Proceedings First
Plant Propagators Society
Meeting

The group, assembled for the purpose of discussing the possibility and feasibility of organizing a Plant Propagators Society, and to listen to a fine program of skilled technicians was called to order by temporary chairman Edward H. Scanlon at 10 a.m. Mr. Scanlon welcomed the attendants to the meeting and then introduced Mr. Arthur L. Munson, Director of Properties for the City of Cleveland. Mr. Munson extended greetings from Mayor Thomas A. Burke and then proceeded to tell the gathering of his own interest in plant propagation. He concluded by assuring the group that a splendid opportunity for service lay within their grasp if they decide to put the meeting on an organized basis.

The first speaker on the formal program was then introduced by Chairman Scanlon—Mr. James S. Wells, Koster Nursery, Bridgeton, N. J.

The Plant Propagator—The Basis of Our Industry

By James S. Wells

Koster Nursery, Bridgeton, N. J.

I have often thought that the plant propagator is more closely akin to the medical profession than to any other, for surprisingly similiar qualities are required both for the good doctor and the good plantsman. A long and rigorous initial period of training followed by slow and sometimes painful acquisition of knowledge through a lifetime devoted to his work are equally true of both. The comparison is even closer when one considers how much success may depend upon painstaking study, the careful consideration of all factors, before a diagnosis is given and treatment prescribed, for in both professions it is such attention to small intangible details that make the difference between success and failure.

The last twenty years has seen the business of the horticulturalist emerge from the "rule of thumb" era, even of superstition, to that of scientific certainty. The advances in horticultural knowledge represented by the introduction of "hormones," of new and highly lethal insecticides and fungicides can I suggest be accurately compared to the advances made in the medical profession by Lister and Pasteur. Even such a ritualistic item as the potting compost, which used to be so carefully prepared by the propagator himself according to his own pet formula has been shorn of its mystery and standard procedures prescribed which can enable any grower to obtain similar results year by year. With all these changes going on around him, the modern plant propagator has also altered. He has had to learn to use the new tools which science has made available to him, and must now combine considerable scientific skill with his practical down to earth knowledge in the intricacies of plant behavior and growth. He is part botanist, part scientist, part commercial grower, each part taking its rightful but subordinate place to his true love of plants. For this last, I think is the hallmark of the true plant propagator. He loves the plants with which he works and nothing can give him greater pleasure than to see a fine well grown batch of young healthy plants ready to leave his nursery and take their place in the adult world of landscape garden and home.

The plant propagator also acts as a very wholesome governor, so to speak, upon our daily work. With the advent of each new gimmick, or plant aid, we are usually given to understand that THIS will INDEED solve all our worries, and it is good for us to realize, through the quiet wisdom of the true plantsman that even if these new scientific aids are in themselves excellent—and I am not saying that they are not—they still are no substitute for the knowledge and skill which come only from a lifetime of living with and studying plants. It is today therefore that we see a slow transition of the old time gardener who depended mainly upon empirical knowledge and lore handed down from the dim past into the modern plant propagator, who, while still mainly relying upon his native sense of right and wrong, is able to take full advantage of modern scientific advances to increase his skills to make him into the highly trained craftsman that he is.

I would like to dwell for a moment, if I may, on this question of craft. It is well for us to consider that the craftsmanship and skill of the plant propagator is the very beginning of a long chain of events running through every phase of our industry. It is upon this skill, and upon nothing else quite so much, that all other parts of our great industry ultimately depend. Of what use would the landscape architect or the landscape constructor be to the home owner if no plants of any kind were available? Where would the florist obtain his flowers, his bulbs and seeds, and what could be the value of fertilizers, barrows, garden centers and garden magazines without plants? Webster's dictionary defines horticulture as the art of growing fruits, vegetables and ornamental plants. AND ALL OF THESE—EVERYTHING GROWING IN FACT WHICH IS COVERED BY THE TERM HORTICULTURE, HAS TO ORIGINATE WITH THE PLANT PROPAGATOR. HE IS IN VERY FACT THE BASIS OF OUR INDUSTRY.

Holding such a position as this, it says much for the character and integrity of the plant propagator that he has not wished to take advantage of the situation in any way. Many other groups of workers have though it right to hold the rest of the community or the other members of their business fraternity to ransom in what they like to call their own best interests. Without going into the pros and cons of labor relations, we can look at the record with justifiable pride, for I believe there can hardly be another section of the nation which has such a clean record. The true plantsman has little time for such "goings on." He has more important things to do and just as long as he can make a reasonable living, see that his family is well provided for, then by far the most important thing to him is his work. In this day of machines and mass production, your plant propagator is one of the last and as yet unassailed strongholds of the true craftsman and this I suggest is the pivot upon which this meeting should depend, and upon which we should base our plans for the future existence of an organization. I would interject here that anything I have to say is of course my opinion only, and I put forward my suggestions purely as a basis for discussion.

As I wrote these notes last week, and thinking on the lines of craftsmanship, I looked up what the Encyclopedia Brittanica had to say on the subject of crafts and guilds. The numerous craft guilds came slowly into being in Europe as industry developed. They were first referred to in the year 779 and by the early eight hundreds were quite general among the various industrial sections of France. From this country in the following three hundred years, the idea spread through Norway, Denmark and

Sweden, finally coming to England about the year 1000. The French of course took over England in 1066 and brought with them first-hand knowledge of the flourishing trade guilds then existing in their country and as a result the establishment of guilds in all sections of the industrial life of England then began and continued almost uninterrupted until 1835, at which time the special privileges of the guilds were formally abolished. Notwithstanding this, many of the old guilds still exist and flourish in England and on the continent, having their regular meetings and continuing their traditional practices which date back many centuries. These guilds had three very clear characteristics. The first was strong fraternal cooperation. This in fact was the prime reason for their coming into being. As trades became more organized workers in these trades recognized the benefits which would accrue from regular "get togethers" and the exchange of information on trade practices. The guilds therefore were primarily established to allow for this free exchange between members of the same trade. As they became more highly organized and as the industrial development of the country advanced they gradually took on two other functions, the first under the heading of corporate solidarity and the second Christian brotherhood. The guilds became the arbiters of conduct within the guild and set up a code of ethics and above all a standard of excellence by which a man could be judged. They established the number of years of training for an apprentice, the standard of skills required before he became a journeyman and finally a master at his trade, and in general saw to it that the high degree of integrity, craftsmanship and skill associated with their guild was maintained.

One of the questions which we are here to decide is whether we should set up an organization of plant propagators and if so what form should it take. I am keenly in favor of this being done, because I feel that nothing but good could come from this both for the individual members and for the industry as a whole. And it here of course that we immediately run into thorny problems, the most important of which is certainly "Who would be eligible for membership?" As a basis for discussion, I would like to make the following suggestions:

1. That the requirements for full membership should be stringent and should reflect an extremely high standard both of ethics, skill and experience.

2. That full membership should be preceded by a period as a noviate during which time the prospective member can have ample opportunity to demonstrate his knowledge and skill and his willingness to abide by the rules of the guild.

What then should be the requirements of full membership? I would suggest these:

1. At least 10 years active and practical experience in the art of plant propagation.

2. A high standard of integrity in the community and the trade. This should be vouched for by not less than four people of similar standing.

3. A ready willingness to freely share his knowledge and skills with other members.

It is hard to try to assess which of these three would be considered most important, but a willingness to share with others would quickly show whether knowledge and experience were there, while the very act of sharing would suggest integrity. I think, therefore, that this last should be considered of paramount importance. It is unfortunate that many growers do not subscribe to this idea of free exchange of information which they have perhaps acquired after much time, trouble and expense. There are arguments which they can put forward, based entirely upon the commercial aspects of these matters to support their views but I would strongly urge that we, as a group of craftsmen, would place ourselves above the almighty dollar, and we should take every possible precaution to see that people who are mainly concerned with what they can get out of the organization, and not one bit concerned with what they may contribute, should be rigorously excluded. We should have no time for the highly commercialized dollar grabber whose one idea is to try to steal a march on his competitors, but we should welcome with generous warmth the man who believes he knows a little and is willing to share what he knows with men of similar mind.

I would therefore suggest that any person who can satisfy the first two requirements—10 years experience, plus a high communal and trade standing vouched for by four people—should immediately be admitted to noviate membership, and that for such a person to qualify for full membership, he should produce some tangible proof of his willingness to share with his fellow members. This might take a number of forms but the most readily acceptable would probably be an address, preferably illustrated, showing results obtained from some original method or technique of plant propagation. This might be presented to a meeting such as this—and if we organize, I would hope that we would be able to have at least an annual meeting for the express purpose of hearing such addresses—or it might be presented to different chapters if they finally come into being. Each address should be carefully considered by a committee set up for this purpose and if (and only if) the information given is of sufficient merit, then the person should receive the privilege of full membership in the Plant Propagators Guild. Full membership should be an honor and a prize which has to be won, not handed out on a platter. Full membership in the plant propagators guild should stamp its recipient as a master craftsman in his trade, as a man of unusual ability, integrity and skill, and who has demonstrated for all to see that he is more concerned with the long term advancement of the horticultural industry than with the short term commercial advantages that might perhaps accrue from the close guarding of the knowledge he may have.

To recapitulate—I would like to suggest that before we leave Cleveland, we bring into being a Guild of Plant Propagators. Our charter should have as its three foundation stones those which have stood the test of the centuries in similar organizations in Europe.

1. Strong fraternal co-operation for the good of all
2. Corporative solidarity
3. Christian brotherhood.

and with these ideas in mind, we should set up an organization having as its goal the establishment of the plant propagator as a recognized craftsman in this industry and the free dissemination of knowledge through proper channels to the final benefit of all.

Now I realize that these ideas are controversial and shortly we shall have an opportunity of airing our opinions. But no one has any use for a person who preaches one thing and does another, so I have brought along a few slides to illustrate one phase of our work on propagation which occupied much of my time for the past four years, and which I would like now to show to you. They deal exclusively with the propagation of hybrid Rhododendrons from stem cuttings and I will briefly run through them making a few comments as we go along.

Propagating Rhododendrons From Stem Cuttings

In tackling the many problems which had to be dealt with, we concentrated on one variety, Rhododendron Roseum Flegans. This is one of the most easily rooted of the varieties which we normally grow. Using this variety we commenced a series of experiments which began to show us what Rhododendrons need in order to root and from this base we have worked out into other and more difficult varieties until now we are rooting fair quantities of quite a number including many of the so-called "red flowering" types.

We have found that 12 different factors closely affect the results obtained and in order to achieve good results, it is necessary to know just how to balance these factors for each of the varieties concerned.

TIMING—This is one of the most important single factors. We have found that the difference in percentage of rooting can be as much as 50% with only two weeks difference in the date of taking the cuttings. For instance, Ignatius Sargent taken on August 16th gave 36% rooting while the cuttings taken from the same plants on Sept. 5th gave 74% under identical conditions of treatment. Similar critical timing has come out in many other varieties and under our conditions here in southern New Jersey, we have found that the period from mid August to the end of September is the best.

TYPE OF CUTTING—Thin cuttings taken from side growths have given consistently higher percentages of rooting. Strong vigorous terminal growths are the worst. Similarly cuttings taken from the underside of large trees have rooted very much more readily than cuttings taken from the vigorous growing top growths.

MAKING THE CUTTINGS—We gather cuttings early in the morning when the plant material is fully turgid. We immediately place it in a cool cellar and damp it down to keep it cool and moist while the cuttings are prepared. We have found that short cuttings of 3-4" in length root more readily than longer ones. If long ones are made and inserted they tend to root half-way up the stem at a point closer to the surface of the rooting medium and the insertion of the long stem seems only to delay the rooting process. There seems to be no obvious ease in keeping a heel on the base of the cutting. We have obtaind just as good rsults with or without a heel. The leaves on the individual cutting are reduced to a maximum of four unless they are rather small when perhaps five or six may be kept. No leaves are helfed as is sometimes produced. We retain leaves untouched or remove them entirely.

WOUNDING—This is the second very important procedure which we practice. I do not say that Rhododendron cuttings cannot be rooted without wounding but we have proved time and again that by carrying out this procedure we greatly increase the speed and total percentage of plants rooted. The cutting is prepared in the normal way, excessive leaves removed, the base of the stem is trimmed to the desired length and then using a sharp knife a thin slice is removed from the base of the cutting for a distance of about 1½. This slice cuts through the outer corticle tissue and exposes the cambium layer beneath. We believe it best not to cut right through the cambium laver if it is possible to gauge the cut this accurately but when unskilled people are operating on large quantities, every variation can be found. The actual depth of the wound, as long as it does not cut the stem in half, seems to be not too critical. We have found some variations respond even better to a double wound of this kind whereby a similar slice is removed from the other side of the stem leaving two small sections between the cuttings intact.

HORMONE TREATMENTS—There are growers who say that there are no results obtained by the use of hormones which the skilled propagator cannot develop without them. This is an argument to which we do not subscribe. We believe that used intelligently the plant hormones have a most definite place in modern plant propagation and we use them extensively. For our easily rooted varieties we use a powder containing 6 mg/g of indole utyric acid. This is the strongest commercially available powder in this country. This strength suits admirably the variety Roseum Flegans. However the results of our tests seem to show that many of the varieties of Rhododendrons would respond to very much more stronger treatments. For instance, the variety Dr. Dresselhuys was hardly effected by treatments with this powder. We therefore purchased some indolebutyric acid and mixed our own powder at a strength which would be 20 mg/g and this greatly increased the number of varieties which were successfully rooted. Cynthia gave 15% rooted with the weaker powder but 83% rooted with the stronger one. Many varieties require much stronger hormone treatments in order to be stimulated into the production of roots.

