**The Green Thumb**

A Bulletin of the

**COLORADO FORESTRY AND HORTICULTURE ASSN.**

Organized in 1884

**VOLUME 2**

**JANUARY, 1945**

**NUMBER 1**

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4849 South Santa Fe Drive

Littleton, Colorado

"To preserve the natural beauty of Colorado; to protect the forests; to encourage proper maintenance and additional planting of trees, shrubs and gardens; to make available correct information regarding forestry, horticultural practices and plants best suited to the climate; and to coordinate the knowledge and experience of foresters, horticulturists and gardeners for their mutual benefit.

Published bi-monthly. Sent free to all members of the Association.

Annual memberships $1.00 Sustaining memberships $5.00 Life memberships $25.00

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**Pho to**

Cover Picture: Colorado Spruce

Photo by O. Roach, from "Colorado Evergreens"

**PLANS AND PLEAS**

This issue begins a new year for *The Green Thumb*. As we compare this issue with the first one published we are pleased to see quite an improvement. The first year of publication has established the fact that such a magazine is needed in this area. Where we go from here and what further improvements are made depend very largely on each of the present subscribers.

First, to put the Green Thumb on a sound financial basis we need to at least double our membership. If the present membership think that this is a worthwhile project, they can easily bring in the additional members by telling their friends about the organization and magazine.

It has been a pleasure to work with this Green Thumb family; everyone has been so willing to help.

Now we need your further help in securing new members and in giving us your suggestions for improvements. We would like to have the contents of the magazine satisfy the needs of the greatest number possible of the Horticulturists and Foresters of the state. Will each of you take it as his personal responsibility to let us know what you would like to see in this publication. We want it to cover the problems of the whole state. Its aim will always be to supply information regarding Horticulture and Forestry as it applies to Colorado.

Another way all members may help us greatly is to send in your renewals of membership for 1945 immediately. This will save a great deal of time on the part of our secretary.

**VIBURNUMS FOR COLORADO**

A Summary of our Recent Survey

The genus *Viburnum* includes many of the very fine shrubs for ornamental planting in Colorado. As a group they do not have the spectacular colored bloom of the lilacs, or the brilliant fall color of the sumacs, or the showy fruit of the mountain ash, or symmetry of the spireas; but they do have a combination of a degree of all these good qualities: which makes them really a family of aristocrats. The genus shows a great variation in size and character of growth, in color of fruit, and especially in character of leaves. A complete and satisfying home planting could be made of viburnums alone. Several species commonly used in the east are too tender to be of value here, but our recent survey shows that at least a dozen kinds are useful here. As a group they prefer a rich moist soil, and while some require partial shade, most of them will grow anywhere that has good garden soil. Our survey shows three or four kinds quite widely used in Colorado, but it also indicates that as many more could be used in appropriate locations.

For convenience we will divide the recommended kinds into three groups: those with divided leaves; those with thickish, woolly, or prominently veined leaves; and those with entire, thin, green leaves.

The best-known member of the first group is the common old-fashioned Snowball (*V. opulus* sterile). This makes a large spectacular shrub with its round white balls of bloom, but of late years it is losing favor because of the damage done to it most years by aphids just as the new leaves open. These aphids begin their work as soon as the leaves unfold, and immediately cause the leaves to roll around them, mak-
ing them almost impossible to reach with a killing spray or doped several named varieties, useful especially for their fruit.

In this class comes a little known but superior species, the Sargent's or Manchurian Viburnum (V. sargenti). This has a denser, more upright habit of growth than the other two species, and also has edible fruit. Unless some fault, not now known, shows up; this species may, in time, take the place of the other better known species.

Another little known species in this class is the Pigmy Snowball, a dwarf which seldom gets over a foot tall. If seldom blooms or fruits, and it requires some protection. Used in the right place it is a valuable little shrub.

Our native Viburnum (V. pauciflorum) comes in this class. It is found rarely along our small streams in rich moist soil and dense shade. As the name indicates it is very sparing of its bloom and fruit. It is difficult to transplant, and deprived of its favorite environment it is most unhappy in cultivation.

The best representation of the second class is the Wayfaring Tree (V. lantana). This is the most popular and probably the most useful viburnum for use in Colorado. It is a real aristocrat of shrubs. It is rather slow growing, but in time makes a beautiful, large, dense shrub. The flowers are the usual large flat cluster of small white flowers, but the fruit is very attractive. It is at first green, then yellow, orange, red, and finally black; and as it ripens gradually there are times when all these colors show in concentric rings in each head. The leaves are thickish, prominently veined and woolly underneath. The smaller stems are also brown woolly. It grows in any good soil in sun or partial shade.

