter conditions should be bright but cool. Many cacti can tolerate quite low temperatures during the winter, and a few are frost-hardy. Once a few basic rules are learned, these plants require relatively little attention.

Soil for both cacti and succulents should be rich but loose and well-drained, with plenty of sand or gravel mixed in. In general, the white or very hairy cactus species prefer a soil high in calcium. Plant them in clay pots for best drainage and air circulation.

Xerophytes should be watered regularly but the soil should be allowed to dry out between waterings. Standing water or waterlogged soils will cause rot. Succulents need more water than most cacti. During the winter, when temperatures are cooler and the plants are experiencing a lull in growth, they should be watered sparingly. The plants should be washed occasionally during the growing season with a heavy mist.

Cacti

A species which is a favorite with many people is *Astrophytum myriostigma*, commonly known as the Bishop's Cap. It grows on the open mesa of the north-central region of Mexico, in the provinces of Coahuila and San Luis Potosi. This cactus lacks spines and is gray and stonelike in appearance, with usually five broad ribs. Its surface is covered with fine white flecks and there are circular woolly markings along the ridges. The plant may grow to 60 cm high and 20 cm across. The flowers are large and light yellow, with red centres, and appear all summer; they are followed by star-shaped fruits. The Bishop's Cap prefers a hot climate and a soil high in calcium. It does indeed resemble a bishop's cap, and it has also been likened to the Sydney Opera House in Sydney, Australia, which has the same distinctive shape.

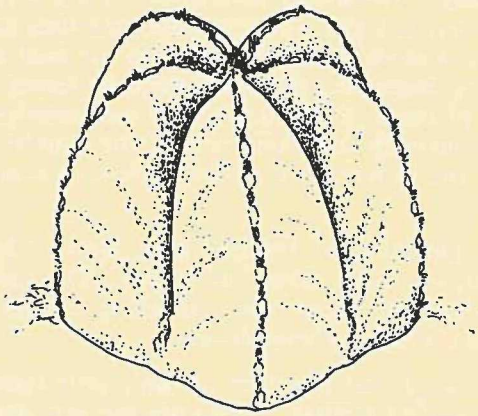


FIGURE 1. *Astrophytum myriostigma*, the Bishop's Cap.

Another cactus of strange appearance is the Brain Cactus, *Echinofossulocactus zacatecasensis*, also from north-central Mexico (the province of Zacatecas). It is a low-growing species, forming a disk which may reach 10 cm in diameter. It is deep green in color, with numerous narrow ribs closely compressed and folded together. The spines are scattered sparsely over the plant in inconspicuous tufts. The flowers are white, tipped with lavender, and appear freely throughout the spring.

The barrel cacti have a distinctive round shape, and strong, sharp spines of many different forms and arrangements. *Ferocactus latispinus*, a barrel cactus from central and eastern Mexico, grows to 40 cm high and

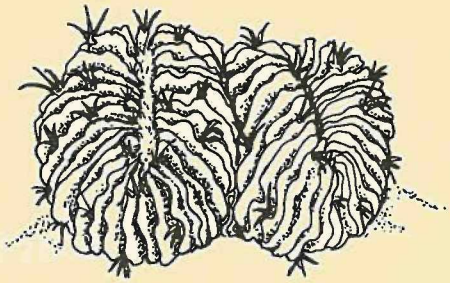


FIGURE 2. *Echinofossulocactus zacatecasensis*, the Brain Cactus.

equally as broad. It has approximately 20 ribs covered with thick, sturdy spines. In each tuft of spines is a central spine that is broader and flatter than the others, and curved at the tip. The color of the spines varies greatly, from reddish when young to yellowish with increasing age. In many species they have distinct crosswise rings or bands of color. The flowers of this cactus are reddish in color and are sweet-scented. This species prefers a temperate climate. Another barrel cactus, *Ferocactus covillei*, has attractively marked reddish spines which are often sharply hooked. It makes an equally good pot plant.

Some cactus species have evolved amazing camouflages to protect them from grazing herbivores. *Ariocarpus trigonus*, often called the Living Rock, is found in the northeastern part of Mexico (the provinces of Coahuila, Nuevo León and Tamaulipas). This cactus closely resembles the stony desert on which it

FIGURE 3. One of the barrel cacti, *Ferocactus latispinus*.

grows. It forms a flat, inconspicuous mound dotted with tubercles, supported by a thick, massive tap root. The flowers are yellow, and appear in November. All species of *Ariocarpus* are poisonous and have been used as medicine.

Another small cactus of prostrate growth form is *Obregonia denegrii*, the Artichoke Cactus. It is found in the province of Tamaulipas and prefers a temperate climate. Like *Ariocarpus*, it is flattened, greyish-green in color and covered with tubercles. The tubercles, which are arranged spirally, point inwards like the leaves of an artichoke head. The flowers appear in the centre of the plant and are white in color, and the seeds which later follow them are large and black.

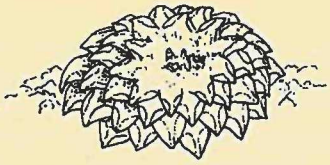
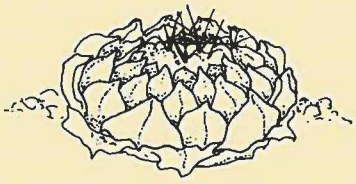


FIGURE 5 (above). *Ariocarpus trigonus*, the Living Rock.

FIGURE 6 (below). *Obregonia denegrii*, the Artichoke Cactus.



Strombocactus disciformis is found in Central Mexico, in the province of Hidalgo. This tiny cactus has a gray-green body with spirally arranged ribs divided into low tubercles. In size and shape, it has a marked resemblance to a pine cone. Near the centre of the crown are a few clusters of spines, through which the flowers appear. The flowers are white tinged with red and yellow, and are followed by brown seeds. *Strombocactus* does well in a soil high in calcium.

Leuchtenbergia principis, a cactus from northern Mexico, grows amongst grasses and agaves and does not look at all like a cactus. It is an interesting plant which grows to about 15 cm in width and forms a rosette of triangular leaflike tubercles. The tubercles are blue-green

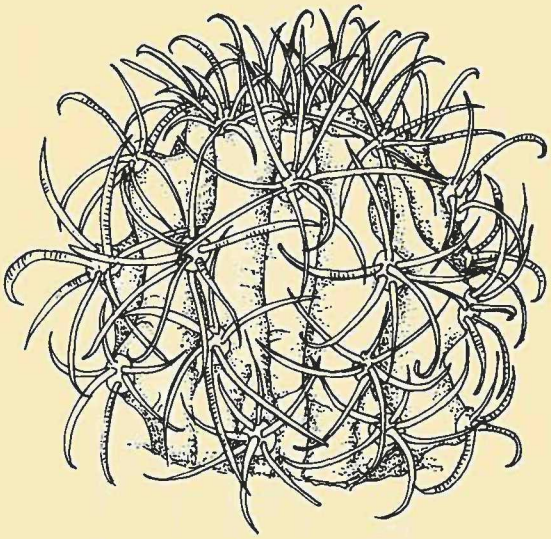
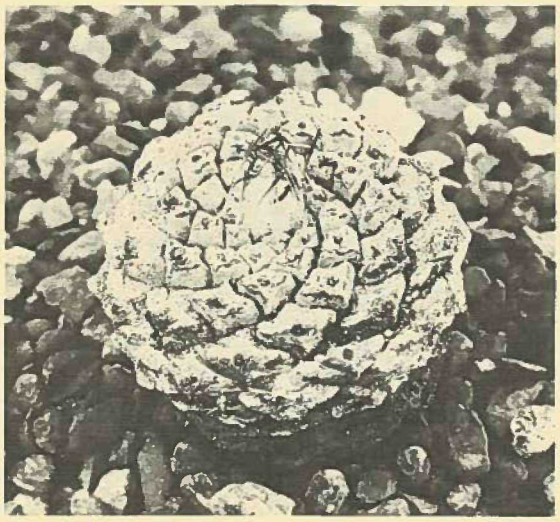