Even although we were using these stronger powders which for all normal plants would be quite lethal, some of the extremely difficult red-flowering varieties still resisted our efforts and remain untouched by these stronger powders. This last year, therefore, we have tested some powders which are 12 times as strong as the strongest one we had used to date. We have obtained some clear-cut results which seem to show that our arguments were right. They are however on only small test quantities and these results have to be interpreted this year in a commercial way to establish their true value.

MEDIUMS—We have tested a number of different rooting mediums, including vermicolite, but we prefer a mixture of about 90% acid type or German type peat and 10% clean, sharp sand.

INSERTING THE CUTTINGS—We insert the cuttings fairly close together in the benches so that the leaves support each other in an upright position. It is important not to insert the cuttings too deeply. Nothing is gained thereby because roots are only produced higher up the stem close to the surface. We have the cuttings so that if it is 3-4″ long we insert about 2-2½″ in the rooting medium. All leaves should of course be clear of the bench.

BOTTOM HEAT—We maintain a steady bottom heat of about 70°-75°. Cuttings taken in August will respond to a very high temperature but if they have not rooted in three months then they are more likely to do so if the bottom temperature is dropped to 60°

HUMIDIFICATION—This is the third point which we have found to be of extreme value in the rooting of Rhododendrons. For the past two seasons we have maintained our propagating houses close to 100% as possible. This has made a marked difference in the percentages rooted. I would quote one example. On the variety American, cuttings taken without humidification gave use 6% rooted while cuttings taken from humidification gave 80% rooted. All other factors were similar. This is a somewhat extreme example but the trend is consistent throughout.

AIR TEMPERATURE—As cuttings are taken in August and September when we normally experience very hot weather, the air temperature in the greenhouses even under the fog system can go above 100 which is definitely detrimental. We try to keep the air temperature at a maximum of 85 by running cold water down the outside of the greenhouses and maintaining the fog system running through the day inside. Light shading may be necessary in excessively hot weather.

LIGHT—The question of shading brings up the matter of light intensity in the propagating houses. We believe that this has a very definite bearing upon the results obtained and we try to keep the maximum light intensity comparable with the proper control of air temperature. Humidification, air, temperature and light are all inter-connected and all require very careful watching to maintain a proper balance.

ROOTING—Under the conditions described above, the cuttings will rapidly form a bed of callus and will then apparently remain dormant for some time. They may rest in the bench for 8-10 weeks with little activity and then suddenly they will commence to root. It is necessary to be very careful in the handling of the rooting cuttings because in many instances the roots are lightly attached to the stem of this stage and break off very easily.

RESTICKING UNROOTED CUTTINGS—Cuttings which are otherwise healthy but which have not rooted or which have one or two roots just commencing should be restuck into the bench. This is particularly true of the red-flowering varieties and slower rooting types which sometimes require as long as six months to produce a proper bell of roots. Speed of rooting will vary according to varieties and those which are slow must be treated with patience.

POTTING—The cuttings are immediately potted into 3″ pots into a suitable acid and peatty pot mixture and returned to the houses from whence they have just come. The object of this is to keep them in a similar atmosphere and to encourage them to produce a sturdy pot ball of roots before being taken from the greenhouse and placed in frames for wintering. Once firmly established in the pots, the plants can be taken out and plunged in frames in a bed of peat so that the top of the pot is covered and they will come through the winter with no difficulty whatsoever.

These plants set out early in the spring will develop into strong 10-12″ plants in the first season.

Chairman Scanlon: Thank you Jim that was to the point and should certainly give us plenty of ideas to digest.

Considerable discussion ensued on the formation of a permanent Society. Finally the chair appointed a committee on organization to draft a constitution. The first meeting of the committee was set for the evening after dinner.

Chairman Scanlon: The next speaker unfortunately could not be with us. Forrest Strong is one of our good friends and we are all sorry he could not make it. His paper will be read by Dr. Roger U. Swingle. Thank you Roger.

Problems in the Control of Damping-Off

FORREST C. STRONG

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Damping-off of seedlings is a disease problem which confronts every grower of plants: ornamentals, field crops, vegetable crops, and forest and shade trees. Damping-off is of especial importance when seedlings are grown closely together and in great numbers as is done whenever transplanting of the seedlings is practiced. This applies to the growing of forest and shade trees.

In the case of herbaceous plants such as flowers and vegetables, the disinfection of the soil in flats by steaming or by application of fungicides to the soil surface has proved quite satisfactory in reducing losses by this disease. For the forest tree nurseryman who has large areas of outdoor seed beds with a dense population of seedlings, losses often run very high and suitable control measures are difficult to manipulate.

CAUSE OF DAMPING-OFF AND SYMPTOMS

This disease is caused by several fungi which live and grow in the soil. For the most part they belong to the genera Pythium, Phytophthora, Fusarium and Rhizoctonia. Some or all of them are usually present in the nursery. These fungi are capable of feeding on the humus materials in the soil without the presence of living plant roots or stems. However if seedling plants are present, they will attack and rot the succulent living tissues of the stem and roots. The typical condition from which the name "damping-off" is derived, is the invasion and killing of the seedling stem tissues, near or at the soil surface. The infected tissues are rotted and the seedling drops over and lies on the soil surface. Since this disease occurs most abundantly during periods of wet weather, the descriptive name "damping-off" is very appropriate.

In a few weeks after the seedlings emerge, the stem tissues become more strong and rigid and plants are less susceptible to rotting of the above ground parts. However, the roots may be killed and rotted by these fungi. This phase of the disease is recognized as root rot.

These described forms of injury by parasitic soil inhabiting fungi are called post-emergence damping-off. These same organisms very often attack the young seedling as soon as it starts to germinate and before it emerges above the soil surface. Pre-emergence damping-off is usually not recognized and the reduced numbers of emerging seedlings is attributed to poor viability and germinibility of the seed.

In some cases such as with the Rhizoctonia fungi, the roots may be attacked after the stems become rigid and not subject to invasion. This is true of conifer seedlings whose roots may be rotted with resultant death of the plants even into the second year of growth.

CONDITIONS FAVORING THE DISEASE

The more humus material present in the soil, the more favorable it is for the fungi as more food is available. Hence muck soils are not suitable for seed beds. On the other hand sand usually supports few fungi and is often useful as cover for the seed bed. The water holding capacity of a soil high in humus is also favorable for the development of damping-off while sand affords good drainage. Probably the best medium for the seed bed is a mixture of sand and loam.

The acidity of the seed bed bears some relation to the fungi which will be present in it. An acid soil favors the development of Rhizoctonia, while a neutral or alkaline soil favors Pythium. In general it is considered that a soil which is quite acid favors growth of conifer seedlings while inhibiting most of the damping-off fungi.

A heavy clay soil can be improved by mixing into it a finely ground peat. The amount depends on the acidity of the original clay soil, and of the peat used. The peat will improve the friability of the clay and will change it from a tight, easily water-logged soil, to one affording good water drainage between the soil particles.

The various species of fungi causing damping-off have different requirements for their growth. For example Rhizoctonia grows best in drier soils and at high soil temperatures, while Pythium grows best in wet soils and at low temperatures. The variability of growth habits of these fungi makes the problem of control difficult. One species of fungus may be predominant in the soil one year while another species may predominate in another year. These features account for the good control one year with a given fungicide and poor or no control in other years with the same fungicide.

CONTROL OF DAMPING-OFF

Now that we have seen some of the factors favoring this disease it is obvious that the first control is to provide a well drained seed bed, and avoid over crowding and over watering.

Then comes the problem of combatting the damping-off fungi themselves.

Sterilization with Steam

Various methods of sterilizing the soil are available. One of the best soil sterilization methods is steaming. It is not possible from an economic standpoint to treat large areas. The use of an inverted pan and a mobile steam generator will kill not only all fungi but also nematodes and some of the insects. It will not kill white grubs unless a long steaming for deep sterilization is practiced. Such deep steaming of the soil is not easily done with the inverted pan.

Steaming of the soil should be done about two weeks prior to sowing to permit the nitrifying bacteria to reestablish themselves. Recontamination of steamed soil by tools and other implements should be guarded against since damping-off fungi, if carelessly brought into sterile soil will increase with great rapidity in the absence of other soil flora, and loss of seedlings will be greater than if the soil had not been steamed.

A poor or incomplete job of soil sterilization by steam is for the same reason worse than no sterilization.

Use of Chemical Fungicides

The use of fungicidal chemicals has been practiced for many years. These chemicals are sprinkled or dusted on the surface of the soil, either at the time of sowing or at intervals until the seedlings are a month to six weeks old. Some chemicals are mixed into the soil before sowing of the seed. The practice of seed dusting has been tried but with indifferent success, although this method is very successful for the prevention of damping-off in vegetable and flower seedlings.

Sulphuric Acid

This chemical has been used for years in the treatment of conifer tree seed beds. It cannot be used for broad-leafed trees. In sandy soils low in humus content, it has been effective in preventing damping-off.

It is applied immediately after the sowing of the seed. Usually a 2% solution is made up and applied at the rate of ½ pint of the dilution per square foot.

Sulphuric acid is very corrosive to metals, burns severely when in contact with the skin, and eats holes wherever drops splash on clothing and other cloth.

Formaldehyde

Formaldehyde has been used with success on small areas of seed beds. The chemical is applied at the rate of ¼ to 1¼ fluid ounces per square foot. Dilution with water, varying with the dryness of the soil, will permit of even distribution. The treated soil is immediately covered with tight woven or waterproof canvas. After 24 hours the canvas is removed and the soil allowed to aerate for at least five days. If the soil is wet and cold it must be allowed to aerate for at least 10 days before the seed are sowed. The chief drawbacks to this type of treatment are: the need for lots of canvas; the delay between treatment and sowing; and the poor penetration of the formalin gas into wet cold soils.

Other Chemicals

Other chemicals have been used and found to be effective in some nurseries in some years and deserve consideration.

Aluminum sulphate, iron sulphate, acetic acid and similar chemicals applied primarily to increase the acidity of the soil have reduced the incidence of damping-off markedly in many instances.

In the past few years some of the more recently developed chemical fungicides have been tested. Metallic compounds of copper, mercury, zinc and others, also organic compounds containing these metals, as well as dinitro phenols, quarternary ammonium and other organic compounds have been tried. These materials include calomel, zinc oxide, copper carbonate, and proprietary materials such as Cuprocide, Semesan, Ceresan, Tersan, Crag 658, and many others.

One of the most promising of these materials is Thiram, tetromethyl thiuramdisulphide, earlier known as Tersan or Tuads. This material applied and worked into the soil a few days before sowing has been consistent in reducing damping-off as compared with untreated beds. It is quite effective when used at the rate of 150 pounds per acre. This amounts to .05 ounce or 1.5 grams per square foot. This fungicide is mixed into the top 4 inches of the soil. About 3 days should elapse before sowing the seed. Pre-emergence damping-off is reduced and the percentage of emerging seedlings often runs higher than the average germination per cent of the seed used.

Others which appear to give good control of damping-off in many cases are Crag 658, and a mixture of New Improved Ceresan with Potassium Iodide. Some fungicides still under the experimental numbers given by the companies making them, show promise, but need further testing.

Seed Dusting

Many of these same chemicals have been used to dust the seed prior to sowing. At the present time consistently good control has not been obtained where the seed was sowed in soil highly contaminated with the damping-off fungi. It is hoped that some of the difficulties such as obtaining good adhesion of the chemical to the surface of the seed coat, avoiding injury to the germinating seedlings by the chemical, and obtaining longer duration of protection by the chemical can be overcome.

Surface Application After Sowing

Sprinkling the seed bed with fungicidal chemicals after sowing and at intervals until a few weeks after emergence has shown considerable promise. Some reports indicate very good control of damping-off. However where careful observations and counts in comparison with untreated plots have been made, some chemicals reported to be very good, have not given appreciable reduction of damping-off.

From such work as has been done, it appears that there may be chemicals which if applied at the right time and in suitable amounts will prove effective. Of all the methods of applying the fungicide this seems to be the best from several standpoints, such as avoiding the lapse of time between application of the chemical and the sowing of the seed, the mechanical difficulties of sowing dusted seed, and the possibility of modifying the times of application and the amounts of chemical dependent upon the weather conditions of the particular season.

OTHER CAUSES OF FAILURE OR DEATH OF SEEDLINGS

Beside the damping-off of seedlings by fungi there are several other causes of the failure of tree seedlings. Drought injury may occur at any time during the growing season. It is especially common during periods of hot weather or windy days. It can happen within a matter of hours. The central parts of seed beds are vulnerable because of the root competition for the soil water.

In light soils during sunny days and high temperature, heat injury may take place on the young stems because of the soil surface reflected heat added to the heat of the direct rays of the sun.

Nutrient deficiencies leading to chlorosis, the yellowing of the seedling, stunted growth and even death by starvation also may occur to confuse the picture of the actual losses by damping-off.

Water-logged soils may in themselves cause suffocation of the roots with resultant death of the seedlings.