The Fragrant or Korean Viburnum (V. carlsii) has been much advertised the past few years. It is very much worthwhile when given a suitable location. A protected spot on the north or east of a building suits it best. It never makes a large shrub, and unless given good soil and protection is more likely to grow smaller, year by year, than larger. When it is happily located it produces large heads of beautiful pink buds which gradually open up into creamy white, highly fragrant, flowers. If you are able to pamper it, it is a delightful thing.

The Gardenia Viburnum (V. burkwoodii) is a still later introduction. It is a cross between V. carlsii and V. utile, and has much the same appearance as the Fragrant Viburnum. Some report fair success with it, but many others have found it more difficult than V. carlsii. Until more years have passed to allow more experience with it, it is best to class it with those shrubs which are very nice if they grow, but are of doubtful hardiness.

The Japanese Snowball (V. tomentosum), so far as leaves are concerned would be in this class, but is generally grown as a flowering shrub for use in Colorado. The fruit consists of heads of tiny blue-black berries which birds enjoy. When planted in the proper situations, this shrub should be used much more.

Several other species of Viburnums have been tried in Colorado and found wanting: V. alnifolium, V. acerifolium, V. cassinioides, V. sieboldi, and V. dilitatum. One or two people have had some success with them. Some of these other similar species, particularly V. molle, are much more difficult, or impossible in Colorado. The fruit consists of heads of tiny blue-black berries which birds enjoy. When planted in the proper situations, this shrub should be used much more.

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MEANING OF SOME VIBURNUM SPECIFIC NAMES

Opulus, luxurient.
Sterile, bearing no fruit.
Lantana, an old Greek name for Viburnum.
Lentago, tough, plant.
Dentatum, with toothed leaves.
Nanum, dwarf.

Prunifolium, plum-like leaves.
Molle, soft-haired.
Pauciflorum, few-flowered.
Acerifolium, maple-like leaf.
Alnifolium, elder-like leaf.
Tomentosum, dense with soft hairs.
Casinoides, cassine-like.

WHO HAD THE FIRST GREEN THUMB?
By M. Walter Pesman

We still think our Colorado Thumb was green quite a while before the National Garden Contest "adopted" our slogan or trade-mark. Incidentally, if Washington liked the name well enough to use it nationally, it is a feather in the cap of the Colorado Forestry and Horticulture Association. And their clever illustration of the green-thumbed Mickey Mouse has an appeal for young and old.

Colorado awards in the National Green Thumb contest were made on November 16. A bronze medallion ("La Terre") will go to the three prize winners: Miss Lula R. Morse, 3768 Perry Street, Denver, in the Adult Division, Wayne Delventhal, Brighton, in the High School Division, and Barbara Ann Bocovich, Peyton, in the Elementary Division. These three will also compete for the national awards; a thousand-dollar war bond and two $500 bonds. Awards were made on the basis of the Green Thumb Record Books, entered by the contestants, and showing both what was planted and what was harvested.

The actual record of produce is a source of amazement to anybody who never took the trouble to keep track of the amounts raised. A small garden, 30 by 30 feet, produced six hundred pounds of vegetables consumed by the home folks (and guests), in addition to 71 pints and 9 quarts canned and 111 pounds stored. And the total cash outlay was only around ten dollars! Miss Lula R. Morse, the adult winner, grew 32 vegetables and 25 annuals in her 1400 square feet of plot.

Wayne Delventhal, the High School winner, in addition to the $76.80 worth of fresh food produced, sold $102.50 worth, and gave away a lot more—all on an outlay of $16.50 for seed and $7.25 for insecticides.

Competition was quite close, especially in the adult division. Honorable mention in this division went to R. McDowell of Colorado Springs and M. Walter Pesman of Denver. In the high school and elementary school divisions honorable mention went to Verna Moore, La Veta, Vanita Hall; Peyton; James Rodger; Arvida, and to Patricia and Billy O'Neil, Denver.

I could but be amused at the spirited defense of his three "friends" presented by Squire Stockbridge after his reckless insouciance towards all native plants—and things—these many years. Now had it been Childrend, whose prose and poetry in his unique Rocky Mountain Herald exuberantly exalt our native sons and spruces, I should have been deeply impressed. Or even had the doughty Scot at 38th and Wadsworth spoken his Moor, or whatever it is they have in Scotland, or Buffalo, the matter would have been serious. But Squire Stockbridge, who finds his greatest joy in the manureomas of Spring processions, and the agenies of poisoned angleworms—if he be the champion selected to switch us from Spinacia to Sny|£brush and from Babybreath to Skunkbush, then I am content to let the matter die a natural death (and then after thorough decomposition, be added to the Squire's reeking compost pile).