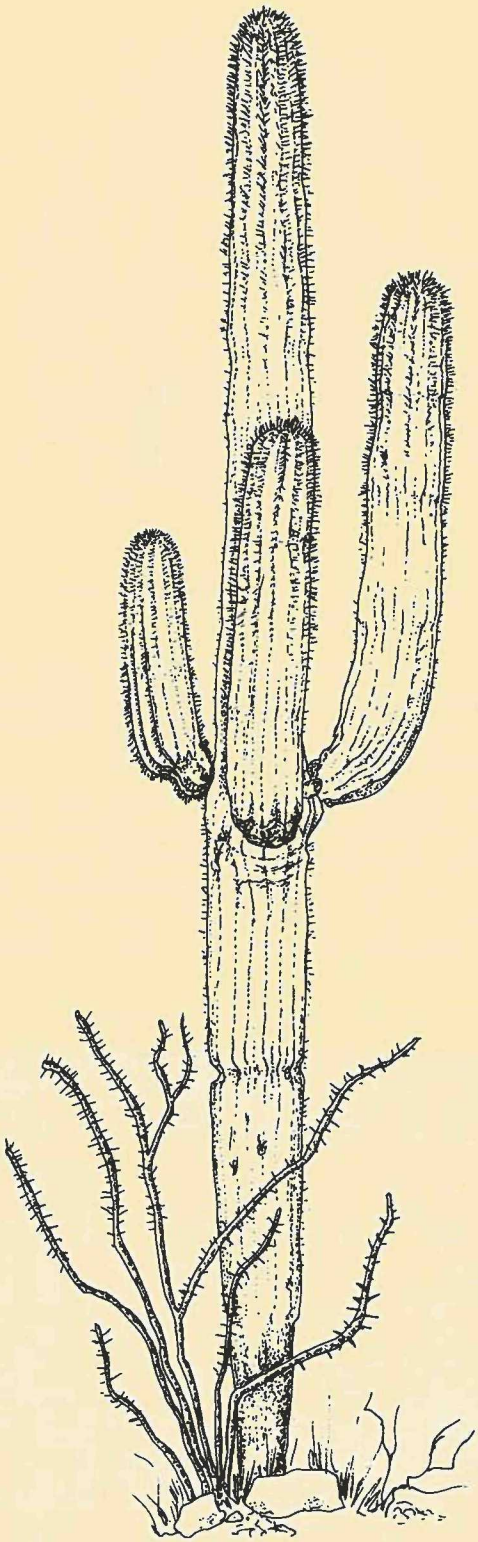
FIGURE 4. The barrel cactus *Ferocactus covillei*, a species which occurs in Arizona and in northern Mexico.

in color and have clusters of papery spines on the tips. The flowers are pale yellow, large and long-lasting. This plant has a well-developed tap root and does best in a rich soil.

The Opuntias, which are among the best-known of all cacti, make up a large group that includes the prickly pears, the bunny ears, and the beaver tails. These plants have stems in jointed sections, the individual sections often being flattened and leaflike in shape. In North

FIGURE 7. *Strombocactus disciformis*. This specimen is about 4 cm across.





and South America, Opuntias have been used to make impenetrable fences and have also been used as a food source. In Australia, however, they have become a nuisance in the interior of the continent, where they have spread unchecked by natural predators. These cacti propagate very readily from the individual stem sections.

Opuntia rufida, the Cinnamon Cactus from northern Mexico, grows to 1.5 m tall. It has a treelike form, with many branches extending from a single main trunk. Like other members of this group, it bears small bristles called glochids in addition to the spines. These bristles are rusty-brown in this species, hence the common name. If touched they embed themselves in the skin, and are irritating and difficult to remove.

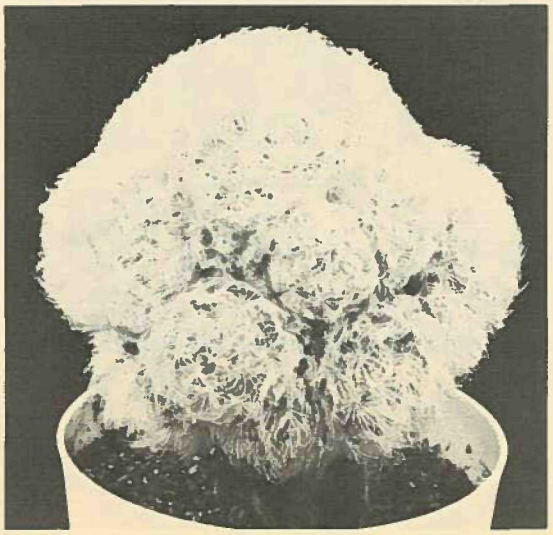
Another member of this group is the Beaver Tail, *Opuntia basilaris*, from northern Mexico. The stems of this species often creep along the soil. The flattened stem sections or "pads" may reach 20 cm in length. The plant is a beautiful bluish color, with coppery-colored spines. In the summer, attractive purplish flowers appear.

Carnegiea gigantea, the Saguaro, grows in northwestern Mexico (the Sonora region) and adjacent parts of the United States. It is a monster of the cactus world, and is tree-like both in size and in silhouette. The "skeleton" or woody portion of the stem has actually been used as a building material, and is often made into lamps and other novelties. The flowers are large, white and nocturnal, appearing on the ends of the long stems. They are followed by juicy red fruits. The Saguaro is the state flower of Arizona.

A marked contrast to the huge Saguaro is the tiny soft *Mammillaria plumosa* from northern Mexico. This tiny cactus grows clustered together in rock clefts, and it is so densely covered in soft feathery spines that the pale tubercles are scarcely visible. It produces small white flowers, which are inconspicuous against the white of the "feathers". This species is only one of many kinds of *Mammillaria*. The genus is a large one, and is widespread in Mexico.

FIGURE 8. A handsome example of *Carnegiea gigantea* (the Saguaro), with *Fouquieria splendens* (Ocotillo) growing at its base.

FIGURE 9 (right). *Leuchtenbergia principis*, one of the most unusual-looking Mexican cacti. The spines are borne on the ends of the leaflike tubercles.



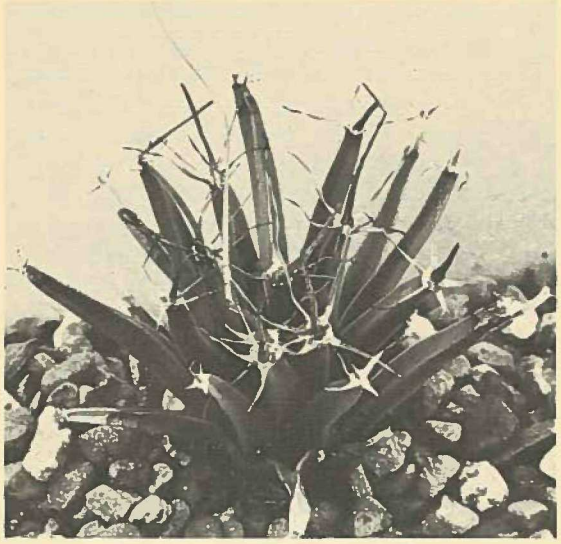


FIGURE 10 (left). *Mammillaria plumosa*. This specimen has been grafted onto another cactus species; normally it forms low ground-hugging clusters.

FIGURE 11. *Opuntia rufida*, the Cinnamon Cactus, lacks the long spines found in most members of the *Opuntia* group.

Another favorite of collectors is *Echinocereus dasyacanthus,* the Rainbow Cactus, from northeastern Mexico. It is called the Rainbow Cactus because of its multicolored spines, which are short and stiff and arranged in bands. Their color varies with the seasons, but regrettably are less striking in cultivation than in the plant's native habitat. The flowers are also very beautiful — large and bright pink. *Echinocereus* is usually barrel-like in shape, but occasionally forms branches.

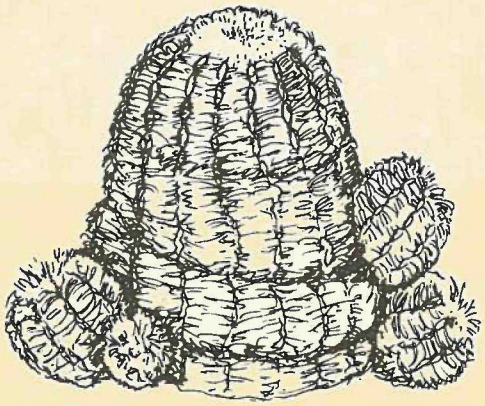


FIGURE 12. *Echinocereus dasyacanthus,* the Rainbow Cactus.