Birds scratching up the seed and various kinds of insect injuries, grubs for example, take a great toll in the seed beds.

CONCLUSION

In conclusion it is apparent that prevention of damping-off of tree seedlings is most dependent on a suitable nursery site, soils free of, or unfavorable for the development of damping-off fungi, and on good nursery practices of handling the seed beds during the critical periods when the seedlings are susceptible.

The use of suitable fungicides mixed into the soil prior to sowing has been most effective in the control of damping-off of seedlings. If sprinkling of the seed beds is to be practiced, applications of the fungicide must be made immediately after sowing and continued at intervals until the seedlings are from 4 to 6 weeks old.

At this time, dusting of tree seeds with a fungicide has not proved consistently good enough to warrant recommendation.

It is possible that a combination of soil treatment prior to sowing, followed by surface applications, may be developed that will prevent damping-off to a satisfactory degree even in the most stubborn cases.

A FEW IMPORTANT REFERENCES ON DAMPING-OFF OF TREE SEEDLINGS

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The discussion following Professor Strong's paper had to be cut off by the chairman after an hour.

Chairman Scanlon: I have some slides of Shade Tree Selections that I should like to show—we will then adjourn for lunch.

Some Tree Selections for Street and Ornamental Purposes

By EDWARD H. SCANLON, Editor "TREES" Magazine—

Commissioner, Division of Shade Trees, Cleveland, Ohio

The history of shade tree husbandry is not an inspiring one. The history of shade tree use is far less inspiring. Thru the past century, and particularly in the last fifty years there has been a tremendous increase of interest in street and ornamental trees, but efforts to improve the more common species by worthwhile selections, and even the introduction to the people of the many splendid exotic species that are available, have been woefully inadequate.

The results of this lassitude generally is reflected in poor plantings with inept trees. Most American cities are now plagued with an over planting of forest giants on narrow city streets. Most homes on conventional size properties are overplanted with the same giants that soon outgrow the available space and have become a menace to life, property and plumbing. That a determined effort on the part of nurserymen and arborist to correct these faults is needed goes without saying. We must get out of the dark ages of ornamental tree culture and make an effort to catch up to the atomic age. It is a long pull but not an impossible or too difficult one to negotiate.

Several years ago the National Shade Tree Conference recognized the need for a program to institute some activity in this completely dormant field. A Shade Tree Selection Committee was established and has compiled some worthwhile case histories on a number of splendid variations. About five years ago the Division of Shade Trees of the City of Cleveland inaugurated a revolutionary program of street tree planting and selection. In this planting program over fifty species and varieties have been placed on city streets. At the same time about twelve selections have been made. These selections have been within the better known species such as the Norway, Red and Sugar maple and Ginkgo. The reasoning in this procedure was that the behaviour of these species was well known because of many years of trial and error use and therefore if we could find improved forms, uprights, globes, etc., we would have the problem whipped except for the actual propagation of the selection. This latter phase of the work is progressing quite satisfactorily; in fact the first planting, that of a selection we call the Cleveland Maple (Norway), will be made in the fall of 1952.

The need for such development of numerous forms and variations and the greatly extended use of the number of species for use on city streets, and small homes as well, stems from the great number of expensive and irritating abuses that have arisen from the indiscriminate use, or overuse, of five or six fast growing species that attain great size.

Sober evaluation of the street tree problem indicates that we can no longer do the job effectively, without a careful evaluation of the space factors of the street to be planted. These factors are: width of planting space; width of street; setback of houses; presence of overhead wires, and street lights, and of course, soil. Once these factors are known a tree can then be selected to fit the ground, lateral and aerial space available with the least amount of conflict. When we begin to plan streets on this basis, and have the trees available from which to choose a suitable one, then and only then will street tree management attain the stature in horticulture and city planning that it so richly deserves because of its tremendous potential for stabilizing property values and generally engendering a sense of beauty, orderliness and comfort to the residents of the street, neighborhood and city.

A few of these selections are shown here:

The "Almira" Maple

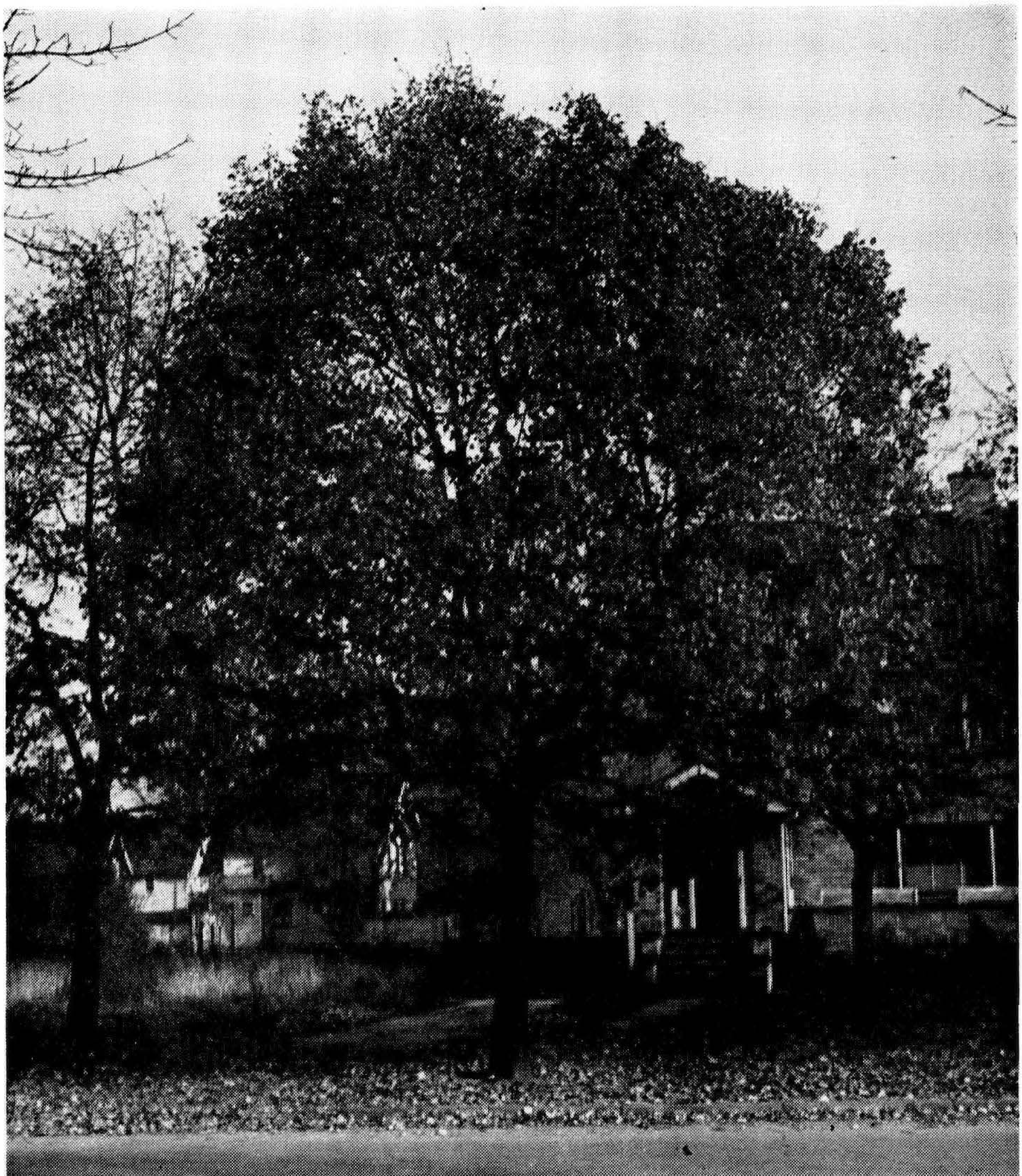
A true dwarf, this highly functional form of Norway maple (A. platanoides) should become an extremely popular tree with street tree planters. It will fit under low wires; in narrow "treelawns" to three feet, and with shallow setbacks. A fine selection for the new trend toward street trees that fit the space available.

The word "treelawn" refers to the space between sidewalk and curb where street trees are usually planted.

The "Cleveland" Maple

This outstanding Norway maple (Acer platanoides) selection is an extremely handsome tree, oval upright in form. It is selected for use on streets with shallow setback and planting space of four feet minimum. Not recommended under wires less than 50 feet high.

The "Charles F. Irish" Maple



Another shapely Norway maple (A. platanoides) selection. This tree is more globular in form than the "Cleveland" maple, but is not a globe. It will also become larger. Recommended on streets with normal residential setback of at least 20 feet and "treelawn" of no less than five feet. Not under wires.

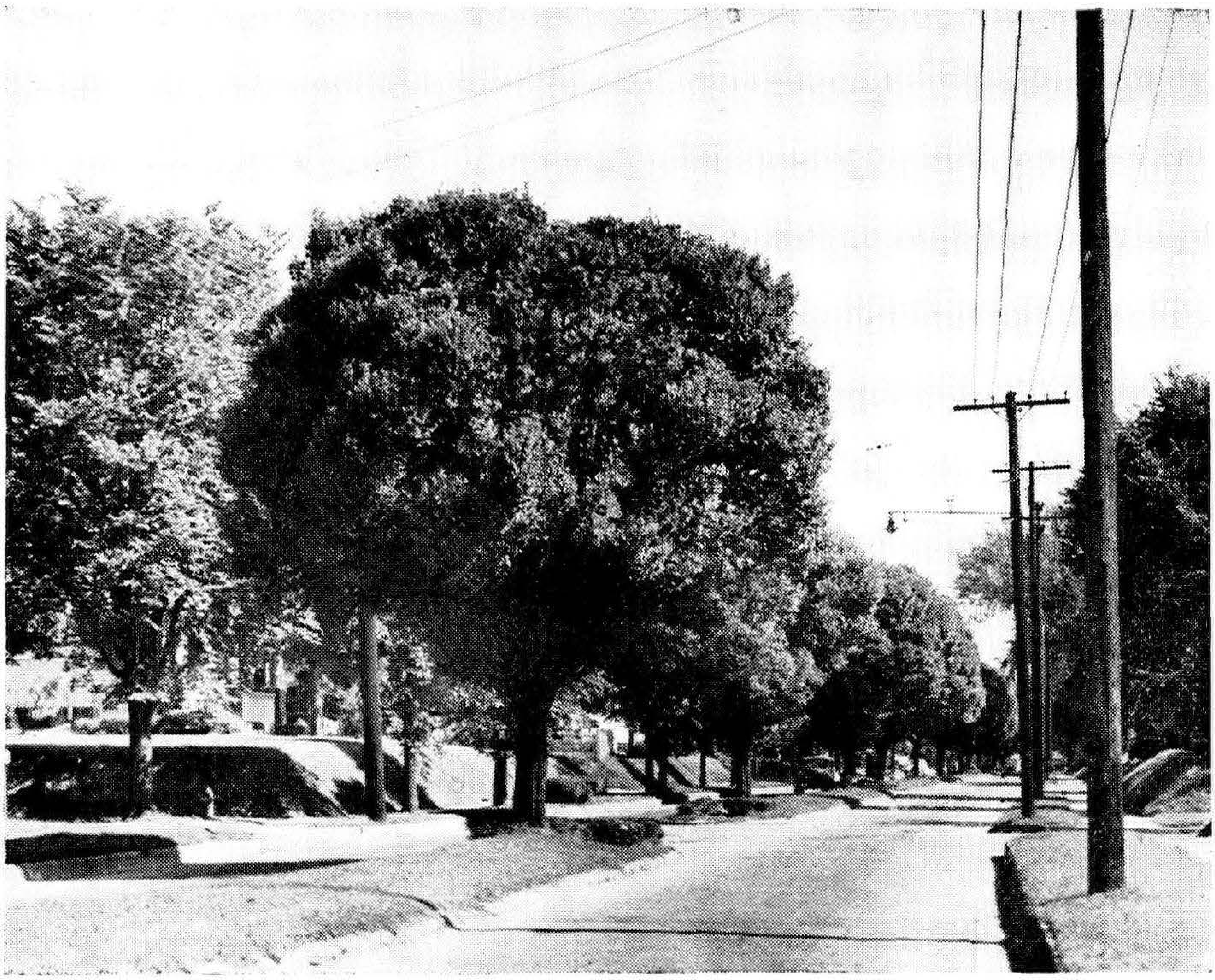
The Cherrybark Maple

For sheer beauty and outstandingly unusual characteristics this tree (Acer griseum) is a masterpiece. Its peeling cherry red bark, trifoliate foliage that turns a brilliant red in the fall; its 25-foot ultimate height and its magnificence in winter, no tree can come close to this Asiatic maple. It is difficult to grow but we are sure continued effort will solve some of the drawbacks. A splendid small street tree and home ornamental.

Improved Sugar Maple

We like this form of Sugar maple (Acer saccharum) better than any upright form we have observed. It is broader in outline and the crown is not so compact. An ideal street and ornamental where an upright is needed.