However, the subject chosen for discussion this month concerns our High Church devotees of things horticultural rather than the vermicularions of the Squire's soil tillers. A few years ago I suddenly aspired to be truly scientific. Being stationed for the winter near one of our classic and ivy-clad institutions of learning upon the American Thrones, I enrolled as a student in a class in taxonomy. After four humiliating months, I returned home well content to learn my plants via field trips with members of our Colorado Mountain Club. For the botanist, you will understand, can never use a word the meaning of which is clear, when it is possible to employ an obscure synonym. I quote from class notes:

"The configuration of juvenile Pinus strobus is attenuate, seldom furcate with muticus strobiles. According to a standard glossary, the professor meant that young White Pines are slenderly tapering, seldom forked, and have cones that are unarmed. Why couldn't he say so! Similarly, we laboriously learned—and promptly forgot—that the fascate fruit of the currant is "berry-like," that the corcease leaves of the Oregon Grape are "leathery," that viscid leaves are "sticky," and velutinus ones "velvety."

Of course we must call things by their names: An anther is just that. However, the subject chosen for discussion this month concerns our High Church devotees of things horticultural rather than the vermicularions of the Squire's soil tillers. A few years ago I suddenly aspired to be truly scientific. Being stationed for the winter near one of our classic and ivy-clad institutions of learning upon the American Thrones, I enrolled as a student in a class in taxonomy. After four humiliating months, I returned home well content to learn my plants via field trips with members of our Colorado Mountain Club. For the botanist, you will understand, can never use a word the meaning of which is clear, when it is possible to employ an obscure synonym. I quote from class notes:

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Of course we must call things by their names: An anther is just that, and no one can object to calling a node by that terse, descriptive title. Sometimes, in wholly scientific journals, the shorthand of technical terms may save a number of pages and justify itself in part. I will wager much, however, that if we could mesmerize most botanists and then wring the truth from them, we should find that the fundamental reason for calling a wrinkled seed rugose and a swollen one tumid is primarily to show the other wise men that there is still another present.

QUERCUS.
SANCTUARIES IN THE PLAINS
By Jules S. Renaud, Associate Forester Soil Conservation Service

All of us have driven along the highways in Eastern Colorado and enjoyed seeing farm and suburban homes nestled within a windbreak of trees and shrubs, homes that have a permanent look, homes where satisfied Colorado people are enjoying life in their own green sanctuary. All of us, too, have seen farm and suburban homes sticking up like sore thumbs on acres barren of trees or shrubs, with all the ugly tools and machines of man exposed to the view of everyone passing by. The look of impermanence is everywhere as if the owner really didn’t have faith in his own ability to make his home a permanent, enjoyable place to live.

Trees and shrubs have the merciful duty to clothe nature’s ugly spots and provide shade, shelter, and food for man and his animals.

Early settlers planted thousands of trees and shrubs under the Tree Claim Act, but many died because of a lack of understanding of the best technique of planting and care. Trees that were planted were those the settlers had lived with all their lives in the middle and eastern states and were not suited for the dry plains country.

Few trees grow naturally in the Great Plains area east of the Rockies except along streams, but windbreaks can be successfully established by carefully observing a few fundamental principles. Insufficient moisture and competition by grass have always made it difficult to grow trees in the plains, but these are not unsurmountable obstacles. We cannot make it rain more, but we can follow the practice of fallowing and increase the moisture available for newly planted trees and shrubs. The competition of grass can be eliminated by continuous clean cultivation around tree plantings.

Years of trial plantings by the Soil Conservation Service and other agencies have shown that at least ten species of trees and shrubs are well adapted for Plains plantings, and the same trial period has revealed the best spacing in and between the rows of the species used. The following procedure is now being recommended to farmers and ranchers of Eastern Colorado:

The best windbreak has been found to consist of seven rows of trees and shrubs placed in an L shape to the windward sides of the house and yard at a distance of at least 100 to 500 feet away from the nearest building. Plantings too close to the house or barn deposit snowdrifts in the yard and plantings over 500 feet away are too far to effectively protect the house and yard from cold, drying winds. Windbreaks of less than seven rows usually do not give adequate protection.

A good windbreak should have three height of plants. Tall evergreens for winter protection, tall hardwoods for summer protection and shrubby species for preventing wind movement close to the ground. Such a planting would consist of Ponderosa Pine in row No. 1 nearest the buildings, Rocky Mountain Red Cedar in row No. 2, Green Ash or Hackberry in row No. 3, Chinese Elm or Hackberry in rows Nos. 4 and 5, Russian Olive in row No. 6 and in the outside row No. 7, either Squawbush, Tamarix, Currants or Chokecherry. Black locust could be substituted for Green Ash, Hackberry or Chinese Elm, but it is subject to the locust borer in Colorado. Wild Plum could be substituted in the seventh row but is a host plant for peach mozaic.