The *Cephalocereus senilis* or Old Man Cactus from central Mexico (Guanajuato, Hidalgo and Puebla) is a most interesting species. Its name is derived from the fine white hairs which clothe the slender columnar stems. It may become very large in nature, growing to 10 or 12 m tall in its native hills and valleys. This plant may live for years before producing its nocturnal pink blooms, but its attractive habit of growth makes it well worth while as a cultivated plant.

Succulents

One family which includes many Mexican succulents is the Agavaceae. *Agave victoria-reginae* is the Queen Agave from northern Mexico. It is a stunning plant, with a low rosette of swordlike, unusually marked leaves. The leaves grow to a length of 15 cm and are deep green in color with white margins and horny tips. This plant is very slow-growing and takes many years to produce the 5 metre high inflorescence with its green blossoms. Once it has bloomed, the plant then dies.

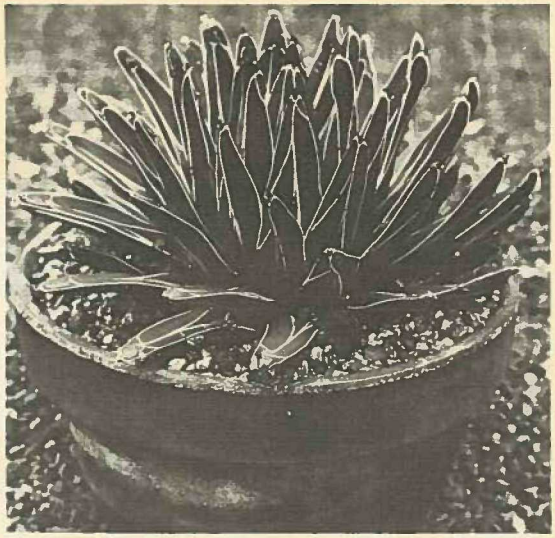
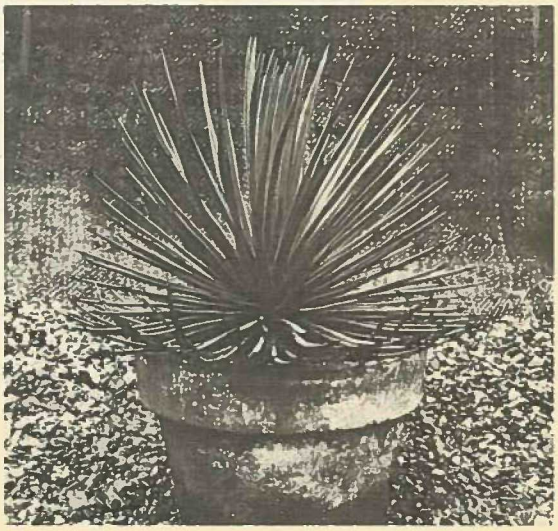


FIGURE 13. *Agave victoria-reginae,* one of the most attractive members of its group.

Agave stricta, found near Tehuacán in the province of Puebla, is a round dense hedgehog of an Agave. It has slender and very sharp leaves, and is a beautiful plant, growing to a maximum of 40 cm high. The leaves are attractively marked, with grey stripes on the margins.

FIGURE 14. *Agave stricta,* a striking slender-leaved species.



A more delicate and less drought-resistant plant is the favorite *Sedum morganianum*, the Donkey's Tail from the eastern coastal province of Vera Cruz. This plant belongs to the Crassulaceae or stonecrop family. Its trailing branches reach a length of 1 metre and are covered with pale green fleshy leaves up to 2.5 cm long. It makes an excellent hanging plant. The blossoms are red, and appear on the ends of the "tails".

Pachyphytum bracteosum is another attractive succulent and is also a member of the stonecrop family. It is grey-green in color, with thick smooth leaves which form an upright rosette. The brilliant red blossoms appear on long upright stems during the summer months.

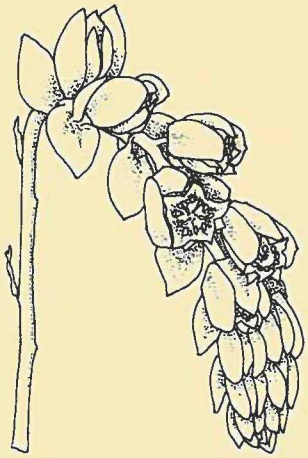


FIGURE 15. A flowering stem of *Pachyphytum bracteosum*.

FIGURE 16. *Echeveria gibbiflora*, the Donkey's Ear, has large handsome rosettes of bluish-colored leaves.

The genus *Echeveria* was named after a Mexican botanical artist. It contains 60 or more species, most of them native to Mexico. *Echeveria gibbiflora*, the Donkey's Ear (from the large flat leaves), is found in central Mexico near Orizaba and Cuernavaca. It is the largest member of the genus, producing a large rosette of leaves up to 35 cm across. The main stem may grow to more than a metre in length. The leaves are up to 18 cm long and 10 cm wide, as many as 20 per rosette, and vary in color from bluish-green through rose and violet, or even bright red when temperatures are low. The flowers are coral red, partly concealed by the violet-gray sepals. They are borne in late fall or winter on flower stalks up to a metre long.

Acer circinatum Pursh

VINE MAPLE

Member of the Family Aceraceae

Natural Distribution

Acer circinatum occurs from British Columbia south to northern California. It is most common west of the Cascade Mountains, but also occurs east of the Cascades (for example, in the Wallowa Mountains of northeastern Oregon). In British Columbia the species is found from sea level to elevations of 900(-1050) m in the coastal forest, as far north as Knight Inlet (51°N) and as far inland as Manning Provincial Park. It is also recorded from Wells Gray Park, 150 miles north of Kamloops. It is probable that there are other occurrences of this tree in the wetter parts of the Interior. On Vancouver Island it is known to occur naturally along the Robertson River (near Cowichan Lake) and the Salmon River (north of Campbell River).

Habitat

Acer circinatum is characteristically found along moist stream banks and in damp woods and meadows, in moist, rich, rocky soils. It may grow in thickets or scattered among other species. It is extremely tolerant of dense shade, and often forms a constituent of the coastal forest understory. It also occurs in forest openings, especially on recently logged-over areas. In British Columbia the species is an edaphic climax shrub in both the Coastal Western Hemlock and Coastal Douglas-fir Zones. The climate in areas where it occurs is characterized as marine subhumid to humid or rainy, with warm dry summers, a mean annual temperature of 5°-11°C, absolute minimum and absolute maximum temperatures of -30° and 41°C respectively, and an annual total precipitation of 66 to 665 cm (Krajina 1969).

Description

The species is an erect to reclining or vinelike, usually several-stemmed, deciduous shrub or small tree, 1-10(-15) m tall with a DBH of 7-20(-30) cm. When growing as a shrub, it has an irregular broad open crown with slender, crooked or crumpled branches; the stems are several to many from the base, weak and slender, very twisted, glabrous or sparsely pilose to almost glaucous, and reddish-brown or light green, becoming brown with age. When growing as a tree, it has a round-headed open crown and a single short crooked trunk which is often prostrate or arching with a few twisted spreading limbs. In dense shade the stems are particularly long and twisted, producing a straggly crooked form, whereas open-grown specimens are apt to be shorter, more compact, and more erect and symmetrical. Dense thickets are often formed due to the vine maple's habit of layering by low-lying branches. The species reaches its largest size on the rich alluvial soil of bottom lands, where it may have 4 or 5 vine-like stems spreading in wide curves and sending out long slender branches. It is much smaller in the southern part of its range.

The root system is fibrous and vigorous.

