

Proceedings Second *Plant Propagators Society* Meeting

FRIDAY MORNING SESSION

December 12, 1952

Registration and various preparations occupied the first morning of this second annual meeting of the Plant Propagators Society. The meeting was scheduled to be called to order at 1:30 p. m. by President James S. Wells.

The Second Annual Meeting of the Plant Propagators Society convened in the Ballroom, Wade Park Manor, Cleveland, Ohio, at 1:40 o'clock, President James S. Wells, Koster Nursery, Bridgeton, New Jersey, presiding.

PRESIDENT WELLS: Gentlemen, we were waiting for the microphone to be fixed but the engineer isn't here, so we propose to start anyway, and to get things rolling I understand that Mr. Arnold Davis, who is the Director of the Cleveland Garden Center, is going to welcome us here. Mr. Arnold Davis! (Applause)

MR. ARNOLD DAVIS: I am here because it is customary for someone to say we are glad that you came. I hope Ed. has already said that to all of you and I need say no more.

This is the second conference of the Plant Propagators Society which is being held in Cleveland. Last year, the first conference was held at Hotel Statler. I am very glad to see so many of you here again this year.

My horticultural background is perhaps of a nondescript nature. I grew up in the east, in the section where we had a large number of private estates and on each of these private estates there was a superintendent. Occasionally, the superintendent would speak to you; most of the time he talked about you. He told you what to do and how to do it, and there is no question that class of men knew how to grow things, knew how to grow them well, and took a great deal of pride in the secrets which they had. Also, at that time there were very few people who were interested in ornamental plants. There were very few people who made any pretense of knowing the technical names of plants.

The group that knew their material by and large were Kew men, men from Glasgow and men from Edinburgh, occasionally a man from Germany and once in a long time a man from Denmark, but their horticulture was sound. They kept it to themselves and when they left this world they took it with them.

Now during this period of some 40 or 50 years, the lifetime of those of us who are here, we have seen the whole picture change. There have been many reasons for that. First of all, there started in this country a great movement for amateur horticulture. Second, the experiment stations

began to investigate the field of horticulture, usually at the request of nurserymen's associations. They had definite problems. They wanted help and they went to the experiment stations, and the information became public. More and more, you find publications coming out on the control of plant diseases, on the propagation of plants, on the field of let's say breeding of new varieties of plants. The result has been that at the present time there is a present interest in ornamental horticulture that reaches down, down not to the private estate man, not the man with a large home, but the little individual who may be far down in the scale. But he is important, and I want to reiterate that statement, that his interest may be in African violets in the kitchen window and begonias, he, however, spends money for plants and as his status changes he will continue to spend more money for plants.

At the present time, it is a great industry. Now I hold two theories concerning this industry. One is that you and I who are not horticulturists do not appreciate the dignity of those whom we employ. We underestimate ourselves with the knowledge we have accumulated and we are inclined to pass things by lightly and say anyone can grow it. I think we need to evaluate the information which we have acquired the hard way. I think we need also to exchange ideas and one of the valuable things that you get out of a conference of this sort is the fact that you give something and you get something. Somebody else gets some new ideas. He may become a competitor of yours. I sincerely hope he does, because when he begins to compete with you, you get on your mettle and say, "I am not going to let that bird beat me," and you begin to bring out better things. You grow your plants better, you begin to work out shortcuts. The net result, more people are able to enjoy the results you have. I am a firm believer in competition.

My second point is that gardening today has reached the stage where in this country it is a form of recreation. You and I probably don't think of it as recreation; it is our business. The man who takes care of the greens on the golf course doesn't think of golf as recreation and a professional golf man feels the same way about that particular field.

Now I would like to have you think about this. You have certain forms of recreation in which you indulge. Some of you may have boats or some of you may ride horses and some of you may play tennis, and some of you are maybe content to play penny ante. I don't care what you do for recreation. The point which I think is very important is that in your own recreational activities you expect to spend some money. Now if you and I as horticultural professional promoters—I happen to be a horticultural promoter if you want to know what I am—appreciate the fact that we are working with a field that is recreation let's say to most of the people we come in contact with, then those people should expect to pay for their recreation. Actually, they think more about it if they have to pay for it. It is going to do a great deal to lift the dignity of horticulture, and let's say to give you the type of income for the knowledge you have put into it again to develop or promote the business you are tied up with.

There are two things you can think about as far as the present day is concerned. I sincerely believe that as this country expands, and it is going to expand very rapidly in the next 15 years—that is not my statement; that is the statement of the bankers who make the loans, who see the babies coming along, all of whom want homes—there is going to be a terrific demand for lawns and plants and the things that go with gardens

and it is going to be people in your field of activity that are going to supply that type of plant.