On dry land trees in rows Nos. 1, 2, 3, 4, and 5 should be spaced 16 feet apart, in row No. 6 six feet apart and in row No. 7 four feet apart. On irrigated land trees in rows Nos. 1, 2, 3, 4, and 5 should be spaced 12 feet apart, in row No. 6 six feet apart and row No. 7 four feet apart. Spacing between rows depends upon the type of cultivating machinery available, but should be between 12 and 16 feet for all except the rows Nos. 6 and 7 which should be at least 8 feet apart.

Windbreaks should, of course, be fenced to prevent grazing by cattle, sheep, or horses.

Many older plantings which followed the above principles are outstanding in their effectiveness. M. N. Bailey, whose dry land is located southeast of Simla, had a fine crop of cherries last summer where the trees were protected by a windbreak, and just a little way east Warner Paul has a high producing patch of blackberries, strawberries, and raspberries and a fine vegetable garden all protected by an 18 year old windbreak, where the Ponderosa Pines are now 20 feet in height. These gardens are in the zone of protection from living green walls and are producing fruits and vegetables on a site that would be extremely unfavorable without protection.

Wheat, corn, sorghum and other field crops will likewise increase their yields where protected by a good windbreak. It is pleasing to see more and more green rows of trees dotting the landscape throughout Eastern Colorado, proclaiming to everyone who passes by that here lives a permanent farmer, one who is sinking his "roots" deep in the earth into the good Colorado soil that will give up to him and his children crops in abundance forever.

NATIONAL GARDEN CONFERENCE
Gardening for Beauty Emphasized

Ornamental gardening supplanted food in primary attention at the national victory garden conference held under the auspices of the United States Department of Agriculture, at Washington, D. C., November 28 and 29, in contrast to the original gathering held under the shadow of the Pearl Harbor disaster. About 125 persons represented garden organizations, civic groups, horticultural trade interests and governmental agencies.

They studied the results of victory gardening efforts so far in the war period and considered the need for their continuance. Consideration was given to a national garden program in the postwar period for its aesthetic value.

The first conclusion reached by the conference was to continue the promotion of victory gardens with a national goal of 20,000,000 gardens in 1945. Other conclusions reached by the conference were embodied in the recommendations of five committees, which were submitted to the conference as a whole and adopted unanimously. Among these were recommendations that practical gardening be taught in the public schools, the trend to include ornamentals in victory gardens be encouraged, home planting of fruits be fostered, state extension services be extended to
Late in 1942 a well-defined insect epidemic was discovered in the Engelmann spruce stands of western Colorado. At the time, cooperative preliminary investigations by the Forest Service and Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, revealed that 510,520,000 board feet—over 17 per cent of the original green stand in this type—was dead on the stump in the White River National Forest alone!

So rapid has been the spread of this epidemic, caused by the tiny, dark brown beetle *Dendroctonus Engelmannii* Hopk., that at the present time, estimates of the White River timber killed has leaped to 1,783,050,000 board feet; with losses on the Grand Mesa, 18,000,000; on the Routt, 7,600,000; and on the Uncompahgre National Forest, 3,000,000 board feet. In terms of Colorado's national forests, this represents 16.5 per cent of the total—and, since the great bulk of Engelmann spruce in the state is in its national forests, the figure becomes even more significant.

Although the present infestation is formidable, by千古 outlooking the history of the big blow down of 1939, minor outbreaks beyond its general path are being reported to the Forest Service from time to time. For example, on the Black Mesa of the Gunnison Forest, some 2,000 trees are now dead; and on the Holy Cross, in addition to several isolated infested Engelmann spruce, four separate areas, involving about 1,500 trees, were recently discovered.

The blow down of 1939, the entomologists say, contributed materially to the build-up of the beetle population to its present proportions.

The present epidemic of Engelmann spruce bark beetle is, without doubt, the most serious insect infestation with which this area has been confronted. The infestations apparently got off to a good start following the extensive damage, in the form of uprooted trees, which accompanied the heavy wind storm on June 15, 1939. In these weakened trees the beetles found an ideal haven, and built up their broods in tremendous numbers.

At the present time, all these forests have more or less extensive areas on which the known loss in Engelmann spruce timber is extremely serious. In fact, the attacks are so aggressive that the entire Engelmann spruce forested area may be threatened with complete destruction of all trees of saw timber size, and may even include many of the smaller trees. We can already foresee that in some places there will be no Engelmann spruce left to provide a crop of saw timber for perhaps the next century or so.

