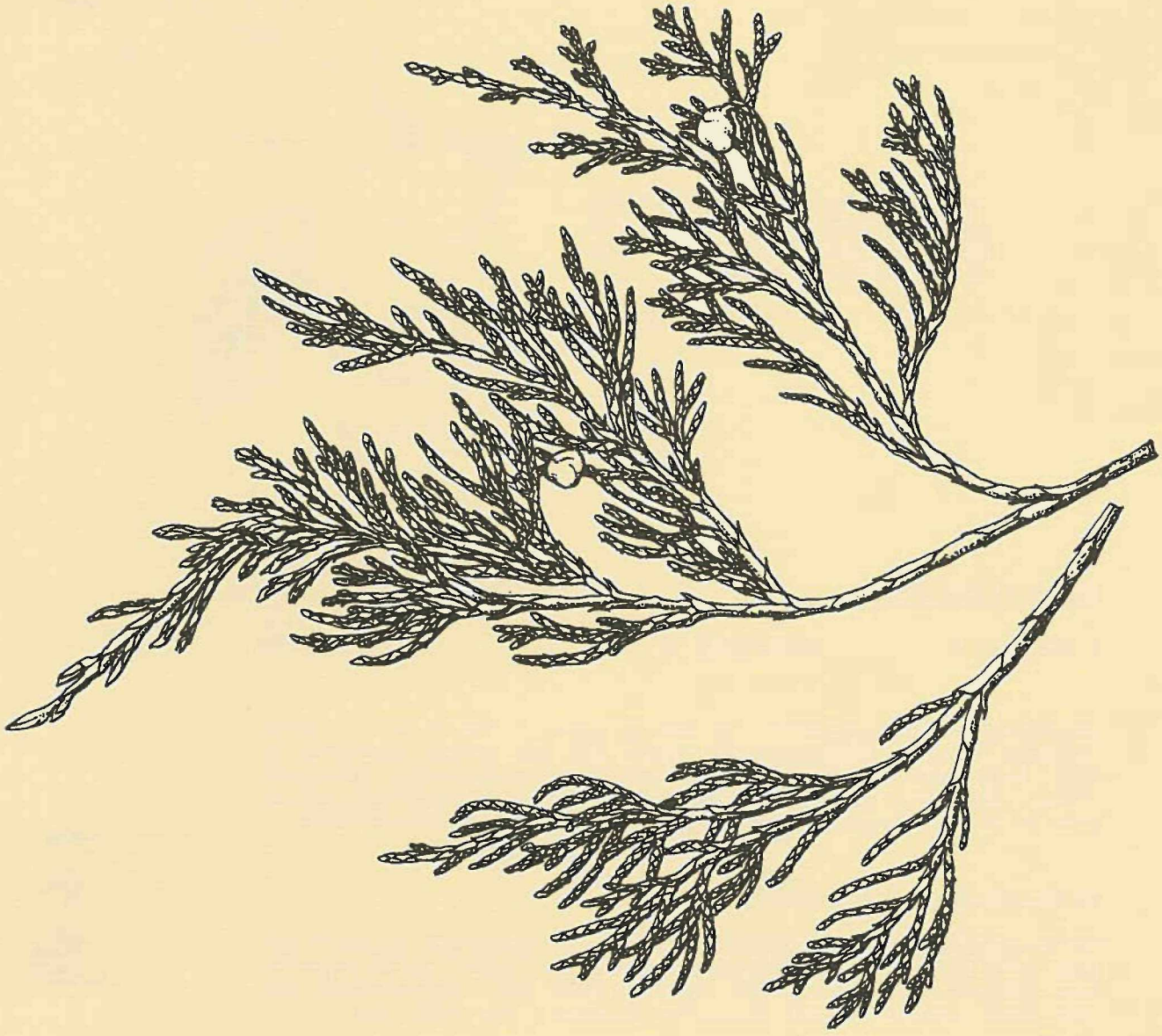
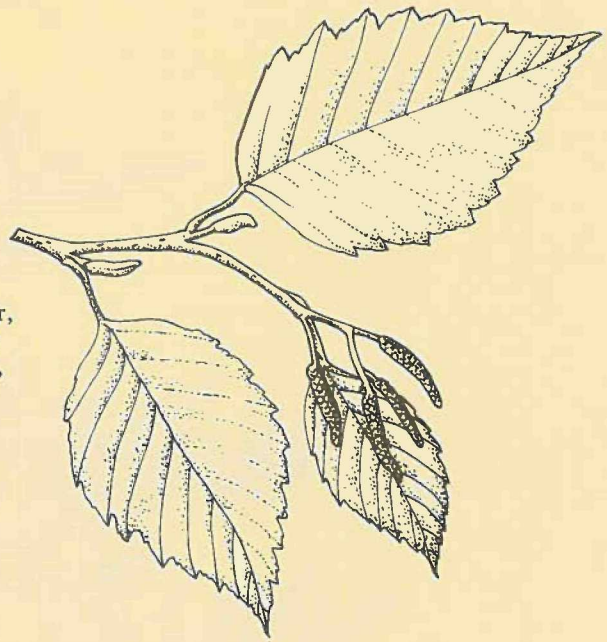
DAVIDSONIA

VOLUME 9 *NUMBER 4* *Winter 1978*



Cover: Juniperus scopulorum,
Rocky Mountain Juniper. Note the closely appressed scale leaves of this species.



Leaves and catkins of *Alnus rubra*, Red Alder, x 0.30. The bark of Alder trees was used by British Columbian Indians to produce a red, red-brown or dark-brown dye.

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Natural Plant Dyes

JANET R. STEIN*

With increased interest in hand-crafted items, especially woollens, there is a revival in the use of natural sources of dye materials. The most obvious and available sources of these dyes in British Columbia and elsewhere are plants. Many books have been written, revised or reprinted during the past 60 years extolling various plants and methods of dyeing (see References for an annotated selection). A large number of different plants can be used and, interestingly, among the easiest to obtain are onion skins — usually considered waste! Botanically, these skins are the dry outer leaves of the Onion bulb and are usually too tough to cook. Other common economic plants easily available include Carrot tops, Coffee grounds and Tea leaves (after brewing), and various spices (such as Turmeric, Mint, Sage, etc.).

For those wanting to use natural plant dyes, several books are appropriate for the West Coast resident (see Bliss 1976, Grae 1974, McGrath 1977, Rice 1974, Thresh and Thresh 1972). The emphasis in this article is on some of the local plants — both native and introduced species — that are easily and/or abundantly available, as well as on some of the attractive effects that can be achieved.

The colors resulting from the use of plant materials are predictable only within certain ranges. They are never identical — even in the same dye bath. This, of course, makes each plant dye unique — a feature not necessarily appreciated by those dyeing large amounts of material or on a commercial scale. However, the uniqueness of each dye can be used to advantage in creating individual items. The vagaries of color are basically the result of the material itself and the conditions in which it lives. That is, a plant grows in response to diverse environmental factors and this response is controlled by its genetic make-up. An example can be seen by collecting flowers from a given plant at different times during the blooming period, or, with a perennial, in different years. Although the flowers are treated identically each time, the colors achieved will vary.

The color produced by a given plant, then, is dependent on such features as temperature, sun, moisture, soil composition, and season. In addition, the age of the plant part being used is important since young tissue often gives different colors, just as young flowers may differ from mature ones. The type of fibre used and the source of the fibre also affect the color. For example, the nature of the soil producing the grass that the sheep graze affects the dyeing of the wool as well as the color of the wool itself (Grae 1974). Even the age of the sheep is important for the "natural" wool color.

Many dye colors are sensitive to light, to water (washing), or to acid or alkali conditions. The fastness (referring to the color retention) of the dye can be relative to the effect of light, particularly sunlight, with some fading quickly. The color of such dyes may be made fast, usually by the addition of a metal salt, termed a mordant (from the Latin *mordere*, 'to bite'). The mordant essentially forms a chemical complex with the fibre used and with the dye itself. Mordants not only make the dye fast but can change the color, with two mordants rarely creating the same effect. Dyes requiring a mordant are termed additive, or adjective, dyes; whereas those not requiring mordants are substantive dyes. Examples of each are given in the discussion of dye plants that follows.

The most commonly used mordant is alum (aluminum potassium sulfate, or pickling alum), often in conjunction with cream of tartar (tartaric acid). Alum occurs naturally in Clubmosses (*Lycopodium*) and Alumroot (*Heuchera*), both of which grow in British Columbia. Alum gives a bright, clear color to the dye and probably changes the color less than any other mordant. Other

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mordants used include chrome (potassium dichromate), tin (stannous chloride), iron (ferrous sulfate), and copper (cupric sulfate), as well as vinegar (acetic acid) and ammonia. Originally the metal salts (alum, chrome, tin, iron and copper) were supplied by the pots used for the dyeing, whereas urine was a ready source of ammonia. Now, a clear laundry ammonia solution replaces the uncertainty of the other compounds present in urine! Vinegar is readily available in most kitchens.

Mordants can be used to brighten (termed 'blooming') or mute ('saddening') colors. For these effects, a different mordant is added in the last 10-20 minutes of dyeing a previously mordanted fibre. Blooming is created using tin and cream of tartar, while saddening involves iron and cream of tartar.

The use of different mordants to create different colors from one dye is well known. Marigold flowers (*Tagetes*) dye wool yellow with alum, but a brilliant orange is produced when tin is the mordant, a golden-yellow with chrome, and a gray-cold with copper. Similar variations occur with the use of many other representatives of the same family (Asteraceae, or Sunflower family), such as Dahlias and Chrysanthemums.

The water used for both mordanting and dyeing should be free of any organic sediment or dissolved materials. Thus, rain water collected in a clean, non-reacting vessel in an area with little atmospheric pollution, or clean spring water are the most desirable. Soft waters (those easily making suds with soap) as in many coastal areas of British Columbia usually can be used directly from the tap. Rain water, spring water, distilled, or deionized water should be used in interior regions where the waters are hard due to dissolved minerals, such as calcium and magnesium. In these hard waters, the mineral salts and ions act essentially as mordants with the results being unpredictable.

In addition to color variation resulting from different mordants, the type of fibre used is important. Wool (sheep) or hair (dogs or goats) are proteins and accept dye colors differently from plant products such as cotton or linen, which are primarily carbohydrates. Synthetic materials create more complex problems, and often do not accept natural dyes without special treatment. The Coast Salish Indians used dog and goat hair plus the "fluff" from Fireweed seeds (*Epilobium*). Sometimes hair from a small white furry dog was blended with down from fowl or with the "fluff" from Milkweed seeds (*Asclepias*). The Tlingits used mountain goat hair and Cedar bark (probably *Chamaecyparis*) for the fibre of their Chilkat blankets.

The dyeing process involves either heating the plant material ('dyestuff') and fibre for an hour or more, or letting the fibre and dyestuff interact without heat, but with whatever bacteria and fungi develop, over a period of time (at least a week). This latter method is called either 'steeping' or 'fermenting'. Essentially, the microorganisms use the dye material as a source of energy for growth and change the chemical structure of the dye in so doing. In addition, these microbes produce compounds of their own which may serve as dyes or even as mordants. Some intriguing colors are achieved by fermenting, especially with some of the dyes from certain lichens.

Plant dyeing can be confusing if the dye color desired is expected to be that of the plant part used. This is especially "hard" on neophyte dyers! Examples are the roots and stems that yield unexpected reds or purples, or the red and purple berries that give grays. Generally, though, plants produce "earthy" colors, such as shades of green, tan, yellow, gray, or brown. Experience and reference to the results of others are the best guides. For the more experienced dyer, or the more venturesome, "anything goes!". One point to remember is that if a particular plant yields dye, it is possible that other members of the same genus, or even the same family, will also yield dyes.