Now we need better types of plant materials. I am old enough to remember the introduction, the every-day introduction of the Japanese barberry, and I am young enough to begin to see the over-production of Japanese yews. Don't feel badly because I made that statement. I think the yews will reach the point where barberry has got to today. We need new plants. The only way we are going to get them—I am not referring to exploration, I am referring to the fact that some of you boys can propagate superior strains and superior types so they hit the market, so people can buy them, so there is an interest for more people to want them, so the market gets bigger.

I am very glad to seriously welcome you here for what I hope will be the most profitable meeting that the Plant Propagators Society has had.

I would like at this time to pay a little tribute which passes off lightly but it is very heartfelt and very sincere, for the work Mr. Scanlon has done in putting together this meeting and I would like to ask you to give Mr. Scanlon a big hand for his courage in calling this meeting and I hope it works out as successfully as he intends it should. Thank you very much. (Applause)

PRESIDENT WELLS: Thank you very much, Mr. Davis. You stole my thunder about Ed. Scanlon. If there is one man here who deserves praise, it is he, because he is the man who has done all the work. That is always the case with the secretary and we are laying plans to see that he continues.

We have had a meeting this morning at which we have been trying to plan ahead and it was originally arranged for me to give you details of some of the things we decided this morning at this time. We decided later that it would be best if we stuck to the program. We didn't quite finish all the things we wanted to do, so we are going to have another meeting this evening at around 7:00 o'clock, finish things up and present them to you at the business meeting at 8:30.

Probably many of you are wanting to know how you can become a member. What are the formalities, and so on? We hope to be able to give you all the answers then. We hope that the business meeting will not be too long with that kind of thing because we might continue into a general discussion on plant propagation, call it a round table, if you will, because that is really what we have come here to talk about.

I would like to set a keynote, if I may, and that is that this is not a meeting that is a stiff and starchy affair, that is all cut and dried. We want to hear from everyone. We want anyone who thinks he has something to say to make an effort and get up and say it. We want discussion. The more discussion we can get the more we believe everyone will get out of it. If you have anything to say at any of the meetings will you try to speak clearly so that this lady can take down what you say. Preface your remarks with your name, and if you like, your nursery or your place of business to identify yourself, and please do speak clearly because we are planning on printing a complete proceedings of everything that goes on here, and that we believe will be one of the most valuable things to come out of this meeting.

With those few remarks, we will get down now to the main part of the program this afternoon, which is a "Viburnum Round Table," in the beginning.

Now before passing the meeting over to Dick Fillmore, I would just like to introduce him with a couple of words.

I first met Dick some four years ago, at the Arnold Arboretum. He is a quiet sort of person, but we no sooner met than we were into his greenhouse and poking around among plants and one of the first things we talked about was viburnums. Since that time, it has been my pleasure and privilege to extend that first meeting into a friendship which I value and I know him to be one of the very best plantsmen in this country.

Now, it is customary for people introducing someone else, particularly in America, to make some fulsome comments. I don't intend to do that, and what I have said is sincere. Dick Fillmore is well worth listening to, so with that, I would like to introduce Dick Fillmore of the Shenandoah Nursery.

. . . Mr. Richard H. Fillmore, Shenandoah Nursery, Shenandoah, Iowa, took the chair as discussion leader . . .

CHAIRMAN FILLMORE: Mr. President, ladies and gentlemen: I am very glad indeed to have an opportunity of speaking before this Second Annual Meeting of the Plant Propagators Society. I prize Jim Wells' friendship very highly and I am glad to have him recognize that friendship on this occasion.

I feel particularly happy today that we have Mr. Case Hoogendoorn of Newport, Rhode Island, to share the responsibility of this program on the propagation of viburnums. I have said to Mr. Hoogendoorn within the last hour that I wish I had the skill in my hands that he has in his. I am sure that we shall enjoy Mr. Kern's discussion of "The Propagation of Viburnum from Seed." I look forward to that discussion, myself. We are intending to grow viburnums from seed at the Shenandoah Nursery during the coming year and I delayed stratification and other work on those viburnum seeds until such time as I could hear his discussion.

I will speak briefly about the "Propagation of Viburnums from Cuttings," and any discussion of this type, to my mind, should be taken up under four or five general headings.

The first heading would be timing. What time of the year shall we make the cutting?

The second topic would be the type of cutting. What type of cutting shall we make?

The third topic would be, having made the cutting, what sort of a medium shall we put in it?

The fourth topic should be what sort of culture should we give the cuttings after we have finally placed them in that medium.

I am not going to discuss all of these topics. I think that the discussion will include comments and questions which will bring out these various points in more detail than I wish to give to them at this time. I

am going to confine my remarks to the type of cutting in relation to the rooting and survival of the cutting.