Outbreaks of forest insects have occurred before in Colorado. As early as 1905, forest entomologists found evidences of an epidemic that 50 years previously had swept what is now the Pike National Forest, paralleled by a similar outbreak many times greater and more serious, many years previously had swept what is now the Pike National Forest, paralleled by a similar outbreak many times greater and more serious, when the big blow down of 1939, minor outbreaks beyond its general path are being reported to the Forest Service from time to time. For example, on the Black Mesa of the Gunnison Forest, some 2,000 trees are now dead; and on the Holy Cross, in addition to several isolated infested Engelmann spruce, four separate areas, involving about 1,500 trees, were recently discovered.

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To all outward appearances, the Engelmann spruce trees flanking the middle example are alive and healthy. They are a fresh green, their needles are intact, and their branches are not indicatively drooped. They are the living dead, however—but only by the closest inspection could their actual infestation status be determined. The center spruce is, of course, a specimen by way of contrast—dead for some time, as a result of beetle attack, with all external evidence apparent.

gant, principal investigator in the present epidemic for the Bureau of Entomology and Plant Quarantine, probably coincides with maturity of the spruce stands and with periods during which climatic conditions or other factors are favorable for the development of the insect.

Since the crowns of the trees remain green so long (a full year or more) after they have been completely killed by the beetles, a serious infestation may be building up and not be noticed by anyone passing through the infested area. The most conspicuous indication of the presence of an infested spruce tree is the work of woodpeckers. These birds often nearly completely strip the bark from the lower portions of the trees in seeking out the larvae (under the bark). This, plus the presence of pellets of boring dust clinging to the bark crevices beneath the tiny, round hole where the adult beetle enters the tree, is all the evidence visible externally.

Actually, very little is known about the habits of the Engelmann spruce beetle. Thus, the investigative program during the current year, undertaken jointly by the Forest Service and the Bureau of Entomology and Plant Quarantine, was necessarily exploratory in nature. While both funds and experts to carry on the study were meager, nevertheless the extent and seriousness of the infestations were determined by surveys, a life history of the insect was partially determined, and control measures of various sorts were tested.

This—and more information is urgently needed on which to base control work since, only after the insects' life cycle is definitely known, can intelligent planning be undertaken.

Although it is believed, based upon past experiences and history, that the epidemic is now perhaps at its peak and, through natural causes may be on the decline soon, for the present, its extent and virulence preclude any widespread control. Where incipient outbreaks occur, it will be necessary to instigate direct control measures. It is economically impractical and physically impossible, says Dr. Wygant, to carry out direct control measures effectively within the confines of the present infestation: the volume within these areas must be lost, but with the aid of natural barriers, it may be possible to prevent its spread to other areas.

The direct control phases of the work are being handled administratively by the Forest Service through sale of bug-killed but commercially salvageable timber. A score of such timber sales, located in the most heavily affected areas on the national forests, have already logged out millions of board feet of this spruce timber. It is steadily entering a demanding market as box shook and miscellaneous crating for use in the war.
CHARLES RENO ROOT
Pioneer Colorado Seedsman

About this time, an older brother, operating the "J. B. Root Company, Seedsmen," one of the first seed houses in Rockford, Illinois, induced Charlie to come and work for him. Raising tomato, pepper, and squash seed, he felt he would be more valuable to them in promotion work and soon prevailed upon them to let him install a printing press and, in 1888, he got out his first list for the seed trade. The following year, he got out a seed catalog listing, by the way, many varieties still being shown in seed catalogs, and of which he was very proud.

Owing to the illness of his father, he returned to Cato, New York, in the summer of 1889. During July of that year, by telegraph, he arranged with Clarence Bowman, manager of Barteldes & Company, to come to Denver.

He arrived in Denver, August 4, 1891, and the next day went to work for Barteldes & Company as a traveling salesman. Those were the days when a seed salesman went out during the summer and the fall selling seeds and then worked in the winter putting the orders up. This Charlie did and received the enormous salary of $65.00 per month for his work!

In 1894 some changes were made in the Barteldes organization and Charlie was made manager, in which capacity he remained until he established his own business 21 years later. In 1906 he was responsible for the building of the Barteldes warehouse at 16th and Wynkoop Streets, a five-story building, considered one of the best of its kind in the city.

In 1912 he, with two associates, started the Colorado Seed Company at 1515 Champa Street, Denver.