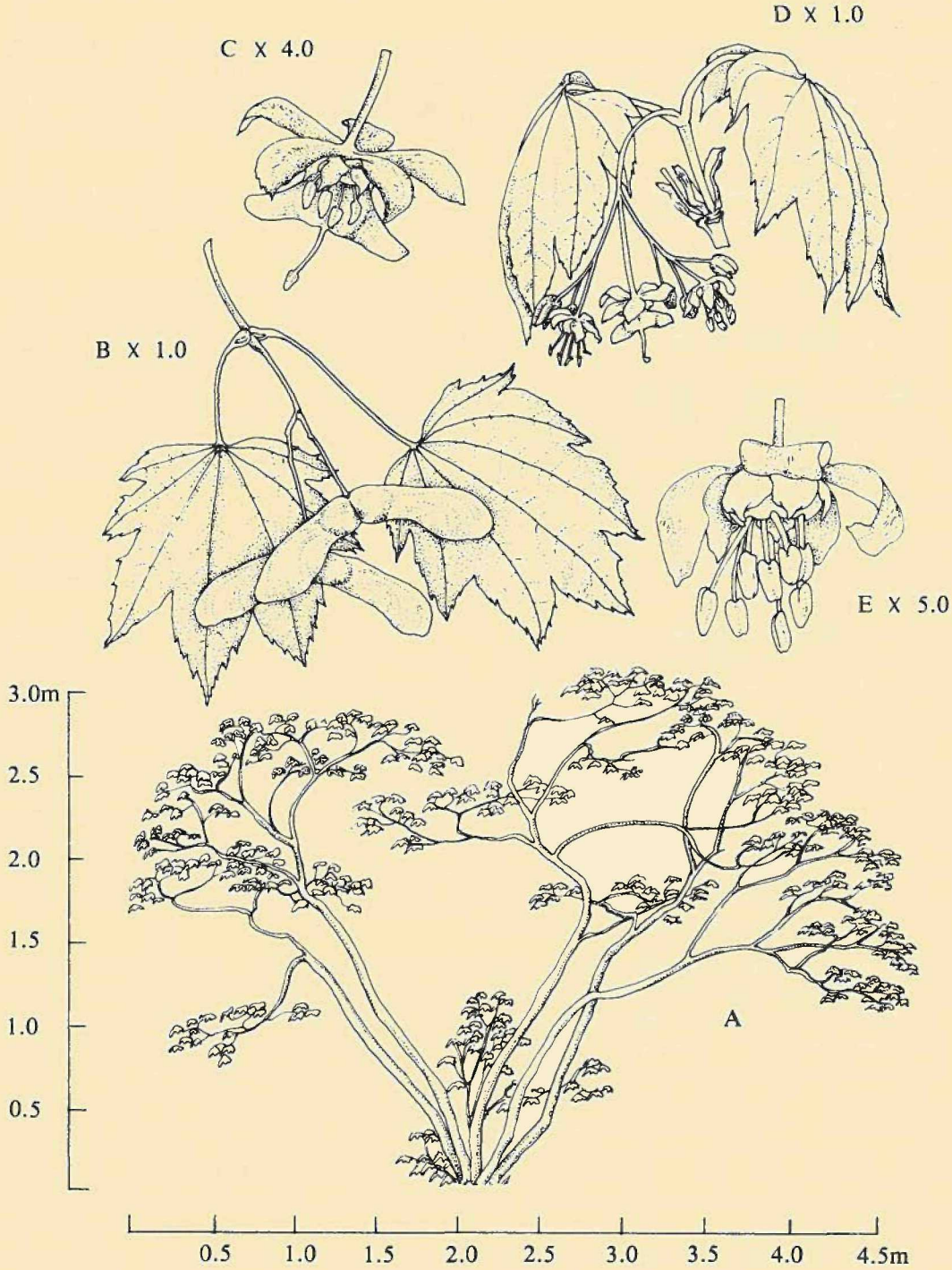


FIGURE 17. *Acer circinatum*. A. habit of tree, B. twig with mature fruits, C. a single female flower, D. twig with flower cluster and newly unfolded leaves, E. a single male flower.

The bark is astringent, thin, smooth or with many shallow fissures (especially near the bases of the larger trunks), greenish at first, but later becoming bright reddish-brown or dull grayish-brown tinged with red.

The twigs are slender, much branched, smooth, glossy red and often covered with a glaucous bloom when young, later becoming greenish-red to red-brown and glabrous. They are very contorted and irregular in shape, occasionally ribbed below the leaf scars, slightly gummy, and almost round to somewhat 6-sided in cross section. The sap is clear and somewhat sweet. The pith is pale, round to slightly angled, and continuous.

The wood is very hard and fine-grained, tough but low in strength. It is dense and surprisingly heavy, but checks badly on drying and rots quickly when in contact with the soil. The heartwood is very pale brown to almost white, the sapwood thick and lighter-colored.

The buds are opposite, 3 mm long, solitary or sometimes collaterally multiple, ovoid or conical, obtuse, and subtended by a fringe of long white hairs from the upper margin of the leaf scar. Terminal buds are generally lacking (except for flower buds), but the topmost lateral bud on each twig is enlarged and appears terminal. The lower laterals are much smaller. The outer scales are usually 4 in number, opposite, rounded on the back, thin, shiny, bright-red and sometimes green at the base, and glabrous, with white-ciliate margins and a tuft of long hairs at the tip. The inner scales along the veins on the upper surface. They are conspicuously palmately nerved with prominent veinlets, and are exstipulate. The petiole is 2-4(-5) cm long, stout, grooved, puberulous at first but later becoming smooth, and clasping the stem by a large base.

The leaf scars are small, opposite, sometimes ciliate, more or less U- or V-shaped, and narrowly linear at the base of the season's growth, becoming broader towards the tip. The bundle traces are 3 in number (rarely 5-7), and stipule scars are lacking.

The leaves are opposite, simple, orbicular, thin and membranaceous, (3-)5-15(-18) cm long and (4-)5-12(-15) cm broad, and palmately lobed almost to the centre. The bases of the leaves are cordate with a broad and usually shallow sinus, or sometimes almost truncate. The lobes are (5-)7-9(-11) in number, the apices of the lobes acute to acuminate, narrowly triangular and separated by V-shaped notches. The leaf margins are irregularly and sharply singly or doubly serrate. The leaves are rose-red or with reddish tints when young, later becoming bright green or bright yellowish-green above and paler below, and eventually turning reddish-yellow to orange and scarlet in the fall. They have the most vivid coloration of any coastal tree or shrub. The leaves are villous when young, becoming glabrate in age except for tufts of hairs near the base, in the angles of the veins beneath, or sometimes along the veins on the upper surface. They are conspicuously palmately nerved with prominent veinlets, and are exstipulate. The petiole is 2-4(-5) cm long, stout, grooved, puberulous at first but later becoming smooth, and clasping the stem by a large base.

The flowers are produced from March to June, depending on the range. They appear with the leaves or when the leaves are about half grown. The inflorescence is a drooping terminal loose corymb, on slender 2-leaved lateral branchlets, usually 4-10(-20)-flowered. The pedicels are long and slender, and branch frequently. The flowers are 6-9 mm across, regular, and polygamous (with intermingled perfect and unisexual flowers), but only one sex is functional in each flower. Most of the flowers are staminate. The calyx is (3)4-6 mm long, dark red to purplish, and villous to sparsely pilose near the tip; the calyx lobes are (4)5, imbricated, oblong to obovate, acute and spreading. The petals are (4)5, white to greenish-white, and cordate with an acute, hooded apex; they are shorter than the calyx. The stamens are (4-6-)7-8(-10-12) in number, the filaments slender and villous towards the base. The stamens are inserted on the inner edge of the fleshy annular disc, and are exserted and fertile in staminate flowers, short and abortive in perfect ones. The styles and stigmas are 2 per flower, the styles slender, connate only at the base and inserted between the lobes of the ovary. The ovary is superior, compressed and glabrous, with 2 spreading lobes each of which contains 2 ovules. After fertilization an elongate divergent wing rapidly develops from each carpel. In staminate flowers the ovary is reduced to a small point surrounded by a tuft of small hairs.

The fruit is a double, winged samara 2-3.5(-5) cm across, glabrous or sparsely pilose, compressed, ridged, and usually separating just before falling. The wings are at an angle of almost 180° from each other and at nearly 90° to the pedicel; they are obovate, up to 4 cm long and 0.9 cm broad, thin, but with a thickened area on the lower margin. The nutlets and wings are rose-colored to tawny when mature. The fruit matures in late autumn, by which time the pedicels have turned upright so that the samaras stand erect above the leaves. The seeds are usually one per samara (the other one aborting), but occasionally two. They are smooth, 0.3-0.6 cm long, pale chestnut-brown, ovoid, compressed and irregularly 3-angled. The seedcoat is membranaceous, the inner coat often fleshy. The species is only a moderate periodic seeder, although some seed is borne locally every year.

Propagation

Vine maples should be propagated by seed whenever possible. Seeds should be sown soon after maturity, or stratified at 5°C and sown in the spring. They soon lose their ability to germinate, and should not be allowed to dry out. The seedlings require partial shade during development.