The differences among dyestuff, dye bath, and final product are some of the most intriguing facets of natural plant dyeing. They are also some of the most frustrating! The beautiful purple-red color from Beet root becomes a tan or gray on wool heated in the dyebath. However, if Beets are left to ferment with the wool for a week or more, various shades of blue to papal purple develop. Unfortunately, these are not light fast, although mordanting with tin, chrome or alum does help to retain the color. The real problem in such fermentation of Beets results from the pungent odor that clings to the wool unless it is sprayed with a "room deodorant" (which some people consider equally unpleasant).

The red or purple berries of plants such as Salal (*Gaultheria*), Cotoneaster, Barberry (*Berberis*), and Blackberries (*Rubus*) also can be unpredictable. Sometimes a pink or a violet color is obtained by using fresh material, certain mordants, and with the temperature below boiling (around 160°C), but grays generally result with warmer temperatures and/or old plants.

The best time to collect dyestuffs will vary with the particular plant and part to be used. In general, one can collect from spring through fall, with the most satisfactory times being during the late summer. It has been noted that more intense colors are achieved if collection is made after a dry, sunny period (Bliss 1976). This can sometimes (and in some years) be a problem in coastal areas; but it is worth remembering, especially after several warm, sunny days, Dye colors are usually stronger when the material is fresh — especially when fruits (berries) and seeds are the source. Leaves give the best colors when just coming into full growth, although roots are better in the fall after both growth and storage have been completed. The material can be dried for use later, but it should be stored in paper and kept dry so that it does not become moldy. Dyestuff that has been dried before use generally needs to be soaked in water for several hours, overnight, or longer to get the full amount of dye available.

With spring here and summer almost upon us, now is the time to contemplate which plants can be used for dyeing. Many cultivated plants are useful, as are the native and introduced (weed) species. Fresh Dandelion (*Taraxacum*) flowers give pale yellows, whereas the roots (which always seem to be present) produce stronger yellows. *Galium*, or Bedstraw, sometimes produces a red from the roots, or a yellow from the leaves and stems. Other interesting "weeds" are Dock (*Rumex*), Horsetail (*Equisetum*), St. John's-wort (*Hypericum*), Pigweed (*Amaranthus*), Cudweed (*Gnaphalium*), various ferns (including *Polystichum*), Scotch Broom (*Cytisus scoparius*), Common Gorse (*Ulex europaeus*), Yarrow (*Achillea*), and Knotweed (*Polygonum*).

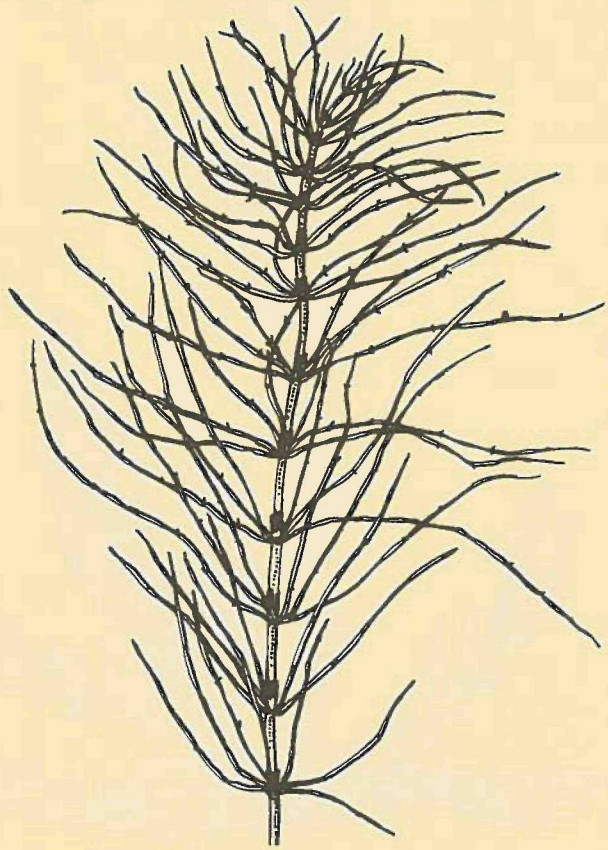
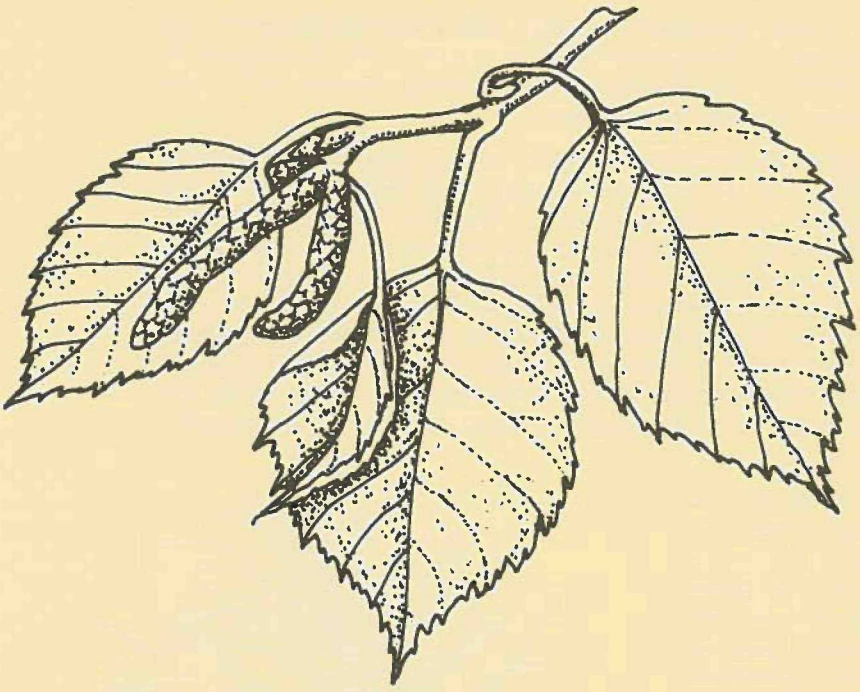
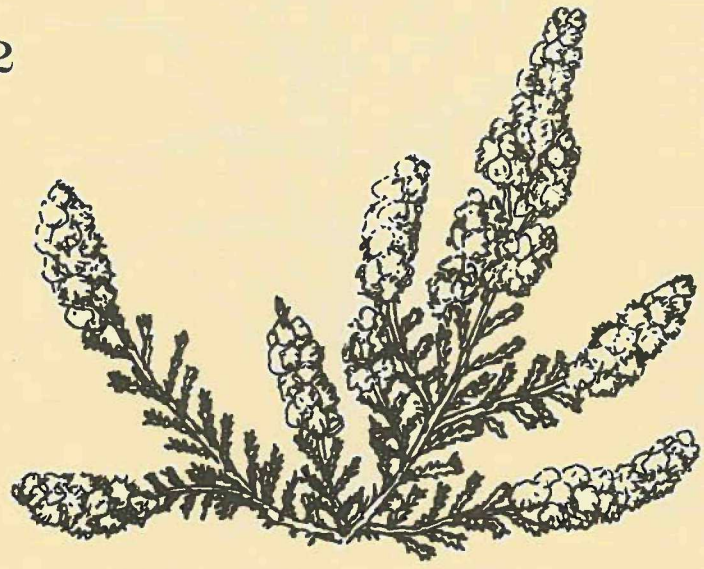


FIGURE 1. *Equisetum arvense,* Common Horsetail, a weedy species which will provide a greenish-yellow dye, x 0.75.

Plants native to British Columbia and adjacent areas provide good dyes. The native Indians of Washington and British Columbia did not use plants much for dyeing fibres, but they did use Oregon-grape roots (*Mahonia*) which give bright yellow or yellow-greens. Similarly, they used berries of Twinberry Honeysuckle (*Lonicera involucrata*), Salal, and various species of *Vaccinium* (Blueberries, Cranberries and Huckleberries) to provide pale purples or grays. Trees will furnish dyestuff for a long period if they are not ringed or stripped completely or bark. Again, the native Indians made extensive use of a few trees, such as Alder (*Alnus*) and Western Hemlock (*Tsuga heterophylla*). Both will furnish reds or red-browns if the bark is boiled for an hour or so. Black or dark browns are produced by long boiling or by the addition of urine to the bark in an iron pot (Turner and Bell 1971, 1973; Turner 1973). The Bella Coola and Coast Salish tribes used these dyes to make their fishnets invisible. Another bark used by the Indians for dyeing fishnets was Douglas Fir (*Pseudotsuga menziesii*). Cascara (*Rhamnus purshianus*) was used to dye mountain goat hair from which blankets were made. Other barks that can be used are Maple (*Acer*), Birch (*Betula*), Oak (*Quercus*), Poplar (*Populus*), and Arbutus, or Madrone, (*Arbutus menziesii*).





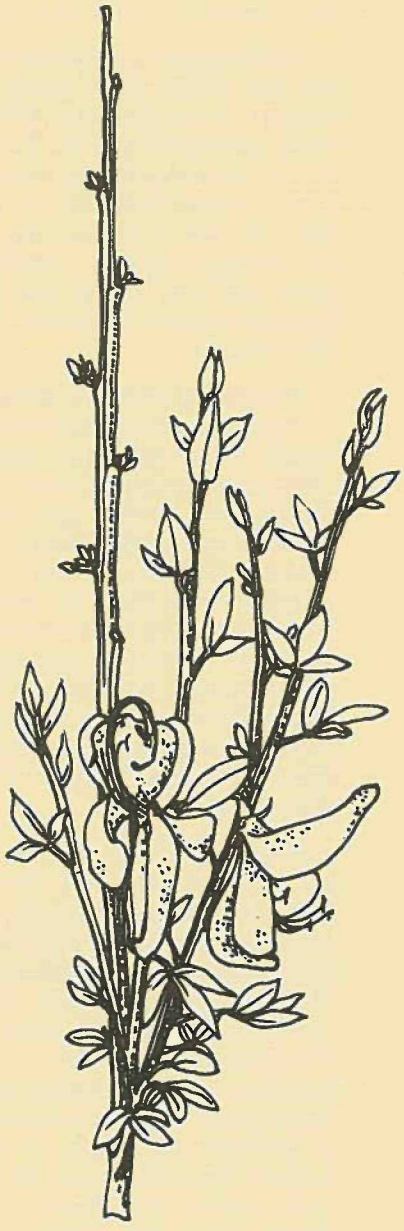


FIGURE 2 (top). Leaves and catkins of *Betula* sp., x 1.0. Birch leaves provide a yellowish dye, and the bark reddish, reddish-brown or gray colors. FIGURE 3 (right). The flowering branches of *Cytisus scoparius*, Scotch Broom, provide a yellow or yellow-green color, x 1.0. FIGURE 4 (left). *Calluna vulgaris*, Heather, x 1.0. Several different colors can be obtained by using different parts of the plant, and at different times of the growth cycle. The young tips before flowering give a green color; plants in full flower a yellow; the tops of the branches a purple; and branches after flowering a brown to bronze-brown.

The woody fruits of cultivated trees such as Walnut (*Juglans*) and Pecan (*Carya illinoinensis*) serve for black and brown dyes, with no mordant needed to achieve a rich, fast color. The outer layers or hulls of these fruits are used, and must be crushed to release the dye. Mordants are usually not needed as tannins are present which serve the purpose.