Charlie joined the American Seed Trade Assn. in 1888 and for 53 years has been active in the seed business in Denver and, after all these years, is still on the job every day. He was one of the early members of the Denver Chamber of Commerce and on the Board of Directors of that organization when the present building was erected, serving on that board for two terms. He was for many years chairman of the Agricultural Committee of the Chamber. He was chairman of the National Dry Farming Congress from 1909-11; president of the Colorado Manufacturers Assn.; on the Denver Charity Board for three years; was president, and instrumental in the formation of the Colorado Apple Exposition; was president of the Colorado Florists Club in 1912-13 and president of the Colorado Seedsmen's Assn. in 1924-25-26 and 1928. He is a charter member of the Denver Rotary Club and a member of the Montview Boulevard Presbyterian Church.

In June 1893 he married Mary Whipple Freeman of Rockford, Illinois, and has two daughters, one of whom was his "right-hand-man" for 25 years in the seed business. She was Miss Clara Root, well-known to the seed trade, and is now Mrs. Howard Gregory of Rockford, Ill.

Over all these years, Charlie Root has been admired by all with whom he has come in contact, and the seed trade, of not only Colorado but the entire country, recognizes in him a seedsman whose business dealings have always been based on honesty and integrity.

HOWARD F. ROERIG.

THE EDDY ARBORETUM
By G. THOMAS ROBBINS

NOTE: Arboreta and botanical gardens have been established in many states with valuable benefits to those communities. Colorado might well profit by these examples. Here is an account of one arboretum which has proven its value in California.

The Eddy Arboretum serves as the experimental ground of the Institute of Forest Genetics, a branch station of the California Forest and Range Experiment Station, operated by the U. S. Forest Service. The Institute's work, begun in 1925, seeks to develop by selection and breeding rapid growing strains of timber trees, especially pines, which will also possess resistance to insects and disease.

The Institute is located in the Sierra Nevada foothills, at an elevation of 2700 feet, near the early mining town of Placerville. It is situated in the heart of a region that contains some of the finest and largest stands of Ponderosa pine and Sugar pine in California.

The Institute has brought together in its arborium one of the most complete collections of pines of the world—including nearly 70 species and 25 varieties, in addition to a number of experimental hybrids. The moderate climate of the area permits the growing of species from many latitudes and many geographic strains of the same species are represented. In addition, there are 32 species of conifers other than pines growing in the arboretum.

Most of the 3700 trees in the Eddy Arboretum are now 15-18 years old and some of them up to 60 feet tall. The trees are arranged, not in park-like fashion, but in regular rows spaced 15 feet apart, principally to conserve space. They are in groups varying from 1 to 30 or more trees for each species and these in turn have been arranged in species relationship groups to permit cross-pollination. In addition to the arborium there are several thousand additional pine trees growing in surrounding experimental plantations.
GROWING PLANTS WITHOUT SOIL
A. M. BINKLEY, Horticulturist, Colorado State College

At the present time there is considerable interest in growing plants without soil, which is no doubt due to the wide publicity and spectacular yields reported. It has appealed to the popular fancy of the amateur and the hobbyist, yet it does have possibilities for use by the commercial greenhouse grower. Soilless culture has been used as a technical tool for a long time, but it is only recently that its adaptation to large scale use has become of interest to the greenhouse industry. It is not adapted to outdoor use in the field except in localities, such as islands, where there is not sufficient soil or the soil is not capable of supporting plant life. The backyard gardener could use soilless culture as a hobby but the results as reported from those who have tried it are not very encouraging. Certain types of house plants can be grown without soil with proper equipment.

A brief discussion of soilless culture is given here with the hopes that it will bring about a better understanding of some of the problems involved. In water culture or gravel culture a chemical solution is used to furnish the necessary nutrient elements to the plant. The difference is largely one in the mechanics of supplying the solution to the roots.

Water Culture
Water culture refers to the growing of plants in a chemical solution, without a rooting medium, such as gravel. The plant is supported by holders and the roots grow in the chemical solution. The term hydroponics has been coined, which means literally water culture. Crop plants, however, will not grow in pure water, but must have the necessary chemical elements in the solution for growth. Roots must have aeration or oxygen for growth so air must be bubbled through the chemical solution for growth.

Plant physiologists have grown plants in liquid nutrient solutions containing the necessary chemical salts for growth for over 75 years. It has been used as a method of determining, under controlled conditions, the factors affecting plant growth. For example, if you are asking information on the effect of phosphate on a particular plant, it would be left out of one series of liquid solutions in which the plants are growing. This would then be compared to treatments with sufficient phosphate for growth and to a series where the phosphate quantity of the solutions varied. The iron, boron, copper and other minor elements requirements of plants have been studied by this method. Thus the experimental use of the liquid solution culture method is helpful in answering both scientific and practical questions. There are many different types of liquid nutrient solution cultures for different species of plants, and different techniques have been developed for experimental use. The plant foods necessary for growth are obtained from the liquid solution, instead of from soil, which means that the concentration of the solution must be maintained at the proper level. As the plant grows, the nutrients or plant food is taken up and the solution will change. The concentration may also cause the pH or reaction to change from acid to alkaline side. Water evaporates from the surfaces of the solution, and the plant loses water through use and loss from leaf surfaces. This means that the water levels and the chemical composition of the solution must be checked at regular intervals and necessary adjustments made. If the solution becomes too acid or alkaline, adjustments need to be made to maintain the reaction at the right level for growth.