Cuttings from half-ripened greenwood may be taken in summer.

Although vegetative propagation by rooting of low-lying branches is common in nature, particularly if the branches are covered by moss or leaf mould, layers in the nursery may take more than a single season to root.

Varieties and rare forms may be budded in summer onto the species.

Transplantation

Transplantation of this species is relatively easy, because of the fibrous nature of the roots and the absence of a well-developed taproot. Provided that the operation is carried out while they are dormant, fairly large specimens can be moved successfully.

Conditions for Cultivation

The species is a very persistent but slow grower, taking many years to reach full size. It has been estimated that a tree with 10 to 12.7 cm DBH was 60-70 years old. The longevity of the species has not been determined with certainty, but 80 to 90 years may be the maximum. The recommended hardiness zone in Canada is Zone 6 (Sherk & Buckley 1968). *Acer circinatum* is easily grown under almost all conditions of soil and moisture, but prefers good moist well-drained soil and a climate with high precipitation and high relative humidity. It is tolerant of fairly dense shade, where it develops the contorted shape so characteristic of wild specimens, but will also grow well in a relatively sunny position. Specimens should be sheltered from cold winds and are prone to damage from late frosts. Very little pruning is required, except that which is required for training purposes. The lower branches may be pruned from a tree form as it grows in height, until sufficient clear stem has formed. As with all maples, pruning should be done during the late summer or early fall or during the fully dormant period, but never in spring because the fast-rising sap leads to severe "bleeding" from the cut surfaces.

Landscape Value

The genus *Acer* as a whole is of great ornamental value. *Acer circinatum* is of considerable value in the garden, particularly in its native area, because it has something of interest in every season. In spring the flowers with their purplish sepals and whitish petals are very attractive, especially when associated with the conspicuous crimson bud scales. In summer the leaves are prettily tinted, and form an interesting delicate pattern with the winged rose-colored fruits. In fall there is the beautiful brilliant orange and scarlet coloration, and in winter the contorted and twisted branches make an attractive silhouette. The species is well adapted for use in gardens because of its small compact size and ability to grow in partially shaded situations, especially under large conifers in a woodland planting. Vine maples may be planted around small garden ponds and pools, as long as these are completely watertight so that the soil is not waterlogged. These trees may also be espaliered against a

wall, or even grown in a large container (35 cm or up) on a patio. Vine maple is better planted in small groups than as a single specimen; the multiple trunks then give the impression of a grove of trees. When grown in the open as a single specimen, it tends to lose its vinelike characteristics and becomes more erect and open. This tree casts moderately dense shade, and the root system, while quite energetic, is not invasive.

Availability

The shrub is readily obtainable from nurseries in the Lower Mainland area of British Columbia.

Varieties and Ornamental Cultivars

No varieties of *Acer circinatum* are recognized. In 1915, J. K. Henry described (from a specimen in Stanley Park, Vancouver) var. *fulva*, with yellowish twigs and sepals and the petals not so cucullately pointed as in the species. However, this doubtful variety is no longer accepted.

One cultivar, 'Elegant', has been selected and named at Ottawa.

Other Uses

The wood is of little commercial value because of its small size, crooked form and weakness, but it is used locally for fuel and for minor domestic purposes such as making tool handles. Woodsmen use green vine maple for pothooks and campfire reflectors, because it is almost impossible to burn. Because of the layering habit of the branches, the shrub may be of some use in reclamation projects. Livestock may also browse this species. Various people have experimented with making maple syrup from the sap, with limited success.

The Cowichan, Salish and Squamish Indians of British Columbia used the wood to make knitting needles, but it was not considered ideal because the wood warps over a period of time. Spoons, bowls, platters and other small household items were carved out of the wood. The Quinault Indians of Western Washington used to refer to the species as the "basket tree". The long straight shoots were used to make an openwork basket, either with a crossed-warp twine or with a broad-spaced checkerboard weave, which was then used for general household purposes such as carrying wood, clams or fish. The same tribe also used poles of vine maple to hold down the roof planks on their houses, and mixed the charcoal with oil to make a black paint. The Skagit tribe used saplings for salmon tongs, and as swings for babies' cradles. Several Washington tribes used vine maple to make fish hooks or wattleworks for fish traps, because of its toughness.

Diseases and Problems of Cultivation

It has been reported that the hairs on the samaras may be irritating to some people, especially nurserymen handling them in large quantities.

Several fungi occasionally attack maple leaves but most do little damage. Toms (1964) reports *Oidium* sp. (a powdery mildew) from the Vancouver area, and *Phleospora aceris* (Lib.) Sacc. (a leaf spot) from the Lower Fraser Valley. Coral spot, a fungus causing orange pustules on infected wood, may cause considerable damage. It initially attacks dead wood but then spreads to living branches, especially if the specimen is in poor health. It causes dieback of branches and may even kill the entire tree. All dead and diseased wood should be cut out and burnt, and all cut surfaces sealed.

Several insects, including *Pulvinaria innumerabilis* (cottony maple scale), *Hemerocampa* spp. (tussock moths), and the defoliating moths *Antheraea polyphemus* Cram. (polyphemus moth) and *Pseudohazis eglanterina* Bdv. may attack maples, including vine maple, but they usually do little serious damage.

The shrub is susceptible to late frosts and should be sheltered from cold winds.

The generic name *Acer* is the classical Latin name for the maple tree. The word means 'sharp', referring to the hardness of the wood, which the Romans used for spear hafts. It may also mean

sharp or pungent, referring to taste as well as touch. The generic name *circinatum* may be derived from the generally rounded or circular form of the leaves, but also means coiled or curled around like a crook, and may therefore be a reference to the general shape of the branches. The common name originates from the often sprawling, crooked, vinelike appearance and habit of the slender weak stems. The word 'maple' derives from the Anglo Saxon word for maple, *mapulder*, which gave rise to the Old English or Middle English *mapel, mapul* or *mapil.* Chaucer used the word *maple* in 'The Romaunt of the Rose' before 1366 and it was in general use by the late 16th century. It is conjectured that *mapulder* may be traced back to the Old High German word *mazzaltra* and possibly to *matlu,* meaning food, the young leaves of *A. campestre* having been eaten as a pickle.

The type locality is 'on the great rapids of the Columbia River', where it was collected by Lewis. It was introduced to cultivation in Great Britain by Douglas in 1826.

REFERENCES

Gilkey, H. M. & P. L. Packard. 1962. Winter Twigs. Oregon State Univ. Press, Corvallis.

Grigson, G. 1974. A Dictionary of English Plant Names (and Some Products of Plants). Allen Lane, London, England.

Gunther, E. 1945. Ethnobotany of Western Washington. Univ. Wash. Publ. Anthropol. 10(1):1-62.

Hitchcock, C. L. et al. 1961. Vascular Plants of the Pacific Northwest. Part 3. Saxifragaceae to Ericaceae. Univ. of Washington Press, Seattle.

Hosie, R. C. 1969. 7th ed. rev. The Native Trees of Canada. Canadian Forestry Service, Department of Fisheries and Forestry. Queen's Printer, Ottawa.

Hottes, A. C. 1942. The Book of Trees. A. T. DeLaMare Company Inc., New York.

Krajina, V. J. 1969. Ecology of Forest Trees in British Columbia. Ecology of Western North America 2(1):1-147.

Lyons, C. P. 1965. Rev. ed. Trees, Shrubs, and Flowers to Know in British Columbia. J. M. Dent and Sons (Canada) Ltd., Vancouver.

Mulligan, B. O. 1958. Maples cultivated in the United States and Canada. American Association of Botanical Gardens and Arboreta, Lancaster, Pennsylvania.

Murray, A. E., Jr. 1970. A Monograph of the Aceraceae. Ph.D. Thesis, Pennsylvania State University.

Sherk, L. A. & A. R. Buckley. 1968. Ornamental Shrubs for Canada. Research Branch, Canada Department of Agriculture, Publication 1286. Queen's Printer, Ottawa.

Smith, A. W. 1971. A Gardener's Dictionary of Plant Names. (Revised and enlarged by W. T. Stearn.) Cassell, London.

Sudworth, G. B. 1908. Forest Trees of the Pacific Slope (republished 1967). Dover Publications Inc., New York.

Toms, H. N. W. 1964. Plant Diseases of Southern British Columbia. A Host Index. Reprinted from: Canadian Plant Diseases Survey 44:143-225. Canada Department of Agriculture, Ottawa.