The Globe-head Elm



As a functional street tree we consider this variety of the European Smoothleaf elm (Ulmus carpinifolia umbraculifera) as unsurpassed. This picture is taken of a 35-year-old planting in Moline, Illinois. We have one outstanding street planting of this beautiful tree in Cleveland that is now four years old and already is eliciting much admiration from the public. One of the standout features of this tree is its low maintenance cost. Useful on five-foot treelawns and 20' to 25' setbacks—can be used under some wire conditions

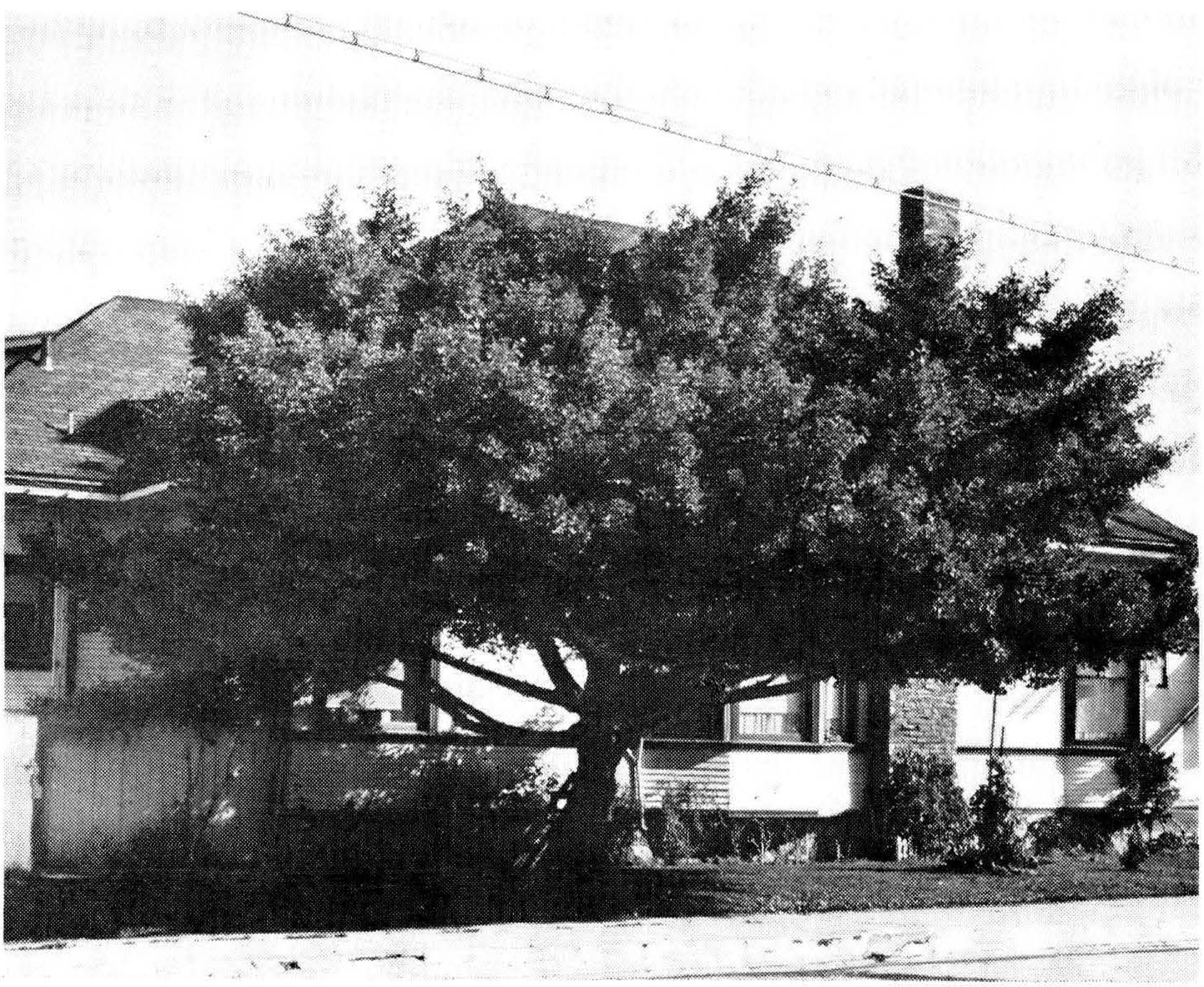
Pyramidal Ginkgo

This pyramidal tree, (G. biloba) a male, should be an excellent selection for narrow treelawns and shallow setbacks.

The "Mayfield" Ginkgo

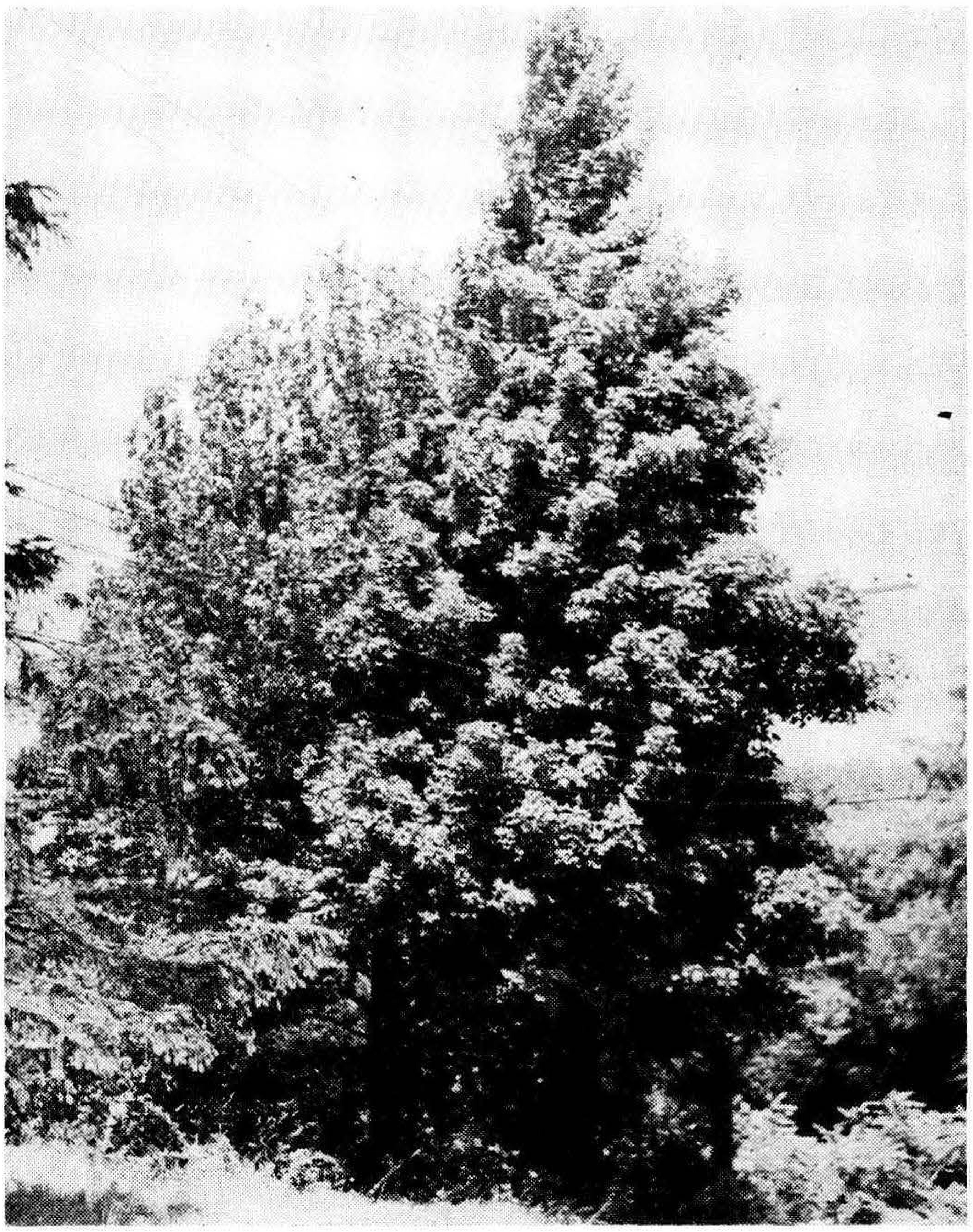
Most upright forms of Ginkgo (G. biloba) are pyramidal but this very narrow tree is strictly fastigiate and "Lombardy-like" in outline. This is a male tree and should be another fine tree to replace the disease ridden upright Poplars.

Umbrella Ginkgo



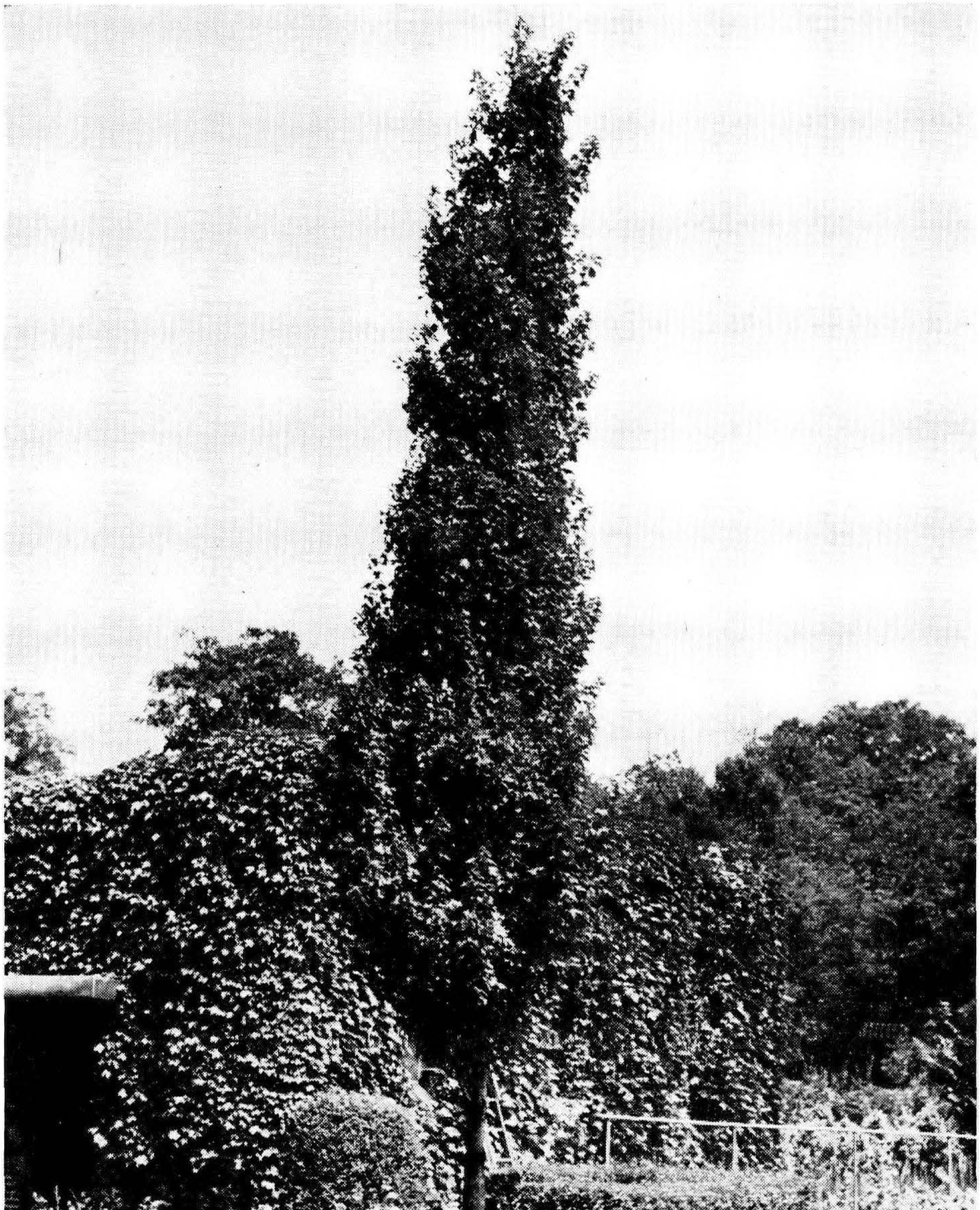
A radical departure from the preceding tree this male umbrella shaped Ginko (G. biloba) should make a fine street tree. The Ginkgo is extremely tolerant of adverse growing conditions and its record as a street tree in all parts of the country is excellent.