Many of these checks must be done for both water culture and gravel culture methods of growing plants. In liquid solutions, air is bubbled through the solution to provide oxygen whereas in gravel culture the gravel media is flooded with the chemical solution at regular intervals during the day, which brings air or oxygen to the roots. Temperature must be maintained at the proper range for crops grown. These points are emphasized to show the importance of having someone familiar and experienced in growing crops without soil.

Gravel Culture
The gravel culture method has been found to be more practical to use because it is more adapted to large scale commercial growing of greenhouse crops. The Horticulture section of the college has been experimenting with gravel culture for over five years to determine (1) the best solution for specific crops; (2) to determine the best medium (gravel, sand, etc.); (3) bench construction; (4) number of airings of the media per day; (5) adaptation of propagation and transplanting methods to gravel culture; and (6) other new ideas in the operation of the method of growing plants. The results of some of these studies have been published, are in preparation, or not yet completed. A few of the requirements of gravel culture are discussed in a general way, based on the work in the college greenhouses.

Bench Construction, Pumps and Tanks
Gravel culture requires concrete or waterproof benches so constructed that growing trays can drain. Drainage of the solution back into the solution tank. The tank, holding the nutrient solution, should be made of waterproof concrete and located so the solution will drain back readily. The size of the tank required should be about the capacity of one-third the cubic content of the bench. The nutrients are pumped from the tank into the bottom of the gravel culture bed until, while within an inch or two of the top of the gravel surface, then the pump is turned off and the solution allowed to drain back into the tank. The pump can be attached to the tank or be of a portable type. Time switches are available which can be set at time intervals to turn the pump motor on and off.

Solutions
The solution which has been found to be satisfactory for our conditions is a modified W.P. solution which contains nitrogen, phosphorus, potassium, calcium, and magnesium, iron and other minor elements added. The solution can be pumped into the gravel culture the two times every 24 hours or as needed, depending on the stage of growing. The method of growing crops has been successful in a small range of species. It is necessary that the solutions be tested twice weekly, and water levels checked daily.

Mr. August Musenbrock, florist in charge of our college greenhouses, has grown successfully a series of crops over a five year period in benches. He has run the quick chemical tests on the solutions, tried out different practices and new bench construction and other ideas. These crops included carnations, snapdragons, chrysanthemums, stocks, sweet peas, tomatoes, hydrangeas, and other crops. The yields and quality have been outstanding considering the problems of temperature control and growing more than one crop in a small range of species. There are still problems of adapting the method to commercial greenhouse ranges, it is
only by growing the crops on a commercial scale that the practicability of the methods can be determined. Large greenhouse operators are interested in gravel culture and even if started on a few benches many things of value will be learned about the nutrient requirements of specific crops of which can be applied to growing in the soil. Some of the advantages and disadvantages of growing crops in greenhouses by the use of the gravel culture methods are listed for comparison.

Advantages:

I. Reduction of labor costs.
   (a) Eliminates hand watering.
   (b) No weed control necessary.
   (c) Eliminates cost of changing preparation and fertilization of soil.
   (d) Reduces haphazard methods of watering and fertilization.

II. Better understanding of elements and their balance required for production.

III. Soil borne diseases less of a hazard.

IV. Lowers fertilization cost.

Disadvantages:

(1) Higher cost of bench construction, tanks and equipment. (Original cost higher but could be charged off over a 10 or 20 year period.)

(2) Diseases may be distributed by nutrient solutions.

(3) Danger from insecticides running into nutrient solution. The gravel should be flooded with tap water or nutrient solution before spraying.

(4) Requires periodic check on solution balance and reaction.

(5) More knowledge required on commercial adaptation and balanced solutions for different crops.

(6) Symptoms of minor element differences may show up on different varieties, especially iron, boron, manganese, and calcium.