First of all I would say that viburnums in general, and many of you folks may not agree with me, are easy plants to root but relatively difficult plants to grow on. That is, they are likely to die following potting or following transplanting, so that having rooted them very successfully, we may find ourselves with nothing but a lot of blackened stumps either three weeks or six months after they have been put in the pot.

It seems to me that the type of cutting has a very great influence on rooting and survival. I have repeatedly made cuttings of *Viburnum Carlesi* and *Viburnum Juddii* out of rapidly growing shoots. They root in three weeks. They die within 3 or 4 weeks of the time they are potted. That is particularly true when the cuttings are made on the early side, in June and July. At the Arnold Arboretum, we had much better success by taking twiggy cuttings of *Viburnum Juddii* and *Viburnum Carlesi*. By the twiggy type of cutting, I mean those twiggy shoots that can be gathered from older plants and which usually have two or three year old wood at the base. Short twiggy shoots root in late July or even early August in the Boston area.

On one occasion, and incidentally, I have not got enough experimental evidence for this method to want to make it universally applicable right away. It needs more experimentation and it is something for you folks to experiment upon if you have the time and the inclination, but in one instance we took 200 cuttings of *Viburnum Juddii*, which is a close relative of *Carlesi*, 125 of those were the tips of shoots, soft tips of shoots such as one would ordinarily regard as being real good cuttings. Practically all of the cuttings of that type which we took died. We did, however, manage to get 37 of those to root. Now with this twiggy type of cutting we got 71 out of 75 to root, the short soft shoot 37 out of 125 and the short twiggy shoot 71 out of 75.

We observed in January the number of potted cuttings which had started and those which had not started. Our idea was that viburnums might follow the pattern of magnolias, for example, which, if they start toward growth, have a much better chance of surviving throughout the winter than those which remain completely dormant. We didn't get any difference with these viburnums. The plants which had started by January did not survive any better, that is in terms of surviving until March or April, than those which had not started by January.

We also tried to determine the importance of the transplanting shock factor. We potted some of these cuttings directly in pots so we would not have to move them following rooting and there again we didn't determine any differences. So neither the starting of the plants in the pots nor the transplanting shock following potting had anything much to do with the loss of the plants either soon after potting or during the winter.

There are a number of things which could cause these plants to die during rooting. In the first place, they could die of starvation if you want to put it that way. They might exhaust their food reserves in the production of roots and the foliage that had developed on them might be incapable of furnishing sufficient sugars to maintain the life of that plant and give it sufficient impetus so it would go on and grow. Now that, frankly, seems unlikely to me; nevertheless, it is possible.

They might die from transplanting shock and that would apply in particular if one were to take his rooted cuttings and pot them too deeply. Deep potting is something to watch out for with cuttings of many types and I think that applies particularly to viburnums. Nevertheless, I don't think that the most of us plant our cuttings too deeply and I would, therefore, not attach too much importance to this factor.

The third thing that might cause difficulty with those cuttings would be the prolongation of dormancy. In other words, when we take the cutting in the rapid growing state away from the plant and put it in the rooting medium and it roots, we do not ordinarily get a continuous growth. It is likely to go into dormancy let's say in July and if dormancy has to be prolonged from July until the following April that is quite a different matter from the normal dormancy which might be experienced from October to April.

There may also be difficulties involved in dormancy at high temperature which usually will be experienced in July and August and the early part of September. I think there might be some difficulty connected with prolonged dormancy which would account in part at least for the failure of these and certain other cuttings to survive the winter and become good plants.

There is a further factor which I think is of considerable importance and that is this: I think that the age of the wood or the age and development of the tissues at the surface of the soil has a very great deal to do with survival. Although I am not a professional plant pathologist, I believe that what we are dealing with may be primarily a disease problem and that the diseases affecting these cuttings are closely related, and possibly even precisely the same, as damping-off of seedlings.

I have further observed if we wait very late with our one-year shoot until it is very hard, then the survival over winter is a little better than it will otherwise be, but if we have this twiggy two or three-year old wood at the base of the cuttings we seem to get reasonably good rooting and reasonably good survival. That system worked out comparatively well on that occasion with *Viburnum Juddii*. It isn't my custom to leave out those occasions on which my little schemes fail, because it very often happens they don't work. The following year with *Viburnum Carlesi* we attempted the same thing with 280 cuttings and none of them were alive on the 20th of March the following year. *Viburnum Carlesi* is another species where we made the cuttings later. Also, they might have experienced quite different conditions during the period of storage because we had them in a pit house in which the temperature fluctuates. Nevertheless, the indication we got with our experiment of 200 cuttings of *Viburnum Juddii* is to my mind of sufficient significance to warrant someone going on with this problem and trying to solve it on the basis of type of cutting wood and on the basis possibly of using a sterile medium and also on the basis of varying the winter storage temperatures and other factors which might contribute to losses in these plants.