Since many shrubs or herbaceous plants that are cultivated for gardens are excellent dye sources, it is possible to have an attractive garden while providing material for dyeing. The most commonly used plants are in the Sunflower family, such as Marigolds, Coreopsis, Cornflower or Bachelor's-button (*Centaurea*), Cosmos, Black-eyed Susan (*Rudbeckia*), and Tansy (*Tanacetum*). Other cultivated plants are Hollyhock (*Alcea*), Bayberry (*Myrica*), Heather (*Calluna*), Privet (*Ligustrum*), Iris, and Rhododendrons. Various shades of yellow to brown or yellow to green result from using the roots, stems, or leaves. As noted previously, the flower or fruit color is not always indicative of the fibre color, and the mordants can determine the intensity of color. A combination of alum, cream of tartar, and vinegar sometimes creates color similar to that of the fruit or flower. Red roses are an example of beautiful flowers, but the dyestuff from them is usually dull gray. However, if you let the fruit develop and use the rose hips, then a pleasant pale pumpkin-orange sometimes is produced. Wild Roses (*Rosa*) are a good source of the fruit — as long as a few are left for seeding new populations.

To some people, the fungi are an unexpected source of dye — especially some of the edible mushrooms and their relatives (excluding the commercial varieties). Tans, golds, browns, and various combinations of these are produced, and even a purple has been reported (Rice 1974). The mushrooms are best collected after a period of rain, as in the fall. Species which grow on the ground, such as the Shaggy Mane (*Coprinus*), Morels (*Morchella*), Boletes (*Boletus* and *Suillus*), and Puff-balls (*Lycoperdon*), can be used, as well as some forms which are parasitic on trees such as Polypores (*Polyporus*). The common Orange Cup Fungus (*Aleuria aurantia*) that occurs in the fall in recently

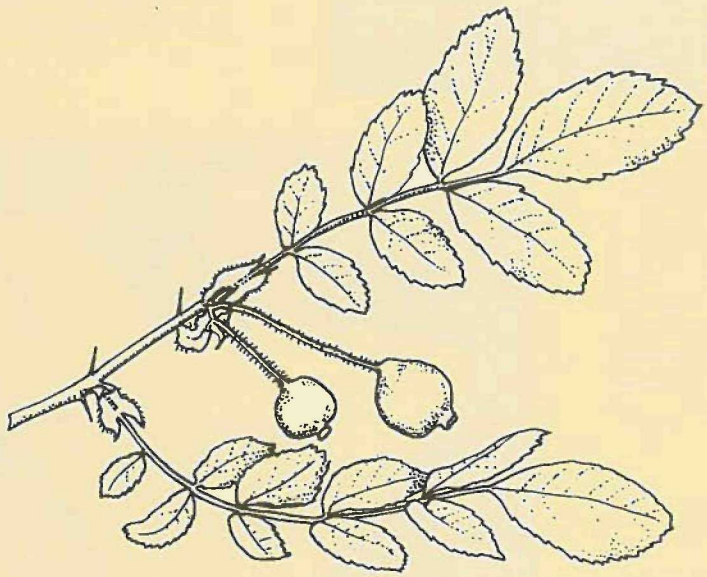


FIGURE 5. Leaves and fruit of *Rosa gymnocarpa*, Baldhip Rose, x 0.75. The hips of many wild Roses can be used to produce a pale pumpkin-orange color.

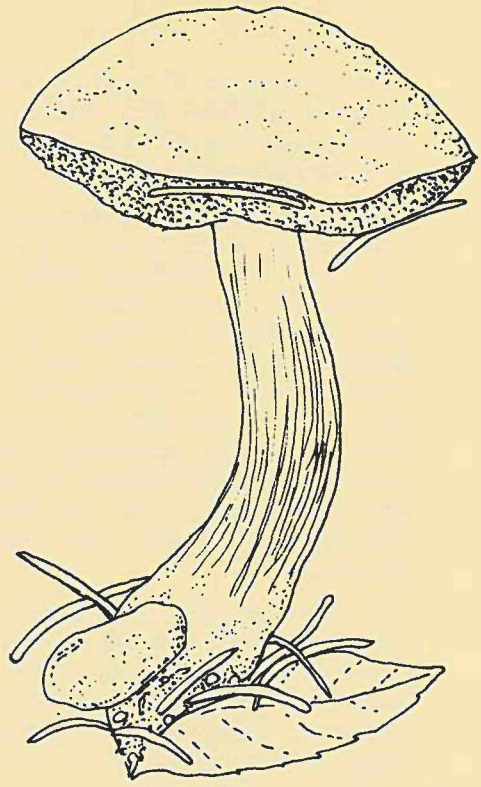
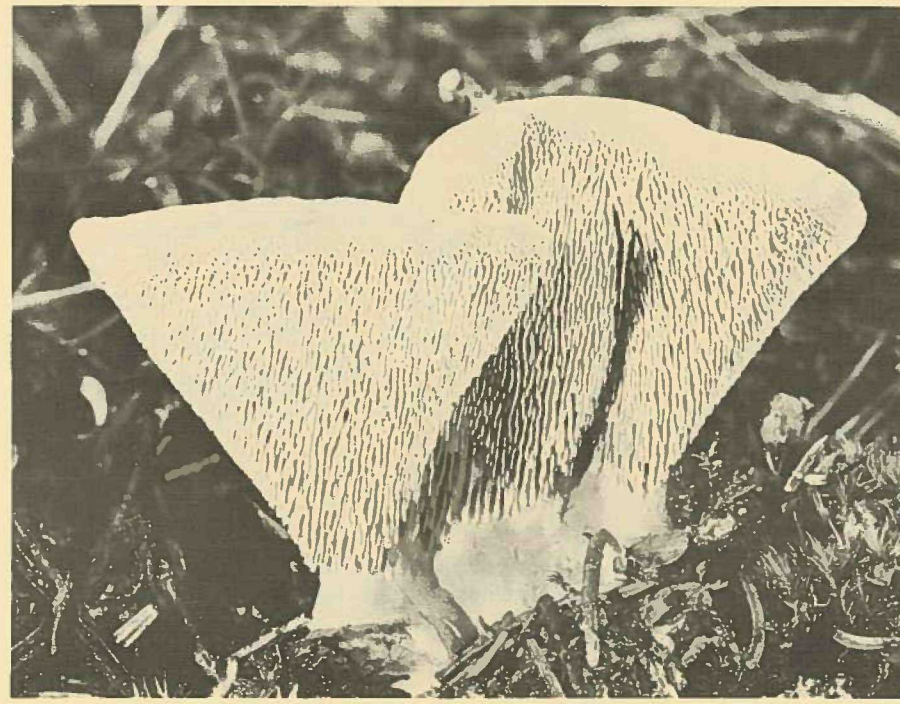


FIGURE 6. *Boletus zelleri*, Zeller's Boletus, x 0.66. The fruiting bodies of various Boletes will produce tan to brown shades.

FIGURE 7 (above). *Cortinarius semisanguineus*, Red-gilled Cortinarius, x 2.0. This species has blood-red gills, and is common in coastal British Columbia. The caps can be used to give a red to deep maroon color. The related *C. sanguineus*, Blood-red Cortinarius, has blood-red cap, gills and stem, and all parts may be used to give pink to red to deep maroon shades. These species should not be eaten, *C. semisanguineus* is believed to be toxic.

FIGURE 8 (right). *Hydnellum aurantiacum*, x 2.0. The complete fruiting body may be used to give a greenish-yellow color.



cleared areas (along roadsides, for instance) has a beautiful orange color but rarely colors wool, no matter which mordant is used. However, preliminary work shows that it may be better if allowed to ferment with wool. For some, the decision whether to use the fungus for food or as a dyestuff is difficult!

Better known sources of fungi are those commonly called lichens, or botanically as the lichenized fungi. These are a combination of two different types of organisms — an alga and a fungus — which produce a characteristic form when they grow together. Two general types of dye can be obtained from lichens: one is achieved by heating the substantive dyes; and the other by fermentation producing the orchil, or archil, dyes. The substantive dyes are shades of tan, gold, and brown; whereas the orchil dyes can be mauves and magentas. It is not possible to look at a lichen and tell the type of dye that will be produced. Some lichens can produce both, but some neither. However, an indication of potential color resulting from fermentation can be determined by crushing a little of the lichen and adding strong ammonia to it. Unfortunately, most orchil dyes are not fast — the color is said to be fugitive. The use of lichens has been known since the ancient Greeks, and lichen dyes are still employed today in Norway, Sweden, Ireland, Wales, Scotland, and various adjacent islands. Lichen dyes were not commonly used in southern Europe (and still are not), although the orchil dyes originally came from Asia Minor (Thurstan 1972). In Scotland lichens are used to produce the typical colors (and unique odor) of Harris, Donegal, and Shetland tweeds (Thurstan 1972). These dyes are prepared by a complex procedure which involves making a concentrated paste that is then stored for years. When needed for dyeing, the dry cakes are partially dissolved in water before adding the fibre. A common name for lichens used in dyeing is "Cudbear".

Lichens in British Columbia that can be used include the bright yellow-green *Letharia vulpina* (Wolf Lichen or Staghorn Moss) which grows in the Interior, often on Ponderosa Pine (*Pinus ponderosa*); *Peltigeria*, the gray-green foliose form found on mosses and humus in moist sites; and *Hypogymnia* and *Parmelia*, which usually grow as small gray-green masses on shrubs, trees, and rocks. Lichens collected from stones evidently produce "better" colors than those from trees (Thurstan 1972). It is best (and easier) to collect lichens after rain when they are fully expanded and can be removed from the substrate with little effort.

Not to be overlooked as potential dyestuffs by the West Coast resident are the seaweeds. These large marine plants have not been used much. Some of the brown seaweeds, in particular the large strap-shaped kelps (*Nereocystis*, species of *Laminaria*, etc.) and the intertidal Rockweed (*Fucus*), give a delicate buff or beige color to white wool. Little work has been done with different seaweeds, and their potential is unknown. One dyer reports using a mixture of different drift seaweeds, collected as the tide receded, to produce an intense pink.

The compounds responsible for the dyes are of several types. All are carbon-containing compounds, and almost all have a particular structure in which five or six carbon atoms are arranged as a ring. Hydrogen and oxygen are always present and sometimes nitrogen also (as in the blue dyes produced by the exotic *Indigofera* or Indigo and related plants). Generally the compounds that serve as the dye are secondary products of metabolism normally produced by the plants. Often the pigment is associated with various sugar-like compounds. The field of organic chemistry and the synthetic dye industry owe their origins to a desire to obtain larger amounts and more repeatable colors than is possible with natural plant sources. At the same time, it has also become possible to produce colors which are fast.

Those interested in natural plant dyes should become acquainted with some of the useful books available for the specific details concerning dyeing. Plant collecting is easy, but it is good to remember NOT to denude an area of all plants of a particular kind — unless you consider it a "weed" in *your* garden! Although brighter colors are achieved with fresh material, it is possible to dry the dyestuff and use it when convenient during the winter or at other times when bright colors are not necessarily desired. Natural plant dyeing also offers many opportunities for experimentation with new materials, colors, and combinations that give unlimited possibilities.

REFERENCES

These references are ones which are considered most useful for natural plant dyeing in British Columbia. Most are available at local libraries; other useful reference sources are books on weaving and handicrafts which are available at handicraft shops or book stores.

Adrosko, Rita J. 1971. Natural Dyes and Home Dyeing. Dover Publications, Inc., New York. This was originally published in 1968 as a Bulletin of the United States National Museum (Smithsonian Institution), and gives a historical background as well as tested recipes.

Bearfoot, Will. 1975. Mother Nature's Dyes and Fibers. Olive Press, Willits, California (Charles Scribner's Sons, New York). A short section on the various fibres used — everything from birdskins to grape stems — is followed by recipes for various plant dyes.

Bliss, Anne. 1976. Rocky Mountain Dye Plants. Johnson Publishing Co., Boulder, Colorado. An interesting compilation of information and recipes that are of good use for those living in dry climates.

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Leechman, Douglas. 1969. Vegetable Dyes from North American Plants. The Southern Ontario Unit of the Herb Society of America, Toronto. A small paper-back booklet which is more pertinent to eastern Canada.