The "Bowhall" Red Maple



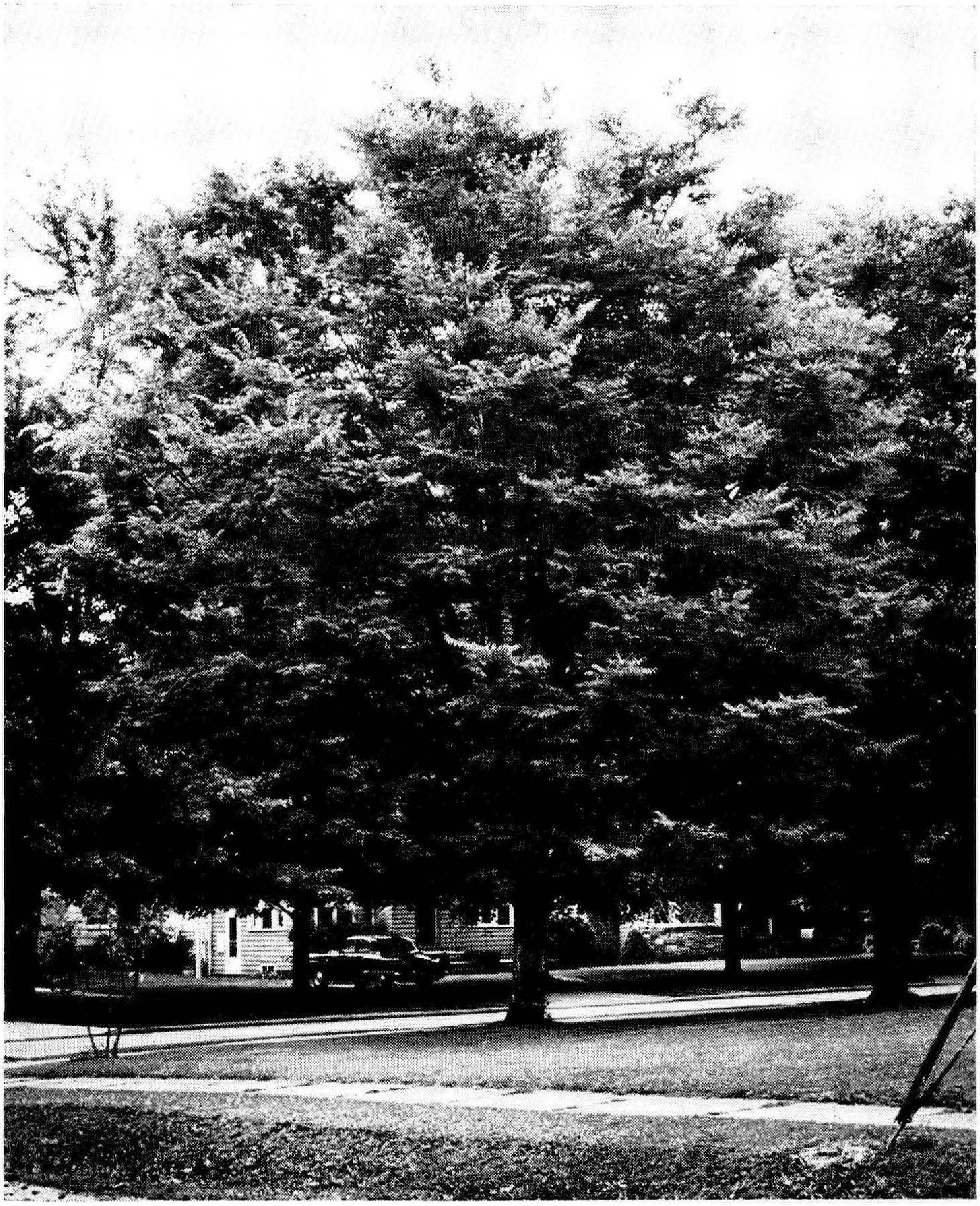
Here is one of the handsomest trees we have ever seen. The tree (Acer rubrum) is a beautiful pyramidal form with a fine compact beautiful crown. As a street and ornamental tree this selection should be unsurpassed.

The "Armstrong" Maple



Another upright red maple selection (Acer rubrum) only this, unlike the "Bowhall," is fastigiate or "Lombardy-like" and has aroused considerable comment as a substitute for the seemingly condemned upright Poplars.

The Japanese Keaki Tree



Why his magnificent member of the elm family (Zelkova serrata) has not been used widely and often is a complete mystery to all who know its charm. In addition to its graceful fountain shape, beechlike bark and slight reddish fall coloration, it is resistant to Dutch elm disease. Recommended for wide streets with at least six foot treelawn—no wires. Also a perfect shade tree for home grounds. A perfect substitute for the American elm.

Chairman Scanlon: This afternoon we have a paper that should generate considerably thought and discussion. I am pleased to present our good friend Steve O'Rourke of Michigan State College.

The Effect of Juvenility on Plant Propagation

By F. L. O'Rourke
Michigan State College

Practical plant propagators have long known that cuttings taken from young seedling plants root much more readily than cuttings from mature plants of the same species. Goebel (11), in 1900 mentioned this relative ease of propagation in younger individuals and established the term "juvenility" to describe the physiological condition involved. Juvenility may or may not be accompanied by morphologcial differences from the mature individual, such as different leaf shapes, thorniness, or other growth characteristics. In many species, however, the superficial appearance of the seedling plant is somewhat different from the mature individual. Ashby (1) reports that Krenke used the leaf shape of the sugar beet leaf to determine the amount of sugar to be found in the roots at that time. Certain characters of the leaf changed gradually over a period of time as the plant progressed from a young seedling toward maturity. Krenke as well as many others (8, 17, 19, 20) indicated that the juvenile characteristics were associated with the *physiological* age of the individual plant rather than the *chronological* or *time* age, as various plant individuals progress at different rates toward maturity, depending upon both their genetic constitution and their varied response to environmental influences. Whyte (20) quotes Lysenko as distinguishing between growth and development in plants. Growth may proceed with little or no development toward the mature or reproductive stage, and under certain conditions the reverse may be true. In like manner the external appearance of the plant may indicate certain internal conditions, but will vary with the species and the environment.

Seedling Age And The Rooting of Cuttings

Gardner (9) in 1929 reported the chance discovery of the ease on rooting of cuttings taken from apple trees in their first season of growth, and further comparisons made with older trees of apple and many other woody plant species. With most fruit tree species, cuttings from one-year seedlings rooted well, from two-year old plants only fair, and practically not at all during the third year or thereafter. Evergreens and shade trees retained the rooting ability of their cuttings for a longer period but in all cases there was a sharp drop in the third year of seedling growth. This investigator also noted that not only were a greater number of cuttings rooted from younger plants but that the time required for root production was much shorter. He tested cuttings taken from one-year budlings of apple with negative results. He then tried treating cuttings from older trees with seed extracts, but without success as far as rooting was concerned. Gardner then cut one-year apple seedlings back to the ground and noted that the sprouts arising the second year furnished cuttings which could be rooted "and in some cases even more readily than that of the first year."

Stoutemyer (17) reported in 1937 that cuttings taken from watersprouts of apple failed to root. Seven-year old seedlings and one-year old seedlings of crabapple were cut back to the ground. Cuttings taken from the resulting sprouts the next season rooted well. Stoutemyer considered these shoots intermediate between the juvenile and mature growth phase.

Stoutemyer observed that shoots arose from scion roots of 17 years old clonal Virginia Crab trees left in the orchard after the trees had been dug out. Cuttings taken from these shoots rooted well and showed the characteristic thin and smooth leaf form of the juvenile phase of growth. These shoots arose from adventitious buds which formed in the secondary cortex of the roots.

Gardner (10) reported a reversion to the juvenile type of leaf form in *Juniperus horizontalis* and noted that such branches "struck root more freely where they came into contact with the soil than had branches of the normal form with adult foliage."

Thimann and DeLisle (19) tested cuttings from one-, two-and three-year and older seedlings of pine, spruce, maple, ash, and oak. The per cent of successful rooting was in descending order with increased age of the tree.

Deuber (4) compared cuttings taken from Norway spruce 5, 26, and 40 years of age. The greater degree of rooting was generally in favor of the younger trees but fair success was obtained in all age classes. He also tested cuttings from white pine ranging from 2 to 60 years old. Rooting was good in the earlier years but dropped sharply between the fifth and seventh seedling years. Hemlock cuttings rooted well from 4 year old trees but only poorly from trees 20 years of age.

The Seat of Juvenility

It has been reported (9, 17) that when young seedling trees are cut to the ground cuttings from the resulting shoots root as well or better than cuttings from one-year seedlings. It has also been indicated (17) that the leaves on shoots arising from adventitious buds in the roots of apple show pronounced juvenile characters and that cuttings from such shoots root well.

Stewart (16) has shown that when a root of *Acanthus* is cut into pieces the appearance of the leaves arising from the root apex show the juvenile growth form, while those from portions of root farther back have a more mature appearance. The same juvenile characters in the leaves are shown from the growth of axillary buds on internodal stem cuttings taken near the base of the plant, while terminal cuttings continue to exhibit the adult foliage conditions.

Several investigators have found that cuttings taken from the lower portion of a tree root better than those taken from the upper part. Grace (12) took cuttings from the upper third and the lower third of an 18 year old Norway spruce tree. Ten weeks after setting in the greenhouse bench, 43 per cent of the upper and 73 per cent of the lower cuttings were rooted. After nineteen weeks in the bench, 48 per cent of the upper and 86 per cent of the lower cuttings were rooted. The cuttings from the lower portion of the tree also had longer roots and greater root masses.

Doran, Holdsworth, and Rhodes (5) compared cuttings taken from the upper third and the lower third of white pine trees. In one instance 70 per cent rooting was obtained with cuttings from the lower third while those from the upper third did not root at all. Another tree showed 20 per cent rooting from the upper and 10 per cent from the lower portion.

Edgerton (6) used cuttings taken from the upper half and lower half of 10 to 20 feet high red maple trees. The same number of cuttings were used for each individual clone. Those from the lower branches of male trees averaged 49 per cent successful rooting and those from the upper branches 27 per-cent. Cuttings from female trees averaged 30 per cent rooting for lower branches and 21 per cent for upper branches.

Thimann and DeLisle (19) reported a greater degree of rooting from cuttings taken from lateral branches than from terminal shoots of white pine and Norway spruce, and a much higher per cent from cuttings near the basal parts of red oak and Norway maple than from either terminal or lateral branches of the same trees.

Stoutemyer, O'Rourke, and Steiner (18) compared softward cuttings taken from stump sprouts of honey locust as against comparable material on lateral and terminal branches and found that the former rooted well and the latter very poorly or not at all.

Juvenility and Thorniness

Frost (7, 8) reported that citrus seedlings, prdouced either by gametic or apogamic means, are thorny in their earlier life but as they mature, the shoots upward and outward from the trunk gradually lose the thorny condition. He also reported that the thorny or thornless condition could be transmitted by budding, depending upon the portion of the shoot from which the bud is taken. This same phenomenon was reported by Chase (2) with honey locust. Desirable clones of honey locust with thorny trunks were propagated to thornless individuals by selecting buds and scions from the thornless portions of upward and outward growing shoots. These clones have remained thornless ever after and also their progeny during successive and repeated buddings.

Stoutemyer, O'Rourke, and Steiner (18) showed that unselected thorny clones of honey locust could be propagated to a practical degree by the use of either dormant stem or root cuttings. O'Rourke (14), however indicated that the thornless clones Millwood and Calhoun could only be propagated by hardwood stem cuttings with the greatest difficulty and that all attempts to propagate these clones by root cuttings resulted in absolute failures. He assumed that the thorny condition of honey locust was associated with the juvenile growth phase with the related ease of propagation while the thornless condition denoted the mature state and the inability to regenerate roots and/or shoots from cuttings.

Rejuvenation by Nucellar Embryony

In *Citrus*, and to a slight degree in *Malus* and some other plant species, seedlings may be produced from embryos which arise entirely from the maternal nucellar tissue surrounding the embryo sac, and subsequently develop within the embryo in the normal way to produce viable seed. The resulting seedlings will therefore be of exactly the same genetic constitution as the seed parent and may be considered clonal since they have been produced by asexual means. Frost (8) and Hodgson and Cameron (13) have reported that such "young clones" produced by apogamy are more juvenile in appearance and characteristics than the "old clones" from which they arose. Buds taken from seedling "new clones" produce more vigorous trees which come into fruiting later than those grown from buds taken from "old clones" of the same variety. The time of fruiting of any clone is apparently associated with the mature growth phase, and as Spinks (15) has pointed out, it cannot be hastened to any degree by treatments and environmental influences. The ease of production of vegetative individuals of uniform genetic constitution and of high vigor has been hailed by Cook (3) as an opportunity for a new field of research in plant science.

Discussion

The evidence is quite clear that plants in their younger stages may express different morphological appearances in certain characters and usually root from cuttings more easily than plants in a mature or senescent condition. The progress of aging is quite closely associated with development but not necessarily with growth. The changes which take place are internal ones although there may be associated external expressions. The process is purely physiological and should not be viewed from a chronological or time age standpoint.

The implications in the field of plant propagation are more reaching than with the use of cuttings alone. Most experienced nurserymen know that it is necessary to use the roots of rather young seedlings in order to secure a good percentage of graft unions with many plant species. The same principle applies to the use of rootstocks to be used for budding purposes. It is quite common to see roots emerging from soil-touching branches of many young shrubs, while those from older plants do not layer so easily and abundantly except where the branch may arise at or below ground level.

The seat of juvenility or that portion of the plant where the juvenile influence remains longest and exerts its greatest influence is at or just below ground level and probably extends well into the lateral roots. The so-called "reversion to juvenility" is evidenced by leaf characters and rooting ability of shoots of adventitious origin from these lateral roots. Coppice sprouts from the main trunk, especially if of below-ground origin, also show excellent rooting ability.

There is no evidence to show that tests on the subsequent behavior of the clone have ever been made between plants propagated from these "juvenile areas" and the more mature sections of the same clone. It would be interesting to note any rejuvenation effects such as reported by Cook (3), Frost (7), and Hodgson and Cameron (13) with citrus produced from nucellar embryos. If, as indicated by the above workers with citrus, clones do become senescent, the value of rejuvenation is apparent and plant propagators may well think of juvenility not only in regard to ease of propagation but also as a method holding forth promise for improvement of many plant clones. Shoots from roots may be preferred cutting material if such results can be achieved.