Turner, N. C. Squamish Plant Names. Unpublished typewritten manuscript.

Pool and Bridge Renovations in the Nitobe Memorial Garden

The Nitobe Memorial Garden, constructed in 1959 and opened in May 1960, has been a source of pleasure and enjoyment for not only the faculty, staff and students at the University, but the many thousands of visitors who have come to the Point Grey area during the past sixteen years. The original garden was designed by Professor K. Mori, the dean of Landscape Architecture in Japan at the time. Professor Mori was well known for the Japanese gardens that he had designed and built in many parts of the world and the Nitobe Memorial Garden at the University is the last garden that Professor Mori designed and developed before his death.

The Garden is a classical stroll garden, and contains a small lake some 22,400 square feet in area. The circulating water system in the garden contains approximately 500,000 gallons of water. Initially the pool was lined with an asphalt-based membrane, and over the years this membrane has hardened and showed some leakage. As a result it was decided in 1976 to renew the pool membrane. We felt it useful to provide documented information about the construction and renovation of this new pool membrane, as we often have enquiries from interested visitors and landscape architects as to how the pool is maintained and developed. This article will provide detailed information for those who are interested in the construction and waterproofing of pools.

Among the outstanding features of the Nitobe Memorial Garden are the stones which have been placed throughout the garden, and in particular those which encircle the main garden pool. The rock was selected from local sources in the Lower Mainland of British Columbia, and some of it came from as far away as Britannia Beach and Harrison Lake. Professor Mori took great care in the selection and placement of these stones, and one of the important considerations in the renovation of the pool membrane was to retain the aesthetic lines of the pool. An initial survey was undertaken after the pool was drained to determine how best the membrane could be replaced without destroying these aesthetic qualities and yet provide the necessary waterproofing. After considering various alternatives it was determined that a cement membrane would be the most permanent solution to the problem, since no maintenance is needed.

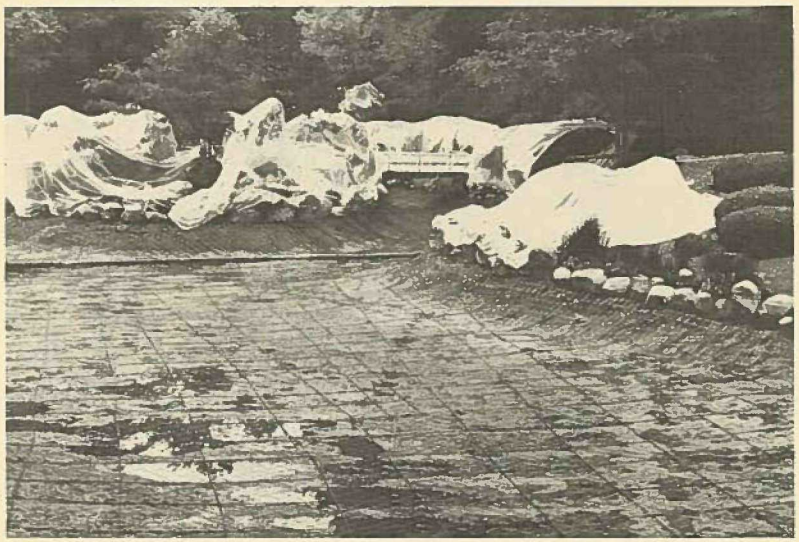
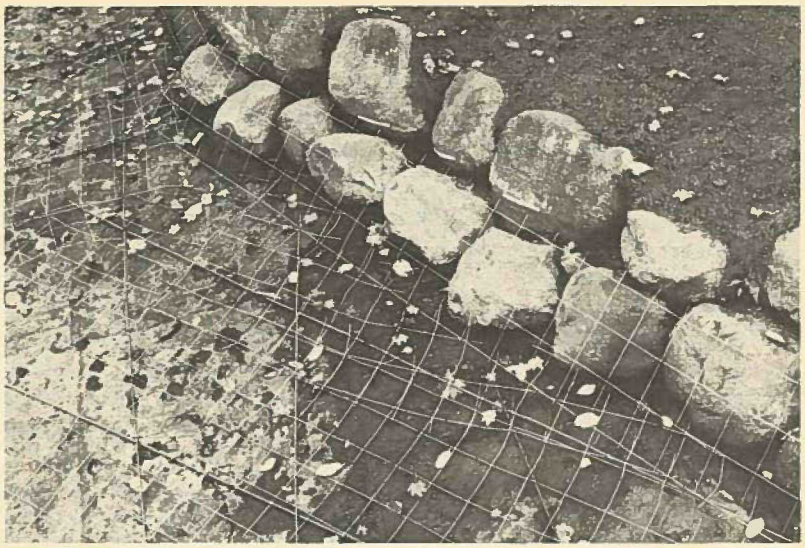


FIGURE 18. A general view of the Nitobe Garden main pool looking toward the island, showing the appearance of the pool surface following the installation of the steel and wire mesh grid, and the covering of the shrubbery and decorative marginal stones.

FIGURE 19 (right). A detailed view of the steel and wire mesh grid placed on the pool surface next to the stone decorative edge. The masking tape on the stones indicates the normal water level of the pool.



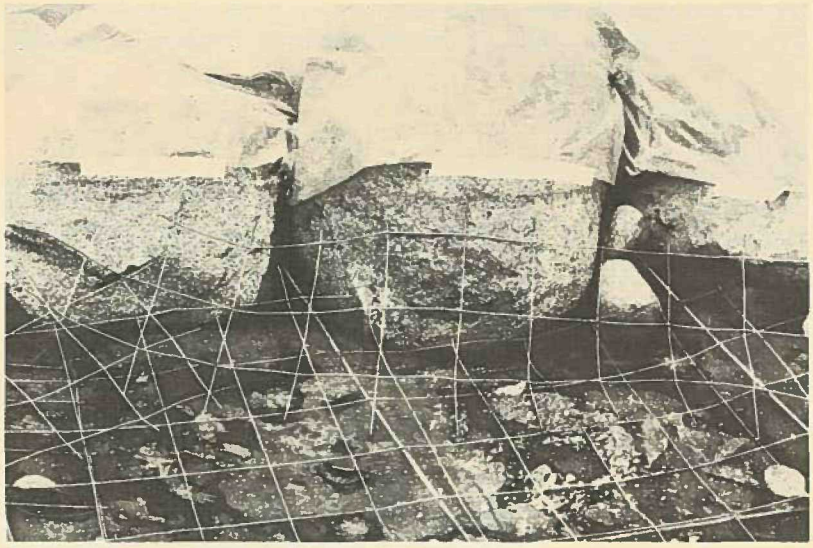


FIGURE 20 (left). Detail of the margin of the pool prior to installation of the shotcrete, showing how the surface of the rocks above the water level was protected by the use of plastic covering.

Basically, construction of the membrane consisted of the laying down of a wire mesh over the entire bottom of the pool, followed by application of a cement mix over the wire mesh to form a single complete surface. The shrubbery, lanterns, bridges and stones around the edges of the pool were covered with 4 mil plastic to protect them from the spray from the concrete pouring process. Our staff worked in consultation with the Department of Physical Plant to establish the strength requirements for the pool membrane, and a formula for the cement mix was developed and approved by the Department of Physical Plant. The cement mix was as follows for each unit:

600 lb Portland cement Type 1
500 lb fine sand
2100 lb coarse sand
700 lb aggregate 3/8″ or less

The program was initiated in the late fall when weather conditions were suitable for the cementing work, and a total of 3½ working days were required by Pacific Shotcrete Installations Ltd. (Burnaby, B.C.) for the application of the cement using the wet shotcrete system. Incorporated in the membrane were three hydrostatic pressure release valves to prevent subterranean water accumulation, so that the membrane would not be broken by pressure from below.