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Rice, Miriam C. 1974. Let's Try Mushrooms for Color. Thresh Publications, Santa Rosa, California. This small paper-back booklet is devoted to mushrooms, but it also contains useful ideas on compiling information about different dyestuffs and dyes.

Shetky, Etheljane M., Editor. 1975. Rev. ed. Dye Plants and Dyeing — A Handbook. Handbook No. 46. Brooklyn Botanic Garden, Brooklyn, New York. A compilation of different techniques and information showing how dyes are used throughout the world.

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Weigle, P., Editor. 1973. Natural Plant Dyeing — A Handbook. Handbook No. 72. Brooklyn Botanic Garden, Brooklyn, New York. Similar to the compilation by Shetky, this handbook considers various aspects including different plants and techniques.

APPENDIX. Colors achieved with selected dye plants.

Consult references for details regarding methods and use of mordants.

Yellow/Gold[a]

Onion skins

Flowers of:
- Marigold
- Dandelion
- St. John's-wort
- Gorse
- Broom
- Chrysanthemum
- Dahlia
- Tansy

Leaves of:
- Chrysanthemum
- Privet

Dock fruit
Yarrow
Oregon-grape
- root, stem

Wolf Lichen
Poplar bark
Cudweed

Tan/Brown

Coffee grounds

Tea leaves

Bark of:
- Oak
- Arbutus

Fruit of:
- Pecan
- Walnut

Lichens, e.g.,
- *Hypogymnia*
- *Parmelia*

Fungi, e.g.,
- Shaggy Mane
- Morel
- Boletus
- Puffballs

Purple/Blue

Fruits of:
- Salal
- Cotoneaster
- Barberry
- Blackberry
- Blueberry
- Cranberry

Iris flowers

Lichens[b], e.g.,
species of:
- *Evernia*
- *Lecanora*
- *Parmelia*
- *Umbilicaria*

Beet root[b]

Gray

Fruits of:
- Blueberry
- Cranberry
- Huckleberry
- Turnberry
- Salal

Green

Leaves of:
- Mint
- Fern

Carrot
Pigweed
Rudbeckia flowers
Heather stem tips

[a] Gold can be achieved with the use of a mordant (e.g., tin).

[b] Fermentation method.

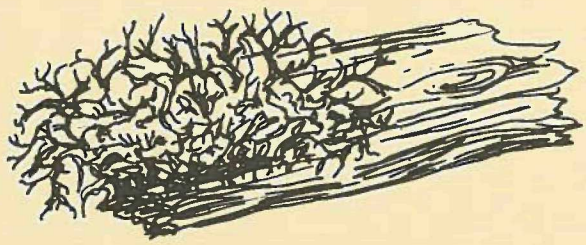

FIGURE 9. *Letharia vulpina*, Wolf Lichen, will provide shades of yellow to gold, x 1.0.

The Genus *Juniperus* in British Columbia

Member of the Family Cupressaceae

JUNIPERUS COMMUNIS Linnaeus
Common Juniper

JUNIPERUS HORIZONTALIS Moench
Creeping Juniper

JUNIPERUS SCOPULORUM Sargent
Rocky Mountain Juniper

Natural Distribution and Habitat

There are 50-70 species of *Juniperus* widely distributed throughout the Northern Hemisphere, from arctic or subalpine to subtropical arid regions. About 15 species are native to North America, of which four occur in Canada and three in British Columbia.

Juniperus communis is the most widely distributed conifer species in the world, and the most widely distributed tree species in the Northern Hemisphere, occurring in several varieties in all temperate areas. It is commonly found on shallow soils, often on chalk or limestone as well as on soils fairly free from lime. It prefers exposed situations such as dry hills, mountain valleys, open rocky slopes and open woods, from near sea level to subalpine or alpine levels. It is found in conditions such as these from Greenland, Newfoundland and Labrador west to northwestern Alaska, then south to central California, northeastern Arizona, northern New Mexico, and in the mountains only to Georgia and the Carolinas; and across northern Europe and Asia.

The species is present throughout British Columbia, being most frequent on dry sites with poor soil between 300-1700 m in the Coastal areas (900-1700 m in the south and 300-625 m in the north), and on rockslides and in arid places between 900-2300 m in the Interior.

Juniperus horizontalis is a boreal and montane species occurring on banks, hillsides, sea cliffs, gravelly slopes, in foothills and river valleys to dry montane valleys — and even occasionally in swamps. The species prefers acid soils, although it often grows on slightly alkaline ones. It is present from Nova Scotia west to southeastern Alaska, and south to Montana (especially east of the Rockies), Wyoming, Colorado, Minnesota, Iowa, New York and Maine.

The species is common in dry regions between 900-1225 m in the lower Yukon Valley and in the Rocky Mountains of northernmost British Columbia. It is also found in the Windermere Valley, at Fairmont Hot Springs, and at the junction of the Peace and Pouce Rivers.

Juniperus scopulorum is most commonly found on dry rocky or sandy soils, in moist rocky canyon bottoms, and along the shores of streams and lakes, as well as on dry rocky south-facing ridges. It will grow on a wide range of soils, but shows the best development on calcareous and somewhat alkaline ones. In general, these soils are stony and shallow, and subject to rather rapid erosion. The range is from southern Vancouver Island (British Columbia), the Olympic Peninsula, and the islands and bordering mainland of Puget Sound, east through British Columbia, Washington and Oregon to Montana, Nevada, northern Arizona, New Mexico, Texas, Colorado, western Nebraska and the Dakotas.

In British Columbia, the species occurs mostly in dry rocky places, on rocky cliffs beside lakes, on the dry sandy soil of the Gulf Islands, and sometimes at the edges of swamps, generally occurring from sea level to 1225 m. It is present in the southern half of the province, approximately between latitudes 49° and 53°N, from east of the Cascades to the Rockies, and in the Gulf Island zone and adjacent mainland. The species has also been collected on southern exposures of the Bulkley River

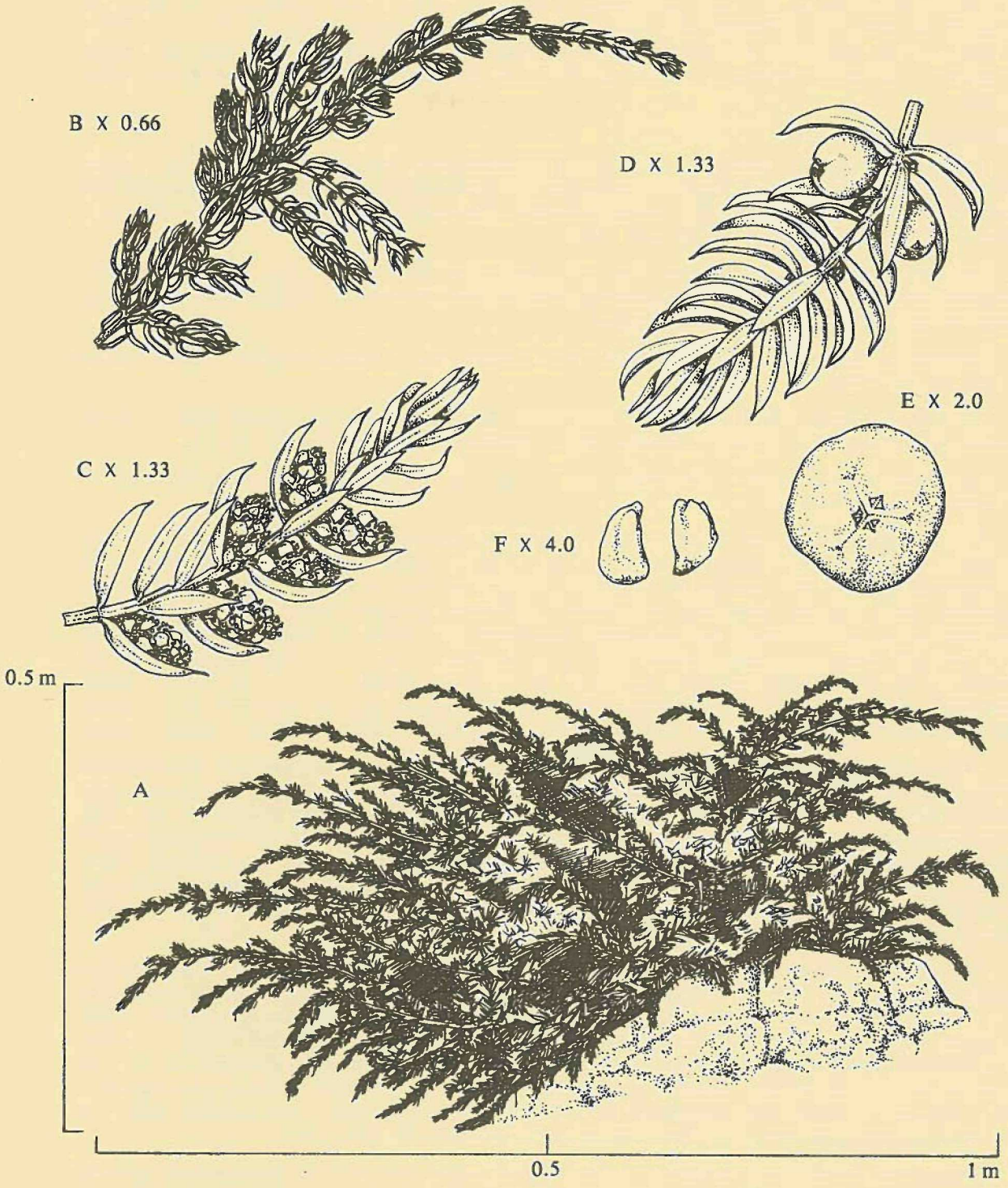

FIGURE 10. *Juniperus communis*. A. Habit, B. branch, C. male strobili, D. fruiting branch, E. cone 'berry', F. seeds.

(54°40'N 126°58'W), on the shores of Francois Lake, Lac La Hache and Kamloops Lake, along the Peace River at Taylor, at Babine Lake, and at Deep Cove on Vancouver Island (48°41'N 123°28'W). *Juniperus scopulorum* may be found in open pure stands, or intermingled on southern and western exposures with Ponderosa Pine or with Rocky Mountain Douglas Fir on northern and eastern facing slopes.

Description of the Genus

Junipers are evergreen, dioecious or occasionally monoecious trees and shrubs, varying in height from prostrate to dense bushy shrubs to tall conical or columnar trees to 31 m high. The branches are generally slender, compact, and horizontally disposed. The branchlets are finely divided. All have a peculiar aromatic and somewhat pungent odor.

The roots are reddish, fairly deep with many finely branched lateral roots, and are generally compact when in good soil. Older roots may develop one or two tap roots, and the major root system may or may not remain fibrous and compact.

The bark of most species is thin, fibrous, often reddish, and usually exfoliating in long narrow strips, rarely scales.

The wood is usually reddish or reddish-brown with pale sapwood, closely grained, finely textured, soft to hard, pleasantly aromatic, durable, rarely injured by insects, and easily worked.

The winter buds are either conspicuous and 3 mm long with small sharply pointed scales, or inconspicuous and naked.

The mature leaves are small, sessile, and of two kinds: a) scale-like, rarely more than 1.6 mm long, opposite in pairs, ovate, glandular or eglandular on the back, closely appressed to the branchlets and closely overlapping; or b) acicular or needle-like, 0.3-2.2 cm long, in whorls of 3 or paired, linear-subulate, sharp-pointed, spreading, with white or glaucous stomatal bands on the upper (inner) surface, convex on the lower, and eglandular. Sometimes the needles are jointed at the base of the free portion. There is a range in color from green to yellow, gray, or steel-blue. The leaves are persistent for several years, and may remain on the shoot indefinitely after death. Juvenile plants always have acicular leaves, while adult forms usually develop scale-like ones; however, some species retain the juvenile form to a greater or lesser extent, mixed indiscriminately with the scale-like leaves.