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Friday Morning November 9th

Chairman Scanlon: The meeting will please come to order. It looks like we have a busy morning ahead of us. In the event you had not heard of the activities of our Organizational Committee, let me first commend them for the hard work they put in last night. They labored until after one o'clock to have a constitution ready for presentation this morning. Also I wish to thank very kindly Mrs. Richard Fenicchia of Rochester, N. Y. who graciously consented to take notes at the meeting and then transcribed them before retiring. This was a very fine contribution to the Society by Mrs. Fenicchia.

The Constitution prepared by the Committee was then read to the body and thoroughly discussed. It was finally voted to carry the Committee over for a year; to hold a second meeting in Cleveland in December of 1952 (12th and 13th), and to make up copies of the revised constitution for each committee member. The committee then agreed to hold a summer meeting in conjunction with the annual convention of the American Association of Nurserymen at Detroit in July.

The afternoon session started with a paper by Dr. L. C. Chadwick of Ohio State University.

Controlled Humidification as an Aid to Vegetative Propagation

PROF. L. C. CHADWICK

Department of Horticulture
Ohio State University
Columbus, Ohio

Many factors are involved in the successful propagation of plants by cuttings. As a basis for the consideration of the factor of humidity, some discussion of the over-all picture of vegetative propagation by cuttings is apropos. Perhaps it can be said that all dicotyledonous plants can be rooted from cuttings, providing the right combination of internal and external factors is attained. Successful rooting of cuttings is dependent upon the careful manipulation of external conditions to fit the internal conditions.

The important internal factors for successful rooting of cuttings can be divided into two groups, anatomical and physiological. The anatomical factors are the healing of the wound made in making the cutting and the presence of root initials or the ability to form them. Roots on softwood cuttings of many plants follow definite patterns, which should be considered in making cuttings. The important physiological factors are food supply, consisting mostly of starches, sugars and amino acids; hormones; water, and some unknown or unclassified factors which can be designated as factor X.

Both the anatomical and physiological factors are variable in plants. The successful propagator realizes this fact and tries to select and handle cuttings in such a way as to offset deficiencies that exist or may develop.

External factors involved in the rooting of cuttings can also be divided into two groups, environmental and cultural. The important environmental factors are water of the rooting medium and of the atmosphere, oxygen, temperature and light. Some of the cultural factors are rooting mediums, leaf reduction, the use of synthetic growth substances and the position of the basal cut. While these and other cultural factors are important, it is probable that they are not so often limiting to successful rooting as the environmental factors.

HUMIDIFICATION CONTROL

Of the environmental factors, water has been the most difficult to control. It is important in all physiological processes. Normally, water is absorbed by the roots and travels through the stem to the leaves, where ninety-five to ninety-seven per cent is lost by transpiration. With cuttings, little water is absorbed from the rooting medium. This amount may be only a few cubic centimeters per cutting until the cuttings are rooted. Since little water is absorbed, it is highly important to prevent water loss from the foliage. The best method of preventing this water loss is by maintaining high humidity. It is also necessary to maintain a moist medium to prevent drying of the base of the cuttings after they are stuck. An optimum moisture content of the rooting medium appears to be about fifteen to nineteen per cent.

Several types of humidifiers have been used to increase humidity. These humidifiers may be classified into several groups, such as mechanical centrifugal atomizers powered by electric motors or water turbines, water under pressure, both air and water under low pressure and compressed air for the atomization of the water.

Atomizers of the centrifugal type operate on the principle of a turntable revolving at high speed, which throws off droplets of water against a baffle, thus producing a fine mist. Electrically driven units cost from $50 to $150 each. If the cost of pipe, strainers, humidistats and installation is added, it would run the cost of this equipment to approximately 25 to 55 cents per square foot of greenhouse floor area. Some of these units use from one to two quarts of water per hour, while others, of the turbine type, may use eight to ten gallons per hour.

Humidification may be obtained by forcing water under pressure of sixty to seventy pounds from nozzles. With some types, the water from the nozzles is forced against a baffle plate, which breaks it into mist form. Nozzles of the first type, with connections, will cost about 10 cents per square foot. A large amount of water is used by nozzles of the first type. Equipment which forces water against a baffle uses around two and a half to three gallons of water per hour under seventy pounds' pressure.

Humidification may be obtained by using both air and water under low pressure. From one to twelve gallons of water per nozzle per hour is used, depending upon the size of the aperture.

At Ohio State University use has been made of the so-called Binks system of humidification. The operating principle of the Binks system is merely the passing of a stream of compressed air over a column of water, so that the water is picked up and distributed in the form of a fine mist from a Binks nozzle No. 164. These nozzles are available from the Binks Manufacturing Company of Chicago, Illinois.

Nozzles along the air pipe are placed about fifteen feet apart. In a 10-foot-wide house one line is sufficient. Under fifty pounds' pressure about two and one-half quarts of water per nozzle per hour is used. With humidistatic control, the humidity can be held fairly constant at medium or high percentages. Details of the installation can be obtained by writing to the Department of Horticulture, Ohio State University, Columbus, Ohio.

A commercial company recently installed the Binks system in two greenhouses, 25x100 feet, at a cost of approximately 22 cents per square foot of greenhouse floor area. This cost included equipment, humidistats and expense of installation. The system is somewhat expensive for small installations because of the cost of the compressor.

Limited tests at Ohio State University have shown that a constant humidity of seventy-five to eighty per cent is satisfactory for evergreen cuttings handled in greenhouses during the winter. Eighty-five to ninety per cent humidity is about optimum for softwood shrub cuttings handled in greenhouses during the summer. Optimum humidities will vary with different varieties and species of plants and with the rooting medium used.

The benefits of controlled humidification can be enumerated as better rooting, less loss of cuttings from disease, less labor involved in making and managing the cuttings under high humidity and the commercial propagator can use his greenhouses for softwood cuttings of shrubs during the summer months.

Chairman Scanlon: Thank you Chad. We will now proceed to the final paper on the program. It is a pleasure to introduce Dick Fillmore of the Arnold Arboretum.

A General Review of Woody Plant Propagation

RICHARD H. FILLMORE

Arnold Arboretum, Harvard University

In the year 1802, in the pioneer community of Manchester, Ohio, a boy of 16 wished to establish an apple orchard. Since there was a nurseryman in his family, he had already been taught how to bud, splice-graft, and cleft-graft on established stocks, but stocks were scarce. Apple seeds were probably available, but Joseph Curtis couldn't wait. He picked up a few apple roots which had been turned up by his father's plow, cut them in pieces and grafted scions onto them. The grafted plants developed into good productive trees and thus began the now common practice of root-grafting.

ROOT GRAFTING

Root and collar grafting are particularly well suited to the propagation of both commercial and ornamental apples. In good cultural conditions, root grafts will produce a high percentage of well-branched salable trees at the end of the second growing season. Since the grafting can be carried out during the winter, this technique helps to spread the propagation work over the entire year.

Modern propagators are rarely confronted with a shortage of stock, since suitable stocks are readily available from several large seedling producers. The Yakima Valley of Washington is a particularly famous area for seedling stock production.

For root-grafting on apple, I usually obtain straight seedlings in No. 1 three-sixteenths and up grade. We find that we can make about 250 grafts from every 100 such seedlings. We make the first graft well above the collar of the stock using a relatively short scion and a relatively short portion of the seedling root. The second and occasional third grafts are made on the piece roots using somewhat longer scions. These grafts are all planted deeply in early spring and I have not noticed any marked differences in their subsequent development.

SIDE GRAFTING

Such ornamental species as Magnolias, Japanese maples, and flowering dogwoods are commonly grafted on started stocks in winter. During recent years, I have worked away from my former practice of plunging such grafts in peatmoss in a 70° case. I believe that it was Mr. James S. Wells of Koster Nursery who first suggested that I ought to try such grafts on the open bench in a 60° house. We are still plunging grafts of flowering dogwood, but we are handling all magnolias and many maples on the open bench. For these plants we use side grafts with dormant scions on very slightly started stocks, usually with the buds just beginning to swell.

Following grafting, we dip the entire graft in ordinary parowax. We have a small thermostatically controlled hot plate which will maintain the wax at about 160°. I feel that it is rather important to maintain this temperature. Colder wax may coat the plant too heavily and delay growth while hotter might destroy the buds. We heat our wax in an old ice cream container which is about 6 inches in diameter and 15 inches deep. At the close of each day's work, we put our container into a home-made insulated half-barrel so that the wax will heat up quickly the next morning. This not only increases our general efficiency, but it helps to avoid the sometimes dangerous practice of trying to heat grafting waxes too quickly.

With deciduous plants in general, we remove the entire stock in one operation by severing it just below the upper end of the graft union. I like to see stocks cut very low, possibly lower than in conventional practice since I believe that low cutting leads to quicker healing at the union. With conifers, we remove the stocks in two or more operations depending upon the species and the progress of the scions.

PLUNGING

We are still plunging our narrow-leaved evergreen grafts usually in a closed case with about 70° bottom heat. There are, however, two serious objections to this practice. One is that it is often difficult to maintain proper moisture conditions in plunged pots. The other is that we frequently lose many leaves on both stock and scion when grafts are plunged for long periods. I have found that grafts plunged in a mixture of Styrofoam A and peatmoss (1 part each by volume) can be syringed frequently without producing much settling and sogginess in the plunging medium. The Styrofoam A adds buoyancy and permeability to the mixture so that both pots and foliage can be kept suitably moist. Although we still lose a lot of foliage at times, I believe that the mixture has produced some improvement over pure peatmoss.

BUDDING

Bud-grafting, or budding, is one of the most efficient and commonly used of all propagating techniques. During the current year at the Arnold Arboretum, we have successfully budded *Malus, Prunus* and *Sorbus* in variety together with a few *Castanea, Cercis* and other species. We usually use budwood of the current season's growth on well-established stocks in which case the buds remain dormant until the following growing season. This year, however, we budded a few apples, using as budwood scions saved from our regular winter grafting. These scions were stored at 35-40° until mid-July, when they were used in plate budding on spring-planted apple stocks. Even at this late date, about half the buds began to grow within a few weeks. The stocks were then cut off above the developing buds.

PLATE BUDDING

We followed the method described by Mr. W. R. Leslie, Superintendent of The Dominion Experimental Station, Morden, Manitoba, in his publication "Results of Experiments 1931-1937." A flap of bark and wood is lifted from the side of the stock by a single downward stroke of the knife just as if the stock were being prepared for a shallow side graft. This flap is then shortened by a horizontal cut, leaving sufficient flap to come up to, but not cover, the bud. The bud may be prepared as in shield-budding, or it may be made into a narrow wedge at the base. In either case, it should be carefully fitted to the cut surface of the stock and securely bound with rubber budding strips or comparable material. Mr. Roger G. Coggeshall, assistant propagator at the Arnold Arboretum, has found this method easier to learn and to carry out than shield-budding.

Mr. Leslie reports that May is the best time to apply plate buds at Morden. If the budding is done before the leaves unfold on the stock, the stock should be cut back to within about 6 inches of the bud; if the leaves have unfolded, the stock should be cut back to the bud. Apple and crab have given best results with stored scions collected the previous autumn, but several species of *Prunus* have done better with scions obtained in late winter and then stored for a relatively short time. Waxing may be of value with both apples and stone fruits, especially the latter.

I should think that plate budding in early spring would be a useful technique in many nurseries, particularly if scion wood were scarce, or if economic or special cultural conditions made it undesirable to leave stocks in the same location for more than two years. In some nursery areas, for example, apple roots are likely to become infested with woolly aphis during their third year in the field. Spring budding on spring planted stock might offer a partial solution to this problem.

On certain occasions, as when one desires to bud after the bark has ceased to slip properly, plate budding might be used to extend the normal budding season into early, or even late, autumn depending upon locality. For such late budding, freshly collected bud-sticks might be very successful.

USEFULNESS OF BUDDING AND GRAFTING

Any grafting technique practically assures the propagator that the grafted plant will be true to type and that it will almost always perpetuate the characteristics of the parent plant. Minor variations may occur in a vegetatively propagated plant, such as the McIntosh apple, but they are of distinctly minor importance when compared to the uniformity of McIntosh apples as a whole.

Although it is this uniformity which makes budding and grafting so valuable, increased vigor, hardiness, insect and disease resistance, and special form may all be imparted to plants by the grafting process. The role of grafting in increasing the vigor of rosebushes and in the development of hardy "frames" for apple trees, will be well known to this group. I should like, however, to speak briefly about insect resistance and special forms.

INSECT RESISTANCE

During the past year, I have become interested in the problem of

Fig. 1.—Rhododendron mucronatum (Azalea ledifolia alba). Plant at left was sprayed with 0.6% maleic hydrazide to induce bushy development; plant at right was not sprayed.

woolly aphis resistance in apple stock. There are several promising stocks in the experimental stage, and two which have been used commercially. The first is Ivory's Double Vigor which originated in the plantation of Ivory's Limited at Rangiora, New Zealand. This stock is believed to be a French crab seedling. It is not commonly available. The second, which has been used extensively in both New Zealand and South Africa, is the Northern Spy of American orchards. Both of these stocks have to be propagated vegetatively, which would doubtless make them expensive in relation to seedlings. I believe, however, that it would be well worthwhile for nurserymen to consider Northern Spy understocks if only to ensure a permanent stock block of apples in woolly aphis infested areas.

SPECIAL FORMS

Grafting may be employed to combine separate sexes in one plant, to produce standards of various kinds, and to produce dwarfs. There is perhaps more interest in dwarfs than in any other special form.