The procedure for the repair of the membrane was as follows: The pool was drained. The Koi carp that are normally in the pool were removed to another suitable pool on campus. The pool was cleaned and washed to provide a clean surface on which the cement would be laid. This was followed by the installation of wire mesh consisting of 10/10 wire welded in 6 x 6 inch squares. A 6 inch overlap was made on all mesh section joints. This wire mesh was laid over a 3 foot square supporting grid of #3 steel rods. Care was taken to ensure that the mesh went up to and around the stones forming the border of the pool. Once this was completed, concrete was delivered by truck to the site, pumped into the pool area, and sprayed onto the surface. The mix, known as shotcrete, was pumped wet from outside the garden through a 3 inch pipe to a 2½ inch flexible pump hose which was used to apply the shotcrete. The shotcrete was applied with a pressure of 1200 to 1800 lb per square inch, to a minimum thickness of 3 inches over the pool bottom and sides. This layer is capable of withstanding pressures of more than 500 lb per square inch after 28 days. Bridge pilings were wrapped with expansion joint material to within an inch of the top of the shotcrete surface, so that a complete seal would be maintained. Special care was taken to ensure back filling of the shotcrete around the decorative stones of the pool margin. Shotcrete was placed to 3 inches above the normal waterline of the pool (indicated on the stones by masking tape). To complete the repair of the pool lining, 203 yards of shotcrete were used.

Following completion of the cementing, the whole membrane was washed down to remove excess lime from the cement. The pool was filled, then drained and filled again. This slushing action was necessary to hasten the return of the water quality to normal. We have estimated that a three month period is required for the quality of the water to return to a level which will allow the fish to be replaced in the pool. No surface treatment of the cement membrane was used, on advice from the

FIGURE 21. A view of the channel between the east side of the garden and the island, showing the problems encountered in the protection of the shrubbery and the bridge against the shotcrete treatment. In the foreground is the 3 inch pipe used to pump the shotcrete into the garden area.

FIGURE 22. A view of the work crew installing the concrete using the shotcrete system. The membrane is a minimum of three inches thick over the entire pool area.

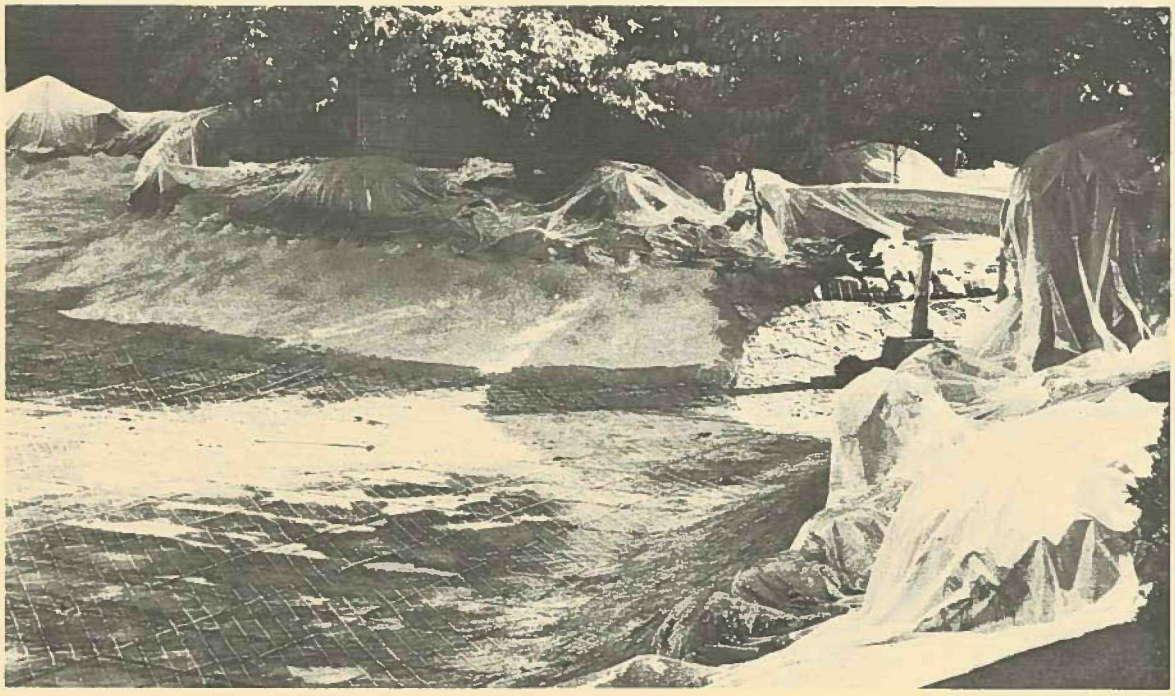


FIGURE 23. An area in which the shotcrete has been completed along the upper margins of the pool. The lower portion of the pool was completed last.

FIGURE 24. A completed portion of the pool, showing the final shotcrete surface and the plastic used in protecting the shrubbery and pool margin.

Vancouver Public Aquarium and other groups dealing with the maintenance of fish in cement tanks. The application of a surface treatment would in any case require maintenance on a continuing basis, and such a program would add a nonessential maintenance cost. The total cost of the program was approximately $27,000.

During construction of the new lining of the pool the bridges were also inspected, and new wooden pilings and decking were installed. Structural members were pressure-treated (to 0.4 lb per cubic foot retention) with Greensalt K33. This preservative treatment will help increase the life expectancy of the bridge structures. New decking was installed on the main bridge, the waterfall bridge and the iris pond bridge. The total cost of this replacement was approximately $7,500.

The new pool membrane is a permanent structure which will require essentially no maintenance in the forseeable future. These repairs should also reduce the total amount of water required to maintain a satisfactory level in the pool. Some problems were encountered with excess spray of the concrete around the decorative stone margin, but this was much reduced by use of the plastic liner to protect the rocks. In some instances, removal of excess cement by chipping was required after the program was completed. Planting pockets along the margin of the pool have been replanted with new plant material so that the original merging of the water with plants and stones can be achieved. The program has been a satisfactory one from an aesthetic viewpoint, and we believe that similar programs could be used with success in pool construction projects in both home and public gardens. We hope that these new improvements will provide reduced maintenance costs for a number of years, while retaining the qualities of the original garden design.

Botanical Garden News and Notes

Friends of the Garden Program — In the Spring of 1976 a new program, the Friends of the Garden Program, was initiated at the Botanical Garden. The first class of the Friends of the Garden consisted of ten people who participated in a training program to learn about the activities of the Garden. In the Fall of 1976 an additional class was established and a similar training program initiated. Also during the Fall a series of projects on specific program areas of public interest were begun by the Friends of the Garden. These include the illustration and development of a new book for children on the Nitobe Memorial Garden, the development of individual trail guides for trails in the B.C. Native Garden, a study of plants suitable for inclusion in the Physick Garden section of the Main Garden, the initiation of a program for the use of house plants as therapy for extended care patients in hospitals, the development of plants displays at the Garden and elsewhere on Campus, and the organization of an art exhibit by illustrators of B.C. plants (to take place in 1979). During the spring, summer and early fall, the Friends of the Garden provided much-needed assistance for the many public tours which visit the Garden, particularly those from hospital groups and public shcools. We anticipate that the Friends of the Garden will be active in developing a tour program for these specialized education groups in 1977.

New Areas Completed — Four new Garden components have been completed under contract in the Main Garden area. These are the Entrance Garden, the Physick Garden, the Arbor Garden and the Contemporary Garden for the display of ornamental plant materials. Initial planting of these areas is now complete. The sun dial, located originally in the old alpine garden on the main campus, has been moved to the new Physick Garden. The Arbor Garden will be planted with an extensive collection of scandent and twining plants to provide a display of materials suitable for growing in the Vancouver area.

Research Associates — Two research associates were appointed to the Garden during 1976. Dr. C. E. Beil, previously an ecologist with the Department of Botany at U.B.C., and Dr. L. K. Wade, an ecologist and head of the Department of Biology at Capilano Community College, are working with the Botanical Garden on specialized programs. Dr. Wade is in charge of a phenological study of the genus *Rhododendron* in the Lower Mainland of B.C., with publication of the results slated for 1979 at the time of the American Rhododendron Society Annual Meeting in the city of Vancouver.

Meetings of Note — Two major meetings were hosted by the Botanical Garden during this summer. The First Interim International Rock Garden Conference was held in Seattle and Vancouver, with more than 500 delegates attending. A most interesting program was presented during the U.B.C. portion of the meetings, and the Alpine Garden Club of British Columbia served as the host club. A special series of workshops were held in the new Botanical Garden area and there were extensive displays of trough gardens, thanks to the efforts of members of the Botanical Garden staff and the Alpine Garden Club of B.C. Fine weather prevailed and the alpines were in reasonable condition considering the time of the season.