The strobili are minute, axillary or terminal on short axillary branches, and appear from April to June. They develop from buds formed the previous fall on branches of that year. The male strobili are 3-5 mm long, ovoid or oblong, erect, and either solitary or in crowded clusters of 3-6. They contain numerous, opposite or ternate, yellow microsporangia. The female strobili are subglobose or ovoid, greenish, small, and have 2-6(-8) opposite or ternate, imbricated, coalescent, pointed, fleshy scales. Some or all of the scales bear a minute ovuliferous scale with one or two erect ovules at the base of the inner surface. The strobilus is surrounded at its base by minute scale-like bracts which persist unchanged under the fruit.

The mature cones are small, indehiscent, fleshy, and berry-like. The scales of the female strobilus become fleshy, fuse, and are enclosed in a membraneous skin which has a glaucous bloom. The "berries" are rounded or ovoid, 6-10 mm in diameter, blue to blackish, brownish or whitish in color, and are either smooth or marked by the ends of the flower-scales or by the pointed tips of the ovules. They may be closed or open at the top, in the latter case the apices of the seeds are exposed. They are mature at the end of the first, second or (rarely) third year, but do not open, persisting on the plant at least through the winter following maturity. The berries have a peculiar, sweet resinous taste. It is possible to have both first and second season berries on the same specimen.

The seeds are usually ovoid to oblong, acute or obtuse, often 3-angled, and longitudinally grooved by depressions caused by the pressure of resin cells in the flesh of the fruit. They are glossy brown, marked below by a large conspicuous hilum, hard, bony, and wingless. There are usually 1-4(-12) seeds embedded in the pulp of the cone, although many may contain no embryo and are therefore

sterile. Junipers begin to bear seed at about 10-20 years of age, with some seed production nearly every year after that, although every third year is usually one of peak production.

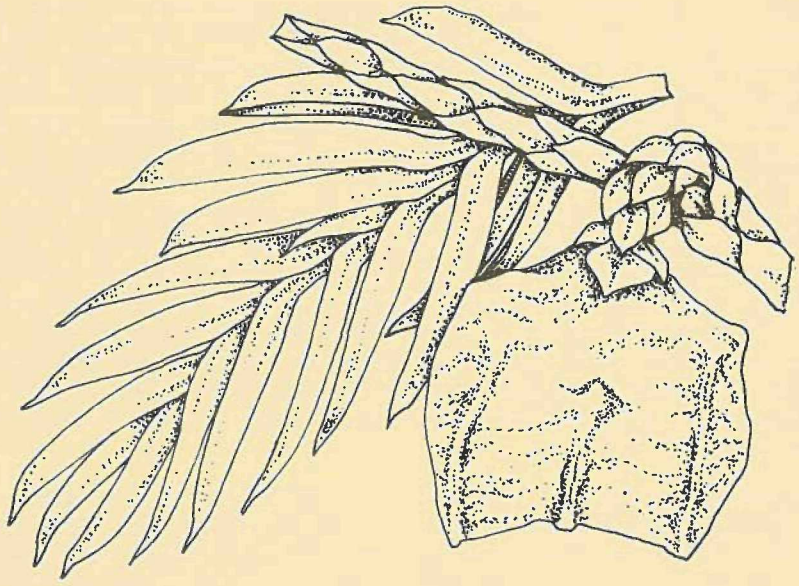

FIGURE 11. Needles and 'berry' of *Juniperus horizontalis,* x 5.0. Note the pendulous 'berry' on a recurved pedicel.

Key to the species in British Columbia

Mature leaves all in 3's, all more or less needle- or awl-like, 5-19 mm long, pungent, not glandular on dorsal surface, jointed at base of free portion; flowers axillary; plants mostly decumbent, rarely over 2 m tall in British Columbia ..... *Juniperus communis*

Mature leaves almost entirely in 2's, mostly scale-like (only the juvenile leaves awl-like, and then only 5-7 mm long), often glandular on the dorsal surface, not jointed at the base of the free portion, appressed to branches; flowers terminal on short axillary branches; plants prostrate or erect.

Shrubs, often prostrate, rarely as much as 0.3 m tall; stems decumbent; leaves strongly apiculate (needle-pointed); fruit pendulous on recurved peduncles
..... *Juniperus horizontalis*

Tree, rarely shrubby, rarely less than 1 m tall; stems ascending to erect; leaves obtuse or acute to only slightly apiculate; fruit erect or nodding on straight penduncle
..... *Juniperus scopulorum*

Description of the species

Juniperus communis — an extremely variable species with almost every possible variation between upright arborescent forms and completely prostrate mats. Usually an erect to prostrate spreading shrub, 0.3-1.5(-3) m tall, sometimes forming a broad mass 2-6(-15) m across. At high elevations and in the extreme north it forms a prostrate shrub with long decumbent branches. In Europe and

occasionally in North America it forms a tree, 6-9(-12) m tall, with a short, eccentric, irregularly lobed trunk, with an open pyramidal or rounded outline. The branches are light yellow when young, gradually becoming darker with age. The bark is gray to dark red-brown, about 1.6 mm thick, and separates into irregular papery shreds. The winter buds are distinct, ovoid, acute, about 4 mm long, and loosely covered with acuminate scales. The leaves are all needle-like, spreading almost at right angles to the branchlets and curved slightly downward in whorls of three (ternate). They are (4-)7-12(-20) mm long, 0.8-1.5(-3) mm broad, linear-subulate to linear-lanceolate, tapering from the base to the sharp-pointed apex, and shallowly channelled. The stomatal band is broad, white, and sometimes divided at the base by a green midrib. The leaves are usually dark green or dark yellow-green to grayish-green, and frequently turn brownish or bronze-colored in the winter. The strobili appear in April to May and are axillary. The male strobilus is solitary, cylindrical, 8 mm long, yellow, and has 5 or 6 whorls of stamens. The female strobilus is solitary, 2 mm long, green, and is surrounded by 5 or 6 whorls of ternate, leaflike scales. The tips of the ovule are persistent on the fruit. The mature cone is subglobose or short-oblong to globular, 5-6(-12) mm diameter, and bright blue or purplish-black with a glaucous bloom. The pulp is soft, mealy, and has a sweetish resinous flavor. There is a triangular line at the apex indicating the junction of the three scales, which occasionally gapes to expose the seeds. They are mature in the second, occasionally third, season, and are persistent. There are usually (1-)3 seeds which are elongated ovoid, acute, irregularly 3-angled or flattened, about 3 mm long, and light brown. There are irregular intervals between seed crops, and dispersal lasts two years.

Juniperus horizontalis — a compact prostrate or procumbent shrub, 0.3-0.45 m tall, but often spreading to 2.5 m or more. The branches are long, trailing, horizontal, flat, rather heavy, glaucous, sometimes as much as 5 m long, and often rooting along their length. The branchlets are ascending to erect, numerous, crowded, 5-15 cm long, less than 1.5 mm in diameter, 4-angled, and densely covered with leaves. The winter buds are inconspicuous. The mature leaves are mostly scale-like, opposite in pairs but 4-ranked, with the pairs connate at the base and the connate portion nearly always overlapped by the alternate pair. They are 1-6 mm long, ovate, and there is nearly always a linear-ellipsoid gland on the dorsal surface which is usually flush with the surface or somewhat depressed. The leaves are glaucous, bluish-green to steel-blue, and some forms develop a purplish color in the fall and winter. Young plants and leaders have acicular leaves, 5-6 mm long, slightly spreading, and sharp-pointed. Cultivated plants often have the acicular leaves dominant even when mature; these leaves are 2-2.5 mm long, crowded, glaucous green, gray-green or blue, varying in intensity, and often plum-purple in winter. The strobili appear in May to June and are terminal. The mature cones are light blue to blue-black or greenish-black with a glaucous bloom, globose or ovoid, and are 5-9 mm in diameter. They are apparently mature in one year. There are (1)2-4(-6) seeds which are 3 mm long and brown.

Juniperus scopulorum — a shrubby tree, (1.8-)3-13(-24) m tall, 0.2-1.0 (-2.75) m DBH. The trunk is short, stout, and often divided near the ground into a number of stout spreading stems. In the open the crown is usually wide, rather open, and irregularly rounded or pyramidal in outline with long ascending branches from near the base of the tree, and short partly horizontal and partly ascending ones in the upper part. On protected sites or in a stand, the crown is slender and often has drooping branches, while on poor sites the species may be reduced to a crawling shrub. The lower part of the trunk may have many dead and partially dead branches. The branches are stout, spreading, ascending, and pale yellowish-green to whitish-green. The branchlets are slender, 4-angled, and about 1 mm in diameter. The bark is divided by shallow fissures into narrow flat connected ridges broken on the surface into persistent exfoliating scales or strips. The winter buds are inconspicuous. Both types of leaves are often present on the tree, with small clusters of juvenile acicular leaves occurring among the scale leaves. The acicular leaves on young plants and vigorous shoots are about 12 mm long, free, light green to dark green, and glaucous. They may be in pairs or in whorls of three, and the tips spread widely. The mature branches have mostly opposite, closely appressed scale leaves which are arranged in 4 overlapping ranks. They are 1.5-3 mm long, rhombic-ovate with an obtuse to acute or acuminate apex, and usually have an inconspicuous oval to oblong gland flush with (or

slightly depressed below) the dorsal surface. They are dark green to yellowish green to light blue, and are crowded. The strobili appear in May to June in British Columbia, mid-April to mid-June in other parts of the range, and are terminal. The male strobilus contains about 6 stamens. The scales of the female strobilus are indistinct in the mature fruit. The mature cone is bright to dark blue with a glaucous bloom, subglobose to globose, 5-8 mm in diameter, and is occasionally recurved. They are mature in the November or December of the second year after fertilization, and remain on the tree until the following March or April. There are 1-2(-4) seeds which are ovate to somewhat triangular, and prominently angled and grooved. They are 4-5 mm long, and a lustrous light chestnut-brown in color. Trees begin to bear seed at 10 years, with the optimum age between 50-200 years. Some seed is produced nearly every year, with particularly heavy crops at intervals of 2-5 years.

Browsed clumps of *Juniperus scopulorum* are similar in appearance to *J. horizontalis*, and care must be taken when identifying such specimens.

Propagation

The genus is easy to vegetatively propagate, but seeds of many species may take up to two years to germinate. Various pretreatments of seeds have been tried, including stratification at room temperature for three months followed by three months at 5°C, or treating with sulfuric acid for 30 minutes before stratifying for four months at 5°C. The seeds may be dried in a well-ventilated area, and then stored dry in sealed containers at -6° to 5°C. The seed retains its viability for relatively long periods; *J. scopulorum* has shown 36% germination after three and a half years at 10-18°C. However, the best germination rate to be expected from *Juniperus* seeds is approximately 50%. It should be remembered that all *Juniperus* species and varieties vary widely in habit, and desired forms are best propagated asexually rather than from seeds.

The seed may be sown outside in well prepared soil in either fall or spring, or in flats in the greenhouse in spring. In all cases, cover the seed with firmed soil or sand to about one and a half times its diameter. Many nurseries, including the one at The Botanical Garden, are now using Granite Grit #2 (Chicken Grit) to cover all tree seeds instead of soil or sand. The grit is clean, allows good aeration, and is heavy, therefore holding down the seeds especially during the first few waterings. Diurnally alternating temperatures of 30°C in the daytime and 20°C at night for 20-30 days have been found beneficial. Keep the seedbed moist, and provide shade during the first season. The seedlings may be transplanted after the first or second year, with the best survival rate being obtained by lifting in the early spring. Undercutting of third year seedlings stimulates the development of strong lateral roots.