DWARFING

The fundamental causes of dwarfing are unknown but, at least in some cases, it is possible to identify a dwarfing stock by observing the relative masses of wood and bark in its roots. Standard stocks are characterized by much wood and relatively thin bark while dwarfing stocks have relatively little wood and very thick bark. This bark-wood ratio is evidently much more important than the growth rate or general development of a given stock on its own roots. There are doubtless slow-growing dwarf apple trees with normally thin-barked roots which would probably not make good dwarfing stocks. They may indeed give rise to normally vigorous trees in which the scion apparently overcomes the lack of vigor in the stock.

A particularly interesting feature of dwarfing stocks is that the dwarfing effect seems to limit the ultimate size of the tree more than its initial growth rate in the nursery row. Trees budded or grafted on dwarfing stocks may make a normal or near-normal growth for two or three years, but they will eventually slow down and will never attain normal size. In order to avoid scion rooting, all dwarf trees must be planted with the graft unions well above ground. This fact should be strongly impressed on every amateur gardener who purchases such trees. If planted too deeply, scion rooting will soon eliminate the dwarfing effect of the stock.

DWARFING STOCKS

The common quince, which is ordinarily grown from cuttings and used as a dwarfing stock for the pear, is perhaps the best known and most widely accepted of all dwarfing stocks. There are several dwarfing stocks for apples of which the various East Malling selections have received much attention. Clark's Dwarf, which has been developed at the Iowa State College, Ames, Iowa, is one of the most commonly used dwarfing stocks in American nurseries. At the Arnold Arboretum, the semi-dwarfing stock *Malus sikkimensis* is being tested both for commercial and ornamental varieties of apples (See Arnoldia Vol. 10, No. 12). Since this species comes practically true from seeds, it combines the desirable features of a clonal line with relative ease of propagation. In combination with McIntosh, the horizontal branching habit of the stock appears in the scion so that the resultant trees have very strong wide-angled crotches.

As far as I know, there is no generally accepted dwarfing stock for any stone fruit, but *Prunus tomentosa* looks very promising for several varieties of peach.

Dwarfing stocks for ornamentals are relatively underdevoloped although Professor L. C. Chadwick of Ohio State has suggested *Juniperus horizontalis* as a possible dwarfing stock for varieties of juniper. Professor Karl D. Brase of Geneva, N. Y., has done some testing of crabapples on Malling IX.

INCOMPATIBILITY

If all the unfavorable or abnormal phenomena, which can follow grafting, may be properly regarded as incompatibility, then incompatibility may be either disastrously harmful or relatively harmless.

Mr. W. D. Weeks, of the University of Massachusetts, Amherst, Mass., has reported that when certain strains of McIntosh are summer budded on Spy 227 rootstocks, both bud and stock are killed by the operation. Such extreme manifestations are relatively rare.

Overgrowths of scions are generally regarded as more undesirable than similar development of stocks, yet both are sometimes relatively harmless insofar as long life, flowering and fruiting are concerned. In the Arnold Arboretum, I have recently observed mature grafted plants of maple and horsechestnut which exhibit marked overgrowths at the point of union, yet both species are apparently vigorous and normal.

In the "perfect" graft union, the wood and bark of both stock and scion lie side by side in such a manner as to permit both elements to perform their normal functions of conduction and support. In imperfect unions, poor conduction of water, mineral nutrients, and elaborated food materials may limit the growth of both stock and scion. The union may also be weakened by the inclusion of thin-walled cells among the normally thick-walled cells of the woody area. Such unions may persist for several years, but ultimately the scions will break off smoothly at the point of union. Such clean breaks, especially when associated with poor growth, are the most common and most serious manifestations of incompatibility.

COMPATIBILITY

Botanical relationships are frequently a relatively poor guide to compatibility in grafting, but it is substantially true to say that seedlings of a species will usually make the best stocks for its subspecies and varieties. This is not to say, however, that one species may not be satisfactory as a stock for several others in the same genus, nor that grafting between genera will be necessarily unsuccessful. Most five-needle pines, for example, may be successfully grafted on white pine, while common quince, or *Cydonia*, is reasonably compatible with several varieties of pear, or *Pyrus*.

It is often possible to achieve a compatible union by using an intermediate stempiece of a variety which is compatible with both stock and scion. Clapp's Favorite pear, for example, is incompatible with quince but it can be successfully grafted on Old Home which unites well with quince. Buerre Hardy is a suitable intermediate for Bartlett pear.

CUTTINGS

Cuttings are of great and increasing importance in the propagation of woody plants, especially ornamentals. I personally do not believe that grafts will ever be entirely superseded by them, yet I am sure that many plants, now perhaps most commonly produced by grafting, will eventually be propagated almost exclusively as rooted cuttings. Broad-leaved rhododendrons, Japanese maples, magnolias, lilacs and even Florida dogwoods are now being profitably rooted by commercial nurserymen while all of us root

Taxus, arbor-vitae, and numerous deciduous shrubs on a more or less routine basis.

Of the numerous factors which may influence rooting and subsequent development, I wish to include only position of cut, hormones, and over-wintering in this discussion.

POSITION OF CUT

Professor L. C. Chadwick of Ohio State University has made extensive studies on the effect of position of cut on the rooting of many species. His original papers are unfortunately out of print, but his recommendations for 86 species are presented in convenient tabular form on page 75 of "How to Increase Plants" by A. C. Hottes.

This table indicates that a cut one-half inch below a node is more effective with a wider variety of woody plants than a cut in the corresponding position above a node. A few genera, including weigela, will root better with the cut in the upper position. Cuts made at a node were more successful for several genera including six varieties of cotoneasters.

In our propagating work at the Arnold Arboretum, we have frequently had good success with cuttings of the basal ring type in which an entire short shoot is cut through its point of origin on an older branch. Some growers call this type cutting with a heel, but I prefer to reserve this term for those instances in which the cutting is removed with a much larger inclusion of older wood. With lilacs and viburnums, we do not ordinarily shorten these shoots, but I believe that removal of the soft tips is desirable with Japanese quinces and some of the more difficult azaleas. With rapid growers, we customarily include only one season's growth in our basal ring cuttings, but with slow growers, such as boxwoods, we may make the cut with two or even three year wood at the base.

HORMONES

The use of synthetic hormones is a well established and often beneficial practice in rooting cuttings. Assuming that one is thoroughly familiar with the most suitable hormone and the optimum concentration for the species under consideration, hormone treatments will unquestionably promote improved results with a wide variety of plants.

When the requirements of this assumption cannot be met, the indiscriminate use of hormones may do more to inhibit than to promote rooting. We must always remember that plants produce their own hormones and that these natural hormones are often present in sufficient amounts to ensure successful rooting.

I do not wish to be misunderstood. I am a pro-hormone man and I have successfully used hormones on dozens if not hundreds of species. In my present position, I am sometimes confronted with plants whose response to synthetic hormones is unknown. Indeed I may not even know what the plant is and it is with such plants that I feel particularly cautious.

When unknown response or identity is also associated with a shortage of propagating materials, we use a medium strength synthetic hormone on all species of the genera *Ilex* and *Rhododendron*. With all other unknown plants, we use no hormone treatments because we feel that we are just as likely to inhibit as to promote rooting. If propagating material is abundant we customarily include both treated and untreated cuttings for every species. In this way, we can accumulate data concerning the most effective use of hormones.

MALEIC HYDRAZIDE

Hormones, or hormone-like substances, may also be used to induce bushy development, thus eliminating laborious hand pinching of rooted cuttings. Although I cannot recommend its use on other than a trial basis, one of my experiences with maleic hydrazide shows definite possibilities in this connection.

Early in 1950, I carried out a series of experiments with maleic hydrazide (See Arnoldia Vol. 10, No. 6), a hormone-like chemical which was sent to us for experimental purposes by Dr. John W. Zukel, Naugatuck Chemical Division, United States Rubber Company, Naugatuck, Connecticut, as a solution containing 30 per cent by weight of the active ingredient in the form of the Diethanolamine salt. This new chemical is apparently effective in temporarily inhibiting growth in certain plants. When growth is resumed, there tends to be a greater-than-normal development of side shoots (See Figure I).

On January twenty-first, 1950, a few actively growing potted cuttings of Rhododendron mucronatum *(Azalea ledifolia alba)* were severely injured by spraying to run-off with a 0.6 per cent maleic hydrazide solution. This solution was prepared by adding 20 grams of the 30 per cent formulation, containing 6 grams of the active ingredient, to one liter of distilled water. A small amount of wetting agent was added to increase the effectiveness of the spray.

Both the treated plants and appropriate controls were left in the warm greenhouse in which they had been growing. On April fourteenth, or about three months after the treatment, the sprayed plants were forming new roots and there was considerable evidence of renewed bud activity. Within a few months, they were as large and apparently as healthy as the controls. They were, however, much more compact and bushy.

I now believe that the concentration of 0.6 per cent was higher than necessary and that a lower concentration might have produced a substantially similar effect with less temporary injury to the plant and a shorter period of inhibition. Maleic hydrazide is apparently more effective and less injurious on ericaceous plants than on some other species.

OVERWINTERING

There is often a big gap between a well established plant and a rooted cutting. Some plants may root well and either fail to withstand potting or die during their first winter. I believe that these difficulties are most frequently experienced with summer wood cuttings.

We have repeatedly rooted *Viburnum juddi* as soft current year twigs taken in July only to have them die within a few weeks after potting. They seemed to be affected at the soil line by some disease comparable to damping-off of seedlings.

In August, 1949, we made a small-scale comparison between soft cuttings of the current season's growth and twiggy short shoots with two or even three-year-old wood at the base. We found that such twiggy shoots would root as well or better than younger material although somewhat more slowly. This type of cutting, however, has given us much better survival and we believe that the age, or at least the firmness, of the wood at the base has a great deal to do with successful overwintering of this viburnum. Contrary to the experiences reported with magnolias and some other species, there seems to be no marked advantage in having these cuttings growing before being placed in a cold house for the winter. We have perhaps not yet secured commercially profitable survival of our twiggy cuttings but we believe that we are working towards it both for *Viburnum juddi* and *V. carlesi.*

SEEDS

Although nearly always characterized by less precision of reproduction and frequently lacking the speedy development obtained from grafts and cuttings, propagation by seeds is still of the utmost importance. The production of seedling stocks alone is of sufficient interest to warrant inclusion of seeds in a review of this kind. One could easily give a whole lecture on the importance of seeds in the production of forest trees and general nursery stocks. I wish, however, to confine this discussion to three little-known techniques which we have found useful in the production of plants from seeds.

CLEANING FLESHY FRUITS

We have recently purchased a Waring Blendor for cleaning small lots of fleshy fruits. We first learned of this machine through an article by Mr. B. C. Smith of Ohio State University who recommended it for cleaning seeds of hawthorn. His results were published in the American Nurseryman (Vol. 92, No. 11).

The Waring Blendor is essentially a motor with a shaft which revolves at high speed to rotate two cutters which are suspended in the base of a specially designed bowl. Unless the timing is very exact, these powerful cutters will smash many seeds, even thick-coated Prunus.

We have been able to reduce such injury by covering these cutters with Tygon Tubing* (1/8 inch wall, 1/8 inch inside diameter). We removed the cutters, dulled the sharpest edges on an emery wheel and then pressed on short sections of the tubing. We believe that this protection would be reasonably adequate and satisfactory for such fruits as ripe crab-apples and many viburnums, but the tubing wears out too quickly to be practical with *Prunus* and other hard coated seeds with sharp edges.

Upon the suggestion of Mr. Alfred Fordham, Assistant Superintendent at the Arnold Arboretum, we removed the cutters and replaced them with a small square of reinforced rubber taken from the center of the tread of a worn truck tire. This rubber square (about 5/16 inch thick and 1-11/16 on the sides) was fastened on the cutter head with the concave side up and we now have a very durable and satisfactory substitute for the original cutters. During the past several months, we have cleaned a wide variety of seeds without injury. We figure that the machine paid for itself the first day.

ROOT DEVELOPMENT

When I was a young boy, my father taught me to remove the tip of the tap root in transplanting small seedlings of such annuals as *Eschscholtzia* and the true poppies. When this tip is removed, the normally downward development is modified and such plants will develop a comparatively good fibrous root system.

In recent years, I have experienced considerable difficulty in securing nut tree seedlings suitable for use as potted grafting stocks. This difficulty has been particularly bothersome with black walnut in which it is very difficult to accommodate the usual long tap root in a pot of reasonable size. When the roots are pruned severely, survival of the seedlings is likely to be poor. I have found, however, that it is quite possible to produce a well

* A plastic tubing furnished through the courtesy of the Greene Rubber Company, Cambridge, Mass

branched root on a year old *Juglans nigra* seedling (See Figures II and III).

On 30 January, 1951, we stratified a quantity of cleaned *Juglans nigra* seeds by planting them close together in flats containing screened sphagnum. Since we wanted to avoid crooked stems, we placed the seeds on their sides with the sutures up. The flats were then placed in a cold house which is kept at about 40° during the winter months.

By the following May 17, many of these seeds were germinating and we then selected 100 seeds which had roots about one inch long and upon which young shoots had not yet developed. On some of these seeds, we snipped off about one half inch of the young root and we left others as controls. Both snipped and controls were then planted in a row out of doors. They were set about 8 inches apart and 4 deep. The plants grew well during the summer and we could see no substantial differences in their aerial development. There was, however, a very important difference in root development.