Gravel culture is an interesting growing method and undoubtedly will be widely used in the future, particularly where quality and yield are important. In all the experiences in growing crops by the gravel culture methods on a commercial basis at the college, the least difficulty is with the solutions used and their adjustment. More difficulties are encountered in the mechanics of operation. It does however, require someone trained and experienced in gravel culture methods. It does not require a technically trained chemist, or some one with a Ph.D. degree to be successful in growing or in the supervision of the method. Gravel culture will increase in use by greenhouse growers as soon as it can be proven to be more economical and that better yields and quality of crops can be produced.

Visitors are always welcome at the college greenhouses.

As previously announced in the GREEN THUMB, a special committee was appointed to make a survey of and report upon the European Elm Scale in Denver. The original plan was to report the specific infested streets and areas. As the survey progressed, however, it soon became apparent that infestation was the rule rather than the exception. Every area in Denver has now been examined, and it appears that the distribution of the pest is universal, the only unaffected trees being those that have been given thorough care recently. As was reported in the November issue of the GREEN THUMB, certain Parkways and Boulevards under city control which have been systematically sprayed and sprayed by the city are in splendid condition. Certain of the Municipal Parks are in the same category. There are also a few private residences where regular care has been given and American Elms in such places are in fine condition. But by and large, unless most of the American Elms in Denver are pruned in the near future, and then thoroughly sprayed while dormant with miscible oil, the majority of Denver's magnificent American Elms will be eventually wiped out.

Infested trees are easy to spot. Mr. F. Herbert Gates, State Entomologist, pointed out in the November issue of the GREEN THUMB, that the branches of scale trees have a "black, sooty, sticky appearance." These branches have, on their under sides, heavy incrustations of visible scale. Such branches soon die, and should be cut off and destroyed. Then a spray program should be instituted, along the lines suggested by Mr. Gates in his aforesaid report.

Complete cooperation in this project is being given by Mayor Stapleton, Manager of Improvements and Parks Cramer, and City Forester Joseph A. Bixby, as well as by State Forester R. E. Ford, the State Agricultural College at Fort Collins, and the U.S. Forest Service. All recognize that the situation is critical.

While the remedy is clear (pruning and spraying) the means of achievement are difficult because of the vast extent of the infestation and the present shortage of labor and equipment. The city is continuing to utilize its entire equipment and manpower on the Boulevards and in the Parks. Private home owners should lose no time in employing the numerous competent individuals and firms that are equipped to do this work. It is recommended that each elm spray job be reported to the City Forester, giving the location and date of the job, so that an inspector may be sent to test the quality of the spray, thus making it certain that proper standards are maintained.

It is further recommended that a newspaper and radio campaign be launched urging property owners to have their American Elms trimmed and sprayed before spring growth starts.

The infested trees are so numerous, however, that the committee feels that ultimately the city wide program will have to be carried out by the city.

Respectfully submitted,

Special Committee on Elm Scale.

Alfred J. Bromfield, Chairman.
Joseph A. Bixby,
R. E. Ford,
Col. Allen S. Peck,
Fred R. Johnson,
Robert E. More,
George Kelly,
S. R. de Boer,
M. Walter Pesman,
F. Herbert Gates,
Mrs. C. Earl Davis.
You wonder what gardening work can possibly be done in January and February. Let us see if there are not some things which need attention.

January is always the seed catalog month. There will probably still be seed shortages so get your order in early. With several good seed catalogs with their bright pictures and alluring descriptions you can sit back before a warm fire and plan your whole seasons garden. The local seedsman are more likely to know what varieties are best for your location.

Trees can have necessary pruning done on them now. Fruit trees especially need a little work each year. Shade trees, except maple may be done now. Don’t do much pruning on shrubs except to take out dead wood and straggly branches. Most blooming shrubs are better pruned right after they bloom.

Look over stored roots and bulbs, especially dahlias. If they are sprouting much they are probably too moist or warm. If they are shriveling they need more moisture. Some damp burlap over them will probably help.

Any time these months that there is a week or more of warm dry weather check your lawn and trees to see if they need water. Evergreens and birch trees need especial attention if the ground was not thoroughly wet when it froze up.

We might repeat that this is an excellent time to make garden plans, and to take up the study of some interesting phase of gardening.

Along in February it is fun to bring in a few twigs of such things as forsythia, pussy willow, spirea and plums to watch them come into bloom in the house.

If you can beg, borrow or steal any good manure, or compost, or peat; now is an opportunity to get it on your garden. It will be all ready to spade under when the ground thaws.

Possibly you can buy your plants cheaper than to raise them, but it is lots of fun to have your own hotbed and start them yourself. Beds should be prepared now.

As soon as the frost is out of the ground is the best time to start transplanting most trees and shrubs. If you are ordering some from a nurseryman the plans should have all been made before the planting season opens up. Birch and some slow growing trees are safer moved just before they come in leaf.

Check your house plants for insect pests.