Juniperus communis seeds should be warm stratified (30°C day, 20°C night) for 60-90 days, followed by cold stratification at 5°C for 90+ days. This treatment should result in 7-75% germination. There will often be variation from fastigiate to prostrate forms in the same seed batch. *Juniperus horizontalis* seeds should be subjected to cold stratification at 5°C for 30-120 days before sowing. Seeds of allied species have shown improved germination after soaking in a 1% solution of citric acid for four days preceding cold stratification, and this could be tried for *J. horizontalis*. *Juniperus scopulorum* seeds should be warm stratified for 45-90 days, followed by cold stratification for 30-120 days. This should result in approximately 22% germination within two years.

Most species can be grown from cuttings, and all dwarf forms are propagated this way. Use shoots of the current year's growth taken late in the season, ensuring that there is a mature wood base. Exposure to freezing conditions before taking cuttings is advantageous, therefore late fall or early winter are the preferred times. Trim all leaves from the bottom third of the cutting, and firmly set in a mixture of 50/50 clean sand and peat moss. Provide mild bottom heat (20°C) if possible, and rooting should occur in 4-8 months. Alternatively, the cuttings may be placed outside in sandy soil in a cold frame in late fall. Wounding the cutting at the base by making slashes (approximately 2.5 cm long) in the bark or by removing a small section of the basal bark has been shown to be advantageous, as has the use of a hormone rooting solution. Cuttings of *J. scopulorum* are difficult to root under most conditions, although 60-90% success has been obtained by using a treatment of Cloromone (an alfalfal extract of unknown consistency) in an open bed with bottom heat (preferably 26°C) and intermittent mist.

Grafting is used for varieties which cannot be increased by cuttings. *Juniperus virginiana* or *J. chinensis* 'Glauca Hetzi' are generally used as the stock for all other species and varieties. The grafts are usually taken indoors in spring on to stocks previously established in pots.

Junipers do not reproduce naturally by shoots, although some prostrate forms (notably those of *J. horizontalis*) will root from their long branches. Layering may therefore be tried with such forms, with no guarantee of success.

Transplanting

Juniperus scopulorum, J. horizontalis and prostrate varieties of *J. communis* resent root disturbance once they have become established, and therefore are not easy to transplant except when young. Upright varieties of *J. communis* may be readily moved if the root system is balled and burlapped. In general, species which form compact fibrous root balls are relatively easy to transplant. Container grown material from a nursery is easy to move. The specimen should be transplanted in spring just before active new growth starts, and the roots should be kept as intact as possible and not allowed to dry out. The use of a plant starter solution frequently helps in the re-establishment of transplanted material. Specimens do not transplant readily from a shady position to a sunny one.

Note that there are regulations against the movement of many forms of *Juniperus* because of the presence of Pear Trellis Rust in parts of British Columbia.

Conditions for Cultivation

The genus contains species and varieties which are suitable for most soils and situations, and most are noted for their ability to survive and grow on dry soils. In general, Junipers prefer deep well-drained soils with a pH of 5.5-6.5, but they will also do well if it is more alkaline or slightly more acid. In areas with a cool summer climate they do best in full sun but will accept light shade, while in hot areas they require partial shade. The tree forms are generally tough and drought resistant, and do well in sunny open locations and under urban growing conditions. All forms do best with good soil and good culture.

Juniperus communis is hardy to Zone 2b (Canadian). The species and all forms prefer deep well-drained soils, but will become chlorotic on alkaline ones. The species is drought-resistant, and will grow in dry rocky conditions as well as under normal garden conditions. This is one of the most accommodating conifers and likes full exposure to the sun.

Juniperus horizontalis is hardy to Zone 2 (Canadian), and the growth rate is slow to moderate. It will grow well in full sun on dry poor sandy, gravelly or rocky soils, and is very drought resistant. The species tends to do better on acid soils than on neutral or slightly alkaline ones.

Juniperus scopulorum is also hardy to Zone 2 (Canadian), and the growth rate is slow, with specimens always remaining small. Trees average 4 m tall at 40 years of age, reaching about 9 m tall and 43 cm DBH at 300 years of age. The largest specimen known is the Jardine Juniper in Cache National Forest (Utah) which is 13.7 m tall, 2.6 m DBH, and about 3600 years old. The average life of the species is 250-300 years, and garden expectancy would probably be about 100 years. The species is highly resistant to extremes of temperature, wind, drought, and poor soil. It grows best on relatively dry calcareous to somewhat alkaline soils. The seedling and early sapling stages require rather dense shade, but later growth needs top light and no shade.

Most species of *Juniperus* require little pruning, although they respond well to pruning. Some of the narrow upright forms should not be pruned as this spoils the upright growth so much that they lose their shape and their identity. Many cultivars of *J. scopulorum* also resent pruning. Shrub forms may be developed into thick well-shaped plants by cutting the tips of the branches back to the first fork. Low growing forms should have the upper branches cut back and the top growth thinned in late spring to allow light and air to reach the lower parts. Remove entire branches wherever possible, and prune during the period of active growth.

Juniperus horizontalis can be pruned by thinning to take an espalier form against a wall. Some of the cultivars, but not the species itself, are resistant to *Phomopsis* Blight (Juniper or Cedar Blight).

Juniperus scopulorum specimens need occasional trimming to maintain a symmetrical form, and will withstand heavy pruning if necessary.

Landscape Value

Juniperus is a most versatile genus, containing plants for most soils and conditions, showing a range of color from shades of green to yellow, gray, and steel-blue. A great many horticultural varieties have been developed, and many of them are noted for their ability to survive and grow on dry sites. Nearly all Junipers are indestructably hardy, and are attractive all year. They are among the most common ground covers for all situations, and are very commonly used in foundation plantings around private and public buildings. They are a good choice for planting around industrial sites because of their indestructability and low maintenance requirements.

The prostrate forms are excellent as ground cover in sunny areas, and several of the dwarf forms are effective in heather and alpine rock gardens. The compact columnar or conical forms are excellent for narrow avenues in formal gardens, and those of bushy habit may be used as hedges as they will withstand a good deal of clipping. Tree forms are not widely used but are interesting because of the picturesque habit of trunk and branches, and they are tough and drought-resistant.

Juniperus communis and its varieties are one of the most satisfactory and pleasing groups of evergreens. The prostrate forms are especially useful in sun, and the slender columnar cultivar Hibernica, Irish Juniper, is a conspicuous feature in many gardens. The species and some of the cultivars are resistant to Juniper Blight and are therefore useful plants in areas infected with *Phomopsis juniperovora*. The subspecies *depressa* is one of the best of all dwarf carpeting conifers, and is excellent as a ground cover in full sun.

Juniperus horizontalis is one of the best species for use as a ground cover. The species and its varieties are suitable for use on steep slopes, and some of the cultivars form dense soft carpets which follow the outline of the substrate in every detail. They are also excellent as rock garden plants. The species is of considerable horticultural merit, and is sold in several forms, some of which become purplish colored in the fall and winter.

Juniperus scopulorum has been long overlooked, perhaps because of its close relationship to *J. virginiana*, but it is an excellent ornamental with good shape and color. It is hardy in difficult city environments, and will grow on a wide range of soils, including alkaline. Because it will withstand drought, it is suitable for ornamental plantings on dry sites and in areas with hot dry summers. It will also form an excellent windbreak or shelterbelt. Most of the cultivars are tall, and several outstanding bluish or silvery-gray pyramidal forms have been developed.

Availability

The native species and varieties, and many of their cultivars, may be difficult to obtain. Most nurseries carry the common cultivars. All Junipers are affected by Federal restrictions on their movement, but many nurseries are now growing them under a control program, and are allowed to sell them locally in the Province.

Varieties and Ornamental Cultivars

Juniperus is a difficult genus, and many species and forms may be difficult to identify unless berries are present. This has led to much confusion in the names of varieties and cultivars. In addition, many species hybridize readily when they come into contact in the wild or in the garden, thus adding to the confusion.

Juniperus communis is a variable species with four subspecies and many cultivars. Two subspecies are recognized as occurring in British Columbia. The subspecies *alpina* (Neilreich) Celakovsky, Common Juniper, occurs in the mountains across the Province between 300-1675

(-2300) m. It is a spreading prostrate or procumbent shrub, 0.3-0.5 m tall and 1.8-2.5 m across, although it may form a bushy upright mat 2-3 m tall when growing in valley bottoms. Included in synonymy in this subspecies in British Columbia are the entities previously identified as var. *saxatilis*, var. *montana*, var. *nana*, and var. *sibirica*. The subspecies *depressa* (Pursh) Franco, Ground Juniper, is common on dry, rocky or otherwise poor soils, often in open fields. It is a dense, widespreading, low or dwarf shrub, usually 1.5-2 m tall, with many stems from the base forming large patches up to 15 m or more across.

There may be as many as 70 cultivars of this species and its subspecies which have been developed and which may be available from nurseries. They vary considerably in habit, color of leaves, and rate of growth, and there is every possible variation between upright aborescent forms (such as 'Hibernica' and 'Suecica') to completely limp prostrate forms (such as 'Hornibrookii'). The form known as 'Hornibrookii' occurs naturally in western Ireland and is believed to be a natural hybrid between *J. communis* subsp. *communis* and *J. communis* subsp. *alpina*, both of which occur in that region. Among the cultivars of *J. communis* are such well-known forms as: 'Suecica' or Swedish Juniper; 'Hibernica', Irish Juniper; 'Compressa', Noah's Ark Juniper, which is a slender cone-shaped shrub of minute dimensions and probably the slowest growing of all conifers; 'Hornibrookii'; and 'Aurea' and 'Aureo-spica'.

Juniperus horizontalis is also a variable species with about 40 forms which have received cultivar status. The form 'Douglasii', Waukegan Juniper, is perhaps the best known cultivar. This is a completely trailing form with soft steel-blue foliage which turns bluish-purple in the fall. A new cultivar, 'Yukon Belle', is currently being advertised as hardy to -45°C, and as hugging the ground with bright silvery-blue foliage. The species hybridizes readily with *Juniperus virginiana* and *J. scopulorum* where the ranges overlap in the wild, and many cultivars have been developed from naturally occurring forms which are believed to be hybrids. The cultivar 'Hermit' was found on Hermit Island in Maine, and is believed to be a hybrid between *J. virginiana* and *J. horizontalis*. A recent introduction, 'Winter Blue', was found as a seedling in a Montana nursery and is believed to be a hybrid between *J. scopulorum* and *J. horizontalis*.

Juniperus scopulorum has one natural variety and approximately 60 cultivars. The variety *columnaris* has been reported from near Amidon in North Dakota. In addition, plants from the islands of Puget Sound in Washington appear to differ from those east of the Cascades in that the foliage is persistent for a longer time, and the cones are less fleshy and rather consistently one-seeded rather than 2-4 seeded. It is not impossible that this will prove to be a distinct geographical race.

Many of the approximately 60 cultivars of *J. scopulorum* are gray columnar forms. One of the few dwarf forms is 'Repens' which was found in the hills near Lake Windermere in British Columbia. This is a very beautiful and distinctive creeping form with glaucous green foliage, and is ideal for rock gardens. Other cultivars include: 'Admiral'; 'Blue Heaven' (also called 'Blue Haven'); 'Chandler's Silver'; 'Gray Gleam'; and 'Pendula', Weeping Rocky Mountain Juniper. A blue low-bush form, 'Kleena Kleene Blue', was discovered in the Chilcotin area of British Columbia by Dr. R. L. Taylor of The Botanical Garden, but has not yet been registered for the nursery trade.

The species hybridizes with *J. horizontalis, J. virginiana, J. deppeana, J. pinchotii, J. ashei, J. monosperma,* and *J. osteosperma* wherever the natural ranges overlap. There are many hybrids, particularly with *J. virginiana*, which are of rare beauty and deserving of cultivation. *Juniperus* x *fassettii* Boivin is a low-growing hybrid between *J. horizontalis* and *J. scopulorum* which is known from the Big Horn Mountains in Wyoming, and which is also believed to occur near Banff in Alberta.