In our best lot of 40 snipped seeds, 37 survived until autumn. The most of these developed root systems as illustrated on the right in Figure II although several produced only horizontal or nearly horizontal roots as illustrated in Figure II. There were only 2 tap roots in this lot while the corresponding controls were nearly all tap rooted.

This method of producing branched roots certainly requires more hand labor than the usual practice of root pruning older seedlings with heavy machinery. I should think, however, that it would be much more economical than root pruning with spades. For our purposes at the Arnold Arboretum, the advantage of a well branched root system on a one-year seedling is the most important consideration. The feasibility of this method in

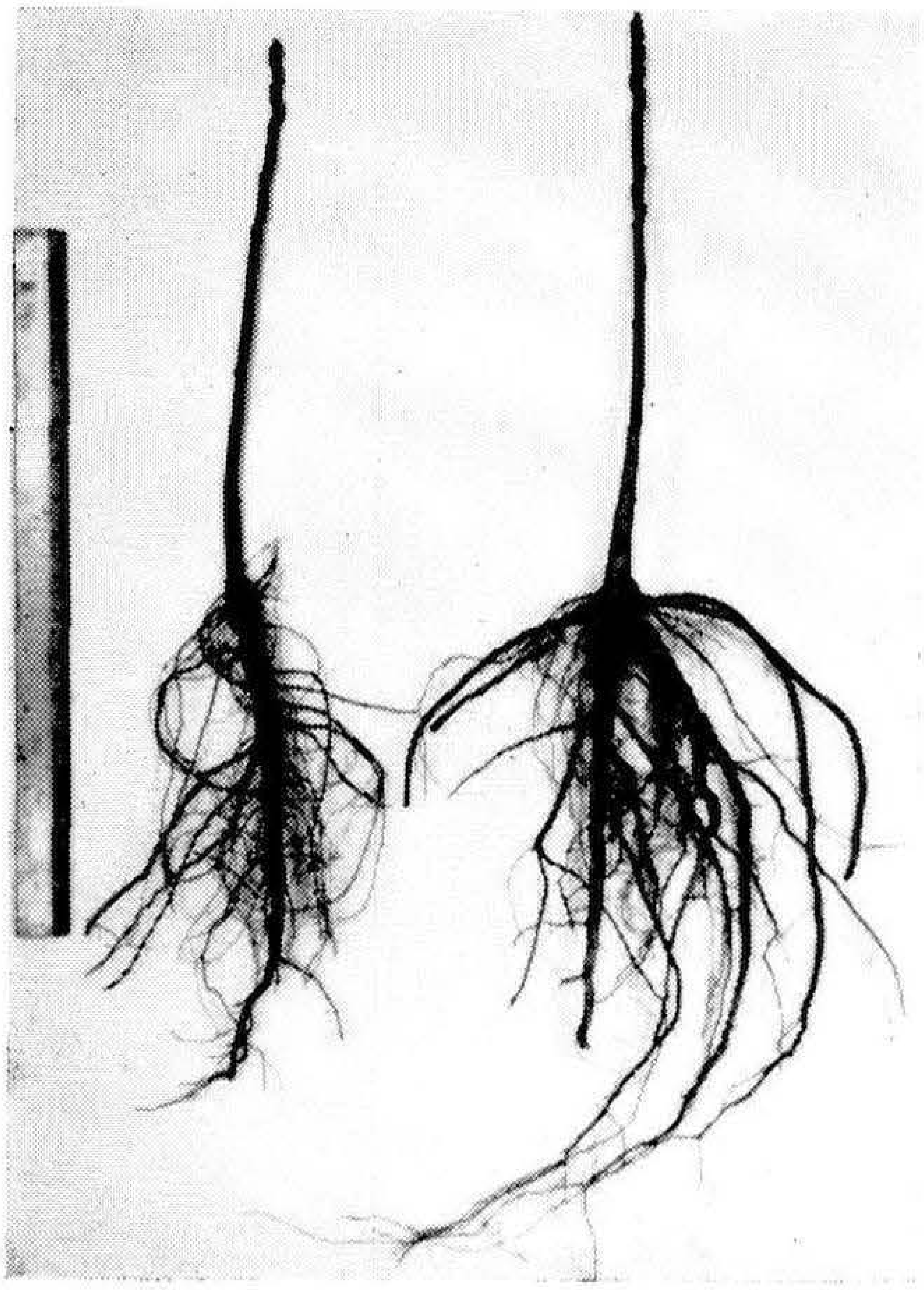

Fig. 2.—One year seedlings of Juglans nigra. Plant at left was tap-rooted; at right, branch roots developed by snipping in early stage of development. Comparable results have been obtained with Juglans hindsi and Castanea species. Scale is 18″.

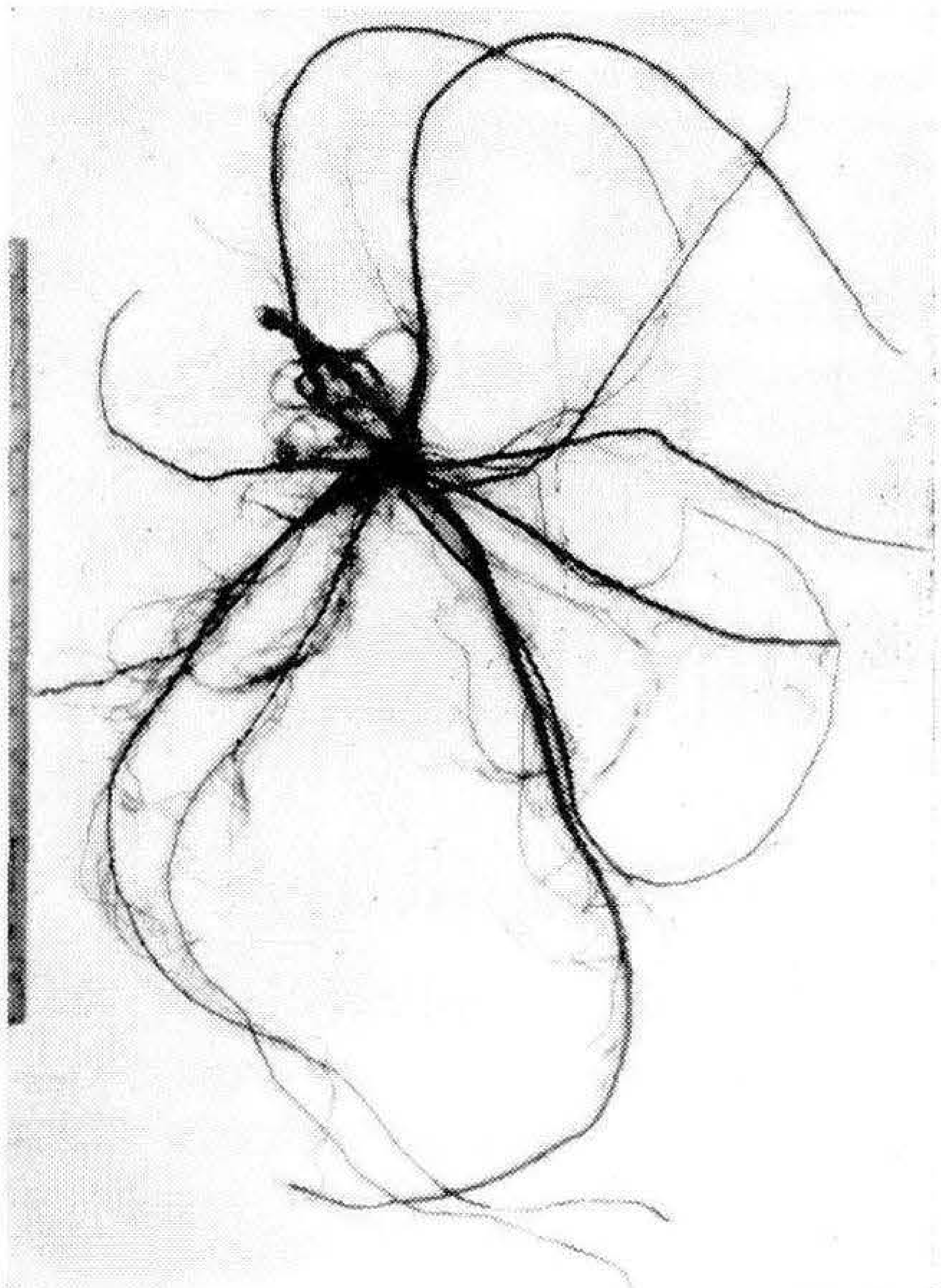

Fig. 3.—One year seedling of Juglans nigra photographed from above. This plant is being held erect by its horizontal type of root system. Scale is 18″.

commercial nurseries is left to the judgment and ingenuity of the individual grower.

SOIL SUBSTITUTES

I have already reported my results in growing azalea transplants in a mixture of Styrofoam A and screened sphagnum moss (American Nurseryman Vol. 93, No. 1). I have brought along two plants of true American chestnut both of which were grown by first planting seeds in flats of pure sphagnum moss. The seedlings were later transplanted into 4 inch pots some in potting soil and some in a mixture of sphagnum moss and Styrofoam A.*

When these seedlings were transplanted in February, 1951, the mixture was watered with a solution containing traces of all the important minor elements together with a solution made by dissolving one level teaspoon of 5-8-7-1 (magnesium) in one gallon of water. This 5-8-7-1 application was repeated in March and early September. The potting soil was well fertilized during its preparation.

Even with this somewhat inadequate nutrient program, there was at the end of the first growing season, no appreciable difference between the growth of the plants in the mixture and that of the corresponding plants grown in fertilized soil.

There may be profitable possibilities for mail order nurserymen in growing certain large-seeded woody species by direct sowing in pots containing Styrofoam A and screened sphagnum moss. This is perhaps particularly true in relation to species which are normally rather difficult to transplant. We have recently sent potted seedlings of American chestnuts to Holland and Sweden by airmail at a cost of less than one-fifth the normal charge for comparable plants grown in soil.

AIR LAYERS*

Layers are not so generally used as are the more common methods of propagation by grafts, cuttings and seeds. There has, however, been one very important development in recent years. In 1947, the ancient art of Chinese air layerage was brought up-to-date when Colonel William E. Grove of Laurel, Florida first used plastic films in air layering litchi trees. Since the film he used is practically impermeable to water and water vapor, it is now possible to keep air layers suitably moist for months at a time even under out-of-door conditions. There may, indeed, be serious difficulty in keeping plastic-wrapped air layers from becoming soaking wet which is certainly disadvantageous to rooting. In a recent article in Horticulture (Vol. 29, No. 8), I have described and illustrated what I now believe to be the best method for applying air layers to northern woody plants.

Although I do not believe that plastic air layerage will ever replace the more widely accepted methods of propagation, I am sure that it has important special uses in the nursery business. While on a visit to the University of Maryland last winter, I talked to a nurseryman whose field of specimen Japanese maples had been severely injured by frost during the previous year. In early spring, plastic air layers were placed on relatively large uninjured branches. They rooted readily and before autumn it was possible to pull out the rémains of the injured plants and replant with air

* Samples of this material may be obtained from Mr. R. N. Kennedy, Plastics Technical Service, now Chemical Company, Midland, Mich.

* Since this talk was given, Dr. Donald W. Wyman has published a summation of our results with plastic wrapped air layers on a wide variety of woody species See Arnoldia Vol 11, No 7-8.

layers. It is in such special ways that plastic air layerage is likely to become of importance in the nursery business.

DIVISION

I cannot complete a review of woody plant propagation without mentioning division. Unless one wishes to increase one's supply in geometric proportions, it is often possible to maintain a good stock of some woody shrubs by simple division.

Spiraea, for example, can be easily propagated by removing suitable side shoots during digging or grading. In small nurseries, it may even be good practice to dig and plant at the same time. I have often dug orders in the field in early spring in situations where it was possible to replant enough small stock to replace the larger specimens which I took out.

CONCLUSION

I have discussed this review of woody plant propagation under the general headings of grafting, cuttings, seeds, layers, and division. I have mentioned a few little-known techniques and practices which I believe will be useful to you as plant propagators. I wish to thank Mr. Edward H. Scanlon for his invitation to attend this meeting and particularly for the opportunity to appear on this program.

The meeting adjourned at 5:30 p.m. The second annual meeting will be held in Cleveland at the Wade Park Manor December 12th and 13th, 1952.

Summer Meeting of Organizational Committee Detroit, Mich., July 16, 1951

Present at this Organizational Committee meeting were: James S. Wells; James I. E. Ilgenfritz; L. C. Chadwick; William E. Snyder; Pieter Zorg, John Siebenthaler; Roy M. Nordine and Edward H. Scanlon. Absent were: Richard H. Fillmore; F. L. O'Rourke and Roger W. Pease.

The action taken consisted of the adoption of a Constitution; the establishment of the Plant Propagators Society with an original Charter Membership consisting of the original committee plus seven additional members who were present—making a total of eighteen Charter Members—however it was voted to extend Charter Membership privilege to any person who attended the first meeting in Cleveland. A complete list of Charter Members will be published in the next proceedings. Final action was the election of officers: James S. Wells, Pres.; L. C. Chadwick, Vice President; Edward H. Scanlon, Secretary-Treasurer.

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