A special symposium hosted by the Botanical Garden and sponsored by the International Union of Forest Research Organizations was held during the last week of the United Nations Habitat conference in the city. This special symposium was concerned with the use of trees in the urban environment and delegates came from throughout North America to attend the meeting. The proceedings of this symposium have been recently published as a book, entitled *Trees and Forests for Human Settlements*, by the University of Toronto Press.

Special Programs — The Point Grey Cliff Erosion Control Program, concerned with revegetation of cliffs, was continued under the direction of Dr. C. J. Marchant. This program was supported in part by the British Columbia Provincial Government (through their summer program for students) and by a grant from the President's Office. The B.C. Forest Service also provided support by donating 15,000 trees. The program has resulted in revegetation of specific cliff test sites. The evaluation of the usefulness of various plant materials and their ability to stabilize and control erosion on the cliff test areas will continue. It is anticipated that a special technical bulletin will be produced to provide the information to other resource area managers interested in erosion control through revegetation.

Special Donation — B.C. Greenhouse Builders Ltd. have donated a small home greenhouse to the Botanical Garden for demonstration purposes and use in extension programs. This greenhouse is used in our program devoted to the management of home greenhouses.

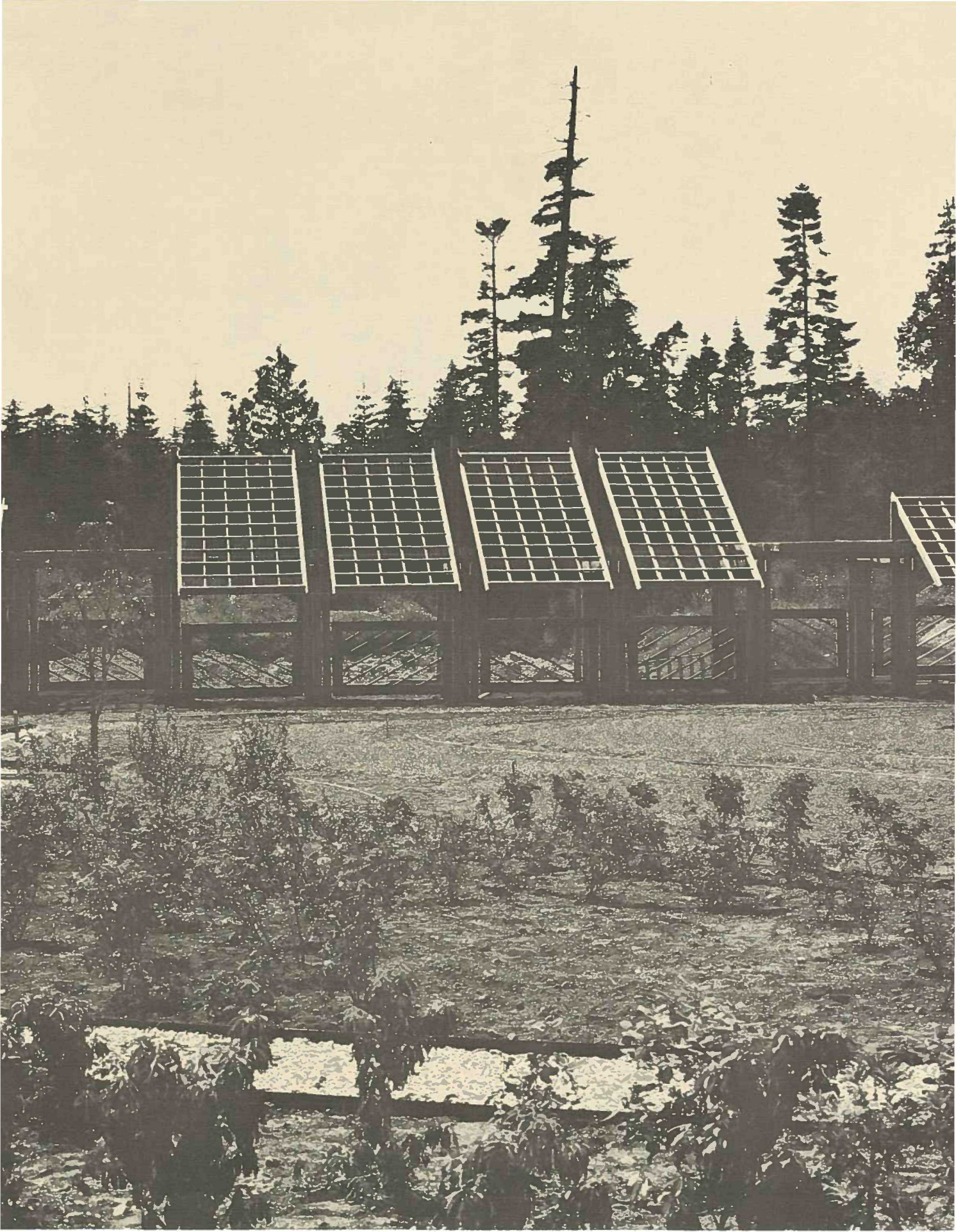
A New Publication — In the Spring of 1976, *Meet the Natives — the B.C. Native Plant Garden Resource Book* was produced by the Botanical Garden. The book was prepared in cooperation with the Vancouver Environmental Education Program of the Faculty of Education at the University. It provides a basic resource book for teachers interested in using native plant materials in their classroom and making use of the resources of the B.C. Native Garden component of the U.B.C. Botanical Garden.

Climatological Summary*

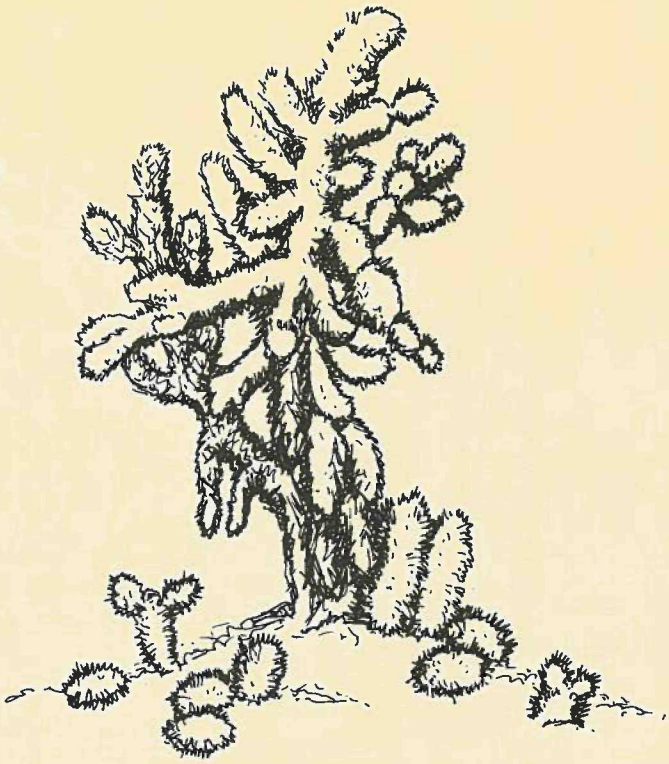
Data 1976	JULY	AUGUST	SEPTEMBER
Average maximum temperature	19.5°C	18.0°C	18.2°C
Average minimum temperature	12.5°C	12.7°C	11.6°C
Highest maximum temperature	23.8°C	22.8°C	24.4°C
Lowest minimum temperature	9.4°C	10.6°C	7.2°C
Lowest grass minimum temperature	2.2°C	5.0°C	0.6°C
Rainfall/no. days with rain	30.4 mm/12	81.3 mm/12	48.3 mm/8
Total rainfall since January 1, 1976	713.7 mm	795.0 mm	843.3 mm
Snowfall/no. days with snowfall	0	0	0
Total snowfall since October 1, 1975	82.8 cm	82.8 cm	82.8 cm
Hours bright sunshine/possible	243.2/482.5	138.1/439.0	179.5/372.2
Ave. daily sunshine/no. days total overcast	7.8/1	4.4/6	6.0/4

**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

Opposite: A view of the Arbor Garden, with the Contemporary Garden and the partly-completed Physick Garden in the foreground. The tall Douglas Fir visible behind the Arbor Garden approaches 200 feet in height, and is the tallest tree on the U.B.C. campus.



The Teddy Bear Cholla (*Opuntia bigelovii*) is formidably armed, with joints that are easily detached from the parent plant. It is found from southwestern Utah to Baja California.



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