Other Uses

Some species supply useful timber although the majority are of little commercial importance because of their small size and irregular trunks. The wood is easily worked and is durable, being used mainly for chests, wardrobe closet linings (''cedar''-lined chests), pencils, carvings, and fence posts. It has also been used for good furniture and interior panelling, as well as for fuel and charcoal.

The fruits of certain species (principally *J. communis*) are used to flavor gin and other cordials, and some foods. The berries are occasionally dried and ground and then used in the preparation of a mush or cake, or a few berries may be crushed and used in a bread and onion stuffing for roast chicken or game hen to impart a different and tasty flavor. The seeds may be polished and used in necklaces or bracelets.

An aromatic essential oil distilled from the wood of some species is often used in perfumery, and sometimes for medicinal purposes. An oil which can be distilled from the leaves and shoots of certain other species has diuretic properties and is used in medicine.

The cones are readily eaten in winter by many animals and various kinds of birds, and the foliage is browsed by deer and sheep when other fodder is scarce. However, stock should not be allowed to eat juniper branches because many of them have powerful diuretic properties. Some species are useful in forest management and for erosion control.

The wood of *Juniperus communis* is too small for building purposes, but has been used for fence posts and made into pails and other domestic articles in some European countries. The berries were used by the ancient herbalists of Greece and Arabia, and by the Romans. The juice of the berries was recommended by 15th and 16th century herbalists as a sovereign remedy against the bites of vipers and against "plague and pestilence". The berries were also an ingredient in a medicine to ensure safe and easy childbirth which involved eating a stuffed turtle-dove every other evening. Medicinally, the berries of *J. communis* are considered to be a diuretic, a stimulant, and a carminative (easing griping pains and expelling flatulence). They are also said to be used with beech-wood in the smoking of Westfalian ham, the peculiar piquant taste of the ham being attributed to the juniper-berry smoke. Berries which have matured and dried for about two years are used to impart the characteristic flavor to gin and some liqueurs. Local distilleries have tried the native berries, but always return to berries imported from Europe (preferably from Italy, Hungary and Yugoslavia) as these impart a better flavor to the gin. The berries were used in Norway to make a kind of beer, and early settlers in North America roasted them to use as a coffee substitute.

Trees of *J. scopulorum* are too scattered to be of commercial importance in Canada, although the wood is excellent for the manufacture of pencils, and is occasionally used locally for small ornamental work. The species is useful in preventing erosion on rocky and gravelly slopes, and is most widely used for forest management, shelterbelt, and wildlife plantings.

Ethnobotany

The Juniper has been used in ethnobotany since the days of the Romans wherever it occurred.

Juniperus communis has been used in several ways by the Indians of British Columbia. The Thompson Indians used an infusion of the twigs for washing sore eyes. They boiled small branches and drank the decoction as a tonic for the stomach, while stems and leaves were boiled and drunk as a tea. Stems with whorls of small leaves were boiled and the liquid used as a wash by hunters, warriors, and young men reaching the age of puberty. The Bella Coola Indians boiled the roots, leaves, branches and bark, and then drank the decoction as often as desired for many ailments, including a "cough from the lungs", stomach pains, and heartburn. The Southern Carrier tribe boiled the branches and inhaled the vapor for a headache or a pain in the chest. The Southern Kwakiutl boiled the berries with Western Hemlock bark (*Tsuga heterophylla*), "roots" of Deer Fern (*Blechnum spicant*) and Licorice Fern (*Polypodium glycyrrhiza*), and then drank the decoction for diarrhoea. They also boiled the wood and bark until a gum was given off (this sometimes took all day), and then chewed the gum as a medicine for short breath and to purify the blood.

Juniperus scopulorum was used by the Indian tribes of the Province. The Thompson Indians sometimes ate small quantities of fresh berries as a diuretic or medicine for the bladder, while a strong decoction made by boiling the berries was used to kill ticks on horses. The wood was considered excellent as a fuel for making heavy smoke, and was often used in smoking skins. The Nicola band often combined the wood with Sagebrush, especially when they wanted a very dark skin.

The wood was also used to make bows, drums and clubs, and sometimes for the hafts of other implements. The Lillooet Indians burned strong smelling boughs because the smoke was considered to be a disinfectant for people who handled dead bodies — the smell of the tree was believed to counteract the odor of decaying flesh.

The Indians of western Washington boiled the roots of *J. scopulorum* and bathed their feet with the infusion as a cure for rheumatism. The leaves were boiled so that the odor would disinfect a house, and a sick person was bathed in the infusion for the same purpose. The infusion was also drunk as a general tonic. The Quileute Indians used the twigs and berries in certain ceremonials.

Diseases and Problems of Cultivation

The genus is generally considered to be easy to grow and maintain.

Upright forms may be subject to wind or sunburn and desiccation in cold areas, and will need protection, e.g., with burlap, in such conditions. The foliage may be damaged by winter injury and drying out, but the plants usually recover during the spring. The roots may rot if the soil is waterlogged, and they are susceptible to attack by nematodes.

Mice frequently eat the bark at ground level, especially in prolonged winter cold and snow, burrowing under the snow to reach the stems. Rabbits are also known to eat the bark and foliage under the same conditions, sometimes resulting in a very neatly "pruned" specimen near the soil.

The major problem in the Lower Mainland, Fraser Valley and Vancouver Island areas of British Columbia is Pear Trellis Rust (Pear Juniper Rust) caused by *Gymnosporangium fuscum* Hedw. This organism infects both pears and junipers, spending part of its lifecycle in each host. At present the only known method of eradication is complete removal of infected junipers to break the lifecycle. It is found on several ornamental forms of Juniper, on introduced species, and on *J. communis* subsp. *alpina*. Because of the seriousness of this disease there are federal restrictions on the movement of Junipers. These are that wild or cultivated Junipers may not be shipped from Vancouver to the interior of the Province, although they may be moved in the reverse direction. Specimens may be shipped from the U.S.A. to Vancouver and then to the interior provided that they have been on the coast only from December 1 to July 1 (i.e., the non-infective period).

Juniperus communis becomes chlorotic in alkaline soil. Toms (1964) reports *Cercospora juniperina,* Needle Spot, *Gymnosporangium clavariiforme, G. clavipes* and *G. tremelloides,* Rust, and *Herpotrichia nigra*, Needle Spot, as occurring in different parts of British Columbia. Attacks by *Gymnosporangium* species can sometimes seriously injure specimens. The alternate hosts for the Rusts are members of the Family Rosaceae, and the only way to check the spread of the infection is to eradicate either one of the hosts.

Several insects may affect *J. communis,* including *Carulaspis juniperi*, Juniper Scale, which is found throughout British Columbia. The scale attacks the cones, needles and twigs, and a heavy infestation may deplete the sap so much that the trees turn grayish or yellowish, produce no growth, and may die partly or wholly. A black fungus may grow in the honeydew secreted by the insects, giving a black sooty appearance to the plants. *Dichomeris marginella*, Juniper Webworm, is found throughout British Columbia on all Junipers with acicular leaves, and may affect *J. communis* subsp. *depressa* more than all other forms.

Juniperus horizontalis seems to be more susceptible to *Phomopsis juniperovora*, Juniper Blight or Cedar Blight, than do the cultivated forms. Toms (1964) reports *Gymnosporangium nelsoni* and *G. nidus-avis*, Rust, on wild specimens in eastern British Columbia. The Juniper Webworm has been reported on this species throughout the Province.

Juniperus scopulorum may be highly susceptible to *Gymnosporangium juniperi-virginianae*, Cedar-Apple Rust or Cedar-Hawthorn Rust, under certain conditions. Careful spray programs are required for control. Toms reports Rust caused by *Gymnosporangium bethelii, G. inconspicuum, G. nidus-avis,* and *G. nelsoni* throughout British Columbia, and Scale Spot caused by *Stigmatea juniperi*

from Fort Steele. The extent of the damage caused in the wild by *G. bethelii* and *G. nelsoni* is unknown, but they may be very destructive to nursery stock. *Phloeosinus scopulorum,* Bark Beetle, has been reported on this species in British Columbia and Washington.

Origin of the Name

The generic name *Juniperus* is the classical Latin name for the Juniper tree, and was apparently used by both Virgil and Pliny. The specific name *communis* is Latin for 'common', referring to the common occurrence of this species. The subspecific *alpina*, 'alpine' or 'from high mountains above timberline', and *depressa*, 'flattened' or 'pressed down', refer to the habitat and appearance of the respective forms. The specific epithet *horizontalis* is from the Latin meaning 'growing horizontally' or flat to the ground, while *scopulorum* is Latin for 'of rocky cliffs or crags' referring to the habitat.

The type locality for *Juniperus communis* is "Europa septentrionalis", and it was first cultivated in 1560; plants and seeds of the cultivar 'Suecica' or Swedish Juniper were available in Britain by 1775 and in North America by the late eighteenth or early nineteenth century. The type locality of the subsp. *depressa* may be "In New York and particularly in the province of Maine" or "Rocky Mountain, July 7, 1806" where it was collected by the Lewis and Clark Expedition, while that of subsp. *alpina* is probably "Britain" (as var. *montana*). The subsp. *depressa* was first introduced to cultivation in Great Britain in 1820, while the earliest reference to the cultivation of subsp. *alpina* (as var. *saxatilis*) is in 1789. The type locality of *J. horizontalis* is "Within the Rocky-mountains" where it was collected by Lewis and named *J. sabina* var. *procumbens* by Frederick Pursh. It has been in cultivation in Great Britain since 1836 and possibly as early as 1830. The type locality of *J. scopulorum* is "On the banks of the waters of the Rocky-mountains" where it was collected by Lewis and named *J. excelsa* by Frederick Pursh, although it may also be cited as "Near the Mammoth Hot Springs in the Yellowstone National Park". The species was introduced to cultivation in Great Britain between 1836 and 1839. This is the largest Canadian Juniper.

The term 'gin' is derived from the Dutch *genever* which in turn is derived from the French *genièvre*, 'juniper berry'. Genever was first made by distilling juniper berries with spirits about the middle of the 17th century (probably by Franciscus Sylvius, a professor of medicine at the University of Leiden) for use as an inexpensive elixir and tonic, but it was also highly alcoholic. English soldiers, then fighting in the Low Countries, took "Holland genever" back to England where it became very popular, especially among the working class because it was cheap. There are several famous paintings of the 18th century period depicting the evils of "Hollands" or "Hollands gin".

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Index Seminum

The Index Seminum, or Seed List, is published annually in mid-winter, and is the means by which The Botanical Garden offers seed for exchange with other institutions. One of the principal ways by which Botanical Gardens and other research institutions acquire new and/or rare plants is by the world-wide exchange of seeds from Index Semina. Many Botanical Gardens, including ourselves, confine their Index Semina mainly to the seeds of native plants, most of which are collected in the wild during the previous summer and fall.

The Index Seminum for the 1977 collection year was distributed to a total of 486 institutions or individuals engaged in research projects in 48 different countries. The list contained 217 taxa in 49 families. We received requests for 4778 seed packets from 286 institutions in 39 countries, of which we were able to supply 4317 packets. The ten most frequently requested taxa were:- *Rhododendron lapponicum* (81 requests), *Picea mariana* (74), *Juniperus scopulorum* (73), *Betula nana* subsp. *exilis* (72), *Tsuga heterophylla* (67), *Cornus canadensis* (67), *Cornus unalaschkensis* (67), *Kalmia microphylla* subsp. *microphylla* (66), *Acer glabrum* var. *douglasii* (62), and *Arctostaphylos rubra* (61). It is interesting to note that only *Tsuga heterophylla* also appeared in the top ten requests last year. The following are the ten countries in which our seed was in most demand:- United Kingdom (34 requests), Czechoslovakia (25), U.S.S.R. (23), West Germany (23), U.S.A. (16), Poland (14), Hungary (14), France (12), Switzerland (12), and East Germany (12).

We acknowledge with gratitude the assistance received from members of the 'Friends of the Garden' who spent many long hours cleaning seeds and dispatching orders.

Botanical Garden News and Notes

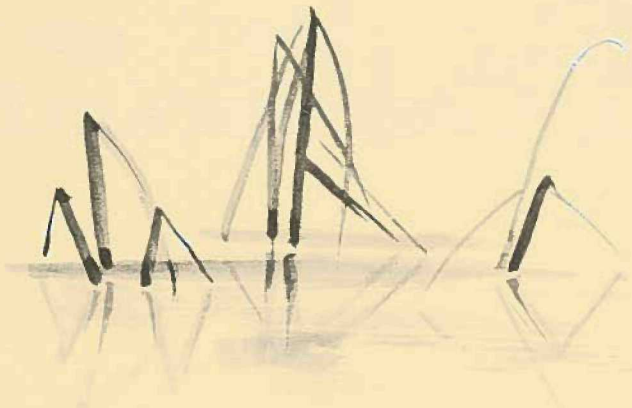
New Nursery Propagation Facility — The new propagation facility in the Nursery will become operational in February 1979. This new building will provide expanded greenhouse space for the development of potential new introductions to the nursery trades as well as the maintenance and development of research collections. A cooperative agreement has been established with the Botany Department at UBC for their priority use of one of the greenhouse units. Special equipment has been installed to facilitate both special soil preparation and the potting up of new propagations. This new unit should enhance the overall development of research and expansion in the Garden.

PLANTAE OCCIDENTALIS — 200 years of Botanical Art in British Columbia — The first major exhibition of plant illustration for British Columbia will be shown at the Museum of Anthropology at UBC from April 18 through September 2, 1979. The exhibition has been developed through a special program of the 'Friends of the Garden'. The exhibition features an original Menzies drawing from the 1700's, on loan from The Royal Botanic Gardens at Kew, and more than 100 works illustrating plants of the Province. Many well-known contemporary artists from British Columbia are represented in the exhibition. *Plantae occidentalis* will travel to Ottawa, Winnipeg and Calgary before returning to Vancouver. Generous assistance for the exhibition has been provided by The National Museums Assistance Programme and The Leon and Thea Koerner Foundation.

Hortitherapy — There was an active program in Hortitherapy in 1978, following the spring Symposium. A one-day follow-up for participants in that Symposium is planned for spring 1979, when it is hoped that there will be an exchange of ideas and a sharing of experiences during the past year. The opening of the new Extended Care Facility on the campus at UBC led to the development of four 4-week courses, each for a group of eight patients. The groups were brought over to The Botanical Garden Office for part of their course and used the special Hortitherapy Greenhouse (see Davidsonia, Volume 9, Number 1).

During 1979, we will hold a spring and summer gardening program with the Psychiatric Unit on campus. There will also be further summer programs for the Extended Care Facility in which each group will have different specific goals. In addition, we hope to hold a second Hortitherapy Symposium either in the fall of 1979 or the spring of 1980.

American Rhododendron Society Annual Meeting — The ARS will hold the Annual Meeting for 1979 in Vancouver during May. A special visit to the University for members of the Society will enable the visitors to see the rhododendron collections of both The Botanical Garden and the Department of Physical Plant.



Climatological Summary for 1978*

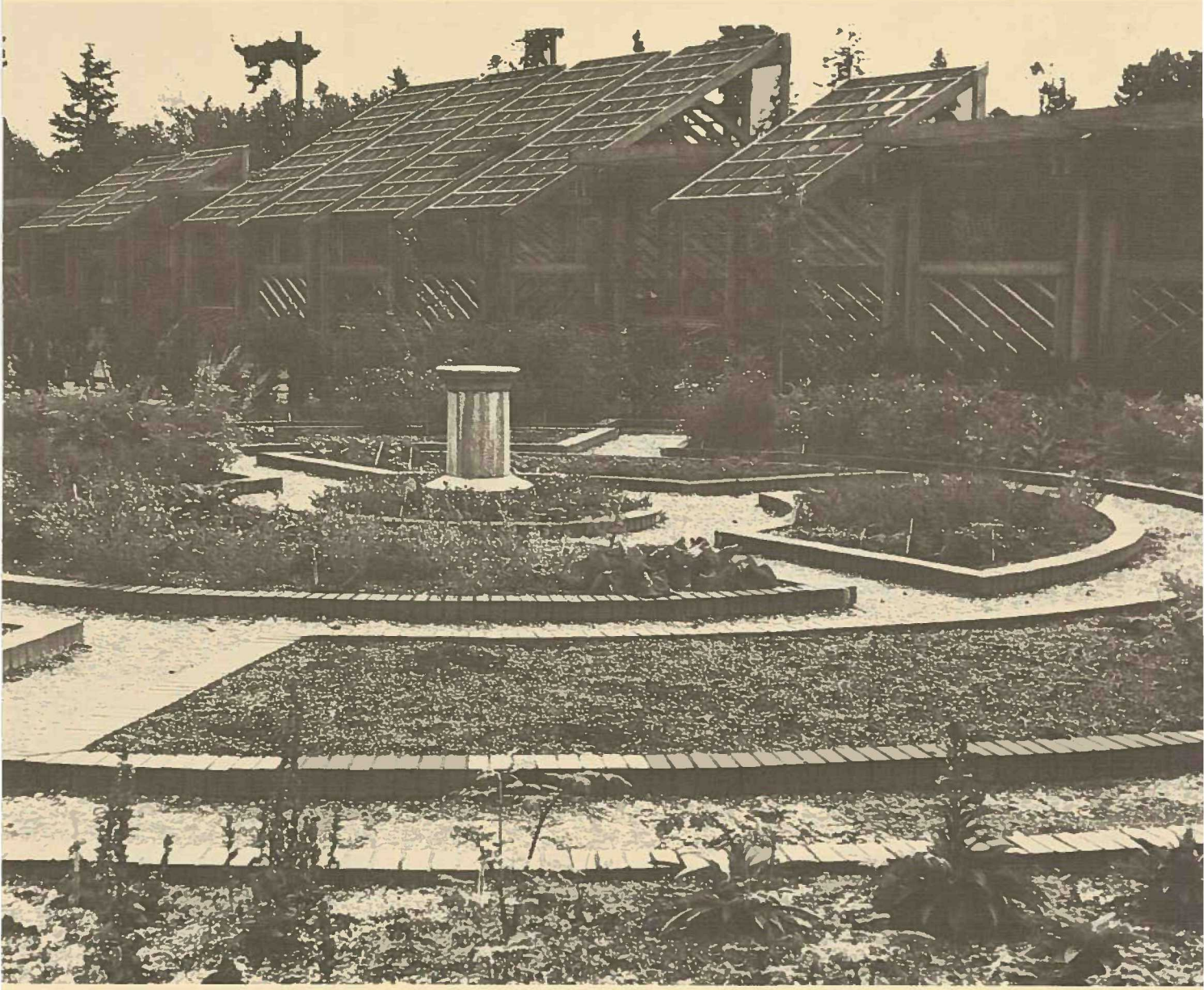
In 1978, rainfall and cold temperatures showed the only significant differences from the norm. August, with almost 159 mm of rainfall, was by far the wettest month of the year, while July was the driest with 14.2 mm. Total rainfall, 954.2 mm, was the lowest for the past 18 years. Yearly totals have declined steadily from 1412.2 mm in 1974 to 1332.2 mm in 1975, 1107.4 mm in 1976, and 1065.5 mm in 1977. This same pattern of declining rainfall also occurred from 1961 to 1965, to be followed by fluctuating totals until the start of the current cycle.

Compared to the same months in previous years, temperatures throughout the year were again remarkably consistent. For example, average maximum temperatures for July 1975-78 were 21.3°C, 19.5°C, 19.5°C and 21.3°C, and January temperatures for the same period were 6.4°C, 6.5°C, 5.6°C and 5.8°C. December average maximum and minimum, highest, lowest, and lowest grass minimum temperatures were all well below normal, mainly because of clear skies in late December, which resulted in rapid heat loss after sundown. Total snowfall for January to December 1978 was 40.7 cm, whereas the total for winter 1977-78 (October 1977 to March 1978) was 41.1 cm.

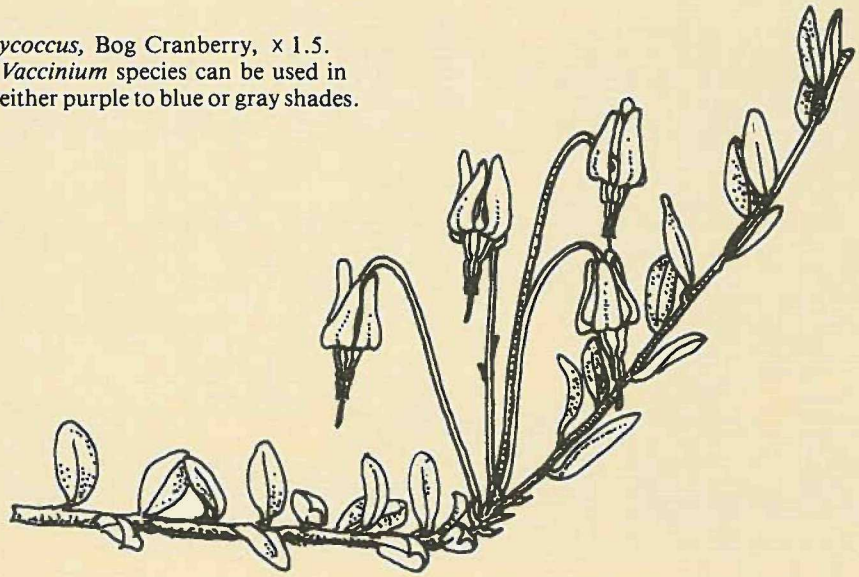
Weather conditions in relation to gardening and plants were nearly ideal. The winter was relatively mild, plant damage was minimal, and there was ample rainfall and sunshine for good spring growth. The above normal rainfall in August, although not popular with holidaymakers, provided ample moisture and eliminated the need for watering. The fall was relatively dry, sunny and calm, providing a spectacular display of fall color for the longest possible time. We can now hope that this long period of ripening of growth in the fall will lessen the possible damage caused by the prolonged freezing temperatures of late December 1978 and early January 1979.

Data 1978	OCTOBER	NOVEMBER	DECEMBER
Average maximum temperature	14.1°C	6.9°C	4.3°C
Average minimum temperature	7.6°C	1.6°C	-0.5°C
Highest maximum temperature	19.8°C	13.0°C	8.5°C
Lowest minimum temperature	1.6°C	-3.7°C	-11.4°C
Lowest grass minimum temperature	-2.0°C	-9.2°C	-14.2°C
Rainfall/no. days with rain	42.5 mm/12	129.7 mm/17	95.2 mm/17
Total rainfall since January 1, 1978	729.3 mm	859.0 mm	954.2 mm
Snowfall/no. days with snowfall	0	0	2.0 cm/2
Total snowfall since October 1, 1978	0	0	2.0 cm
Hours bright sunshine/possible	150.6/318.4	87.9/268.2	88.3/253.1
Ave. daily sunshine/no. days total overcast	4.9/4	2.9/15	2.9/12

**Site: The University of British Columbia, Vancouver, B.C., Canada V6T 1W5*
Position: lat. 49° 15' 29" N; long. 123° 14' 58" W. Elevation: 104.4 m



The Physick Garden has now been planted and will be very attractive in spring and summer. The design is based on the herbal gardens used in the monasteries of medieval Europe.



Vaccinium oxycoccus, Bog Cranberry, x 1.5.
The fruits of *Vaccinium* species can be used in dyeing to give either purple to blue or gray shades.

DAVIDSONIA

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