Now with regard to the rooting itself, the soft shoots will root in about three weeks and the twiggy shoots in about six weeks. The difference in percentage of rooting between those two types of cuttings is practically negligible. It is simply that the older shoots take longer and survive better, and I might say in addition that once these cuttings are rooted and are through the first winter they make fine plants. They do well on

their own roots and I should think if any commercial grower could find the means of rooting these plants 50 per cent that it would probably be a profitable undertaking.

Are there any comments or questions?

MR. FRANK O. ANDERSON (Erie, Pa.): Did you use hormone powder on those?

CHAIRMAN FILLMORE: Yes, I did use hormone powder. I used Hormodin 2. I would say in general that hormone powders probably haven't got much value on viburnums. That is a debatable topic and I should think someone would have comments on it.

MR. JOHN VERMEULEN (Neshanic, N. J.): My question is, Where were these viburnums kept in the winter, in a warm greenhouse or a place where they were frozen and kept dormant?

CHAIRMAN FILLMORE: They were placed in a cold pit house where the temperature runs from 35 to 40 degrees during most of the winter. Following March 15, the temperature went up, they began to grow, and in late May we bedded them out.

MR. VERMEULEN: May I ask one more? We have experimented a lot with these particular types. We have grown *Viburnum Carlesi* for a number of years, I would say almost 10 years, and we have found some of the problems you have found, that the plant takes well when the cutting is late, especially *Viburnum Carlesi*. We have experimented by taking our cuttings out of the greenhouses and putting in a cold frame in October, and after having them in the cold frame when winter comes we just let them freeze and we find we get at least 90 to 95 per cent good plants in the spring. It may be the answer. I can't guarantee it.

CHAIRMAN FILLMORE: Well, that sounds like a very valuable comment. Mr. Vermeulen has found if he stores the cuttings in a frame where they will actually freeze up they will winter better than in a warm greenhouse or even a greenhouse of 35 or 40 degrees. That sounds perfectly possible to me. For one thing, the disease organisms which I personally feel are most responsible for these losses simply will not thrive when the ground is frozen and they may thrive to some extent at 40 degrees.

MR. JACK BLAUW (Bridgeton, N. J.): I would like to know what medium you used in the cuttings.

CHAIRMAN FILLMORE: The medium I used on that particular lot of cuttings was Flowerite, which is also sold under the name of Perlite. It is a light, white, fluffy sort of stuff. I don't think the Flowerite would make any important difference in the results. I think substantially the same result would have been obtained in sand or sand and peat or vermiculite or several other materials which could have been used.

MR. CARL KERN (Wyoming Nurseries, Cincinnati, O.): You spoke of losing some of your rooted cuttings after you had taken them out of the sand. I believe the loss occurs largely because you lift your cuttings out of the sand when they have only formed so-called primary roots. If you permit your viburnum cuttings to remain until they have formed a secondary root system your losses are cut to zero.

I have had experience with *Viburnum Carlesi* with the humidity

system and they form a root system like a bottle brush. I thought they were okay, let's pot them up, since they were 95 per cent rooted inside of 10 days. Out they went and they turned to black stumps, while on the other hand, we rooted Juddii, Carlesi—I just made these for a test—late August or first week in September and permitted them to remain in the sand until just about two weeks ago. We took them up and they had a secondary root formation and every plant lives. Never move your cuttings out of the sand until you have a secondary root system formed.

CHAIRMAN FILLMORE: That sounds like a valuable comment, too. I notice you took them on the late side so you had very firm wood.

MR. LESLIE HANCOCK (Cooksville, Ontario): Further to what Mr. Kern said, and you mentioned starvation, have you given thought to the possibility of liquid feeding, before removing?

CHAIRMAN FILLMORE: I haven't particularly, but I think liquid feeding before taking them out would be important. Years ago we were all taught that the medium had to be sterile, the sand had to be clean and so forth, and a great deal of that is apparently just pure nonsense, because I see lots of folks who are getting excellent results in a medium which is neither sterile nor clean and they use plenty of nutrient solutions to build up the cuttings prior to taking them out of the cutting bed. I should think following rooting a shot of nutrient solution might work out nicely on a good many types of cuttings, including viburnum.

MR. CASE HOOGENDOORN (Newport, R. I.): Since we had so many losses, what we tried a couple of years ago was to make our cutting rather hard after the middle of August and stick them in flats of sand and gradually harden them off and carry them in the cold frame without disturbing. In the spring we take them out and plant them, and have good results by not disturbing them at all.

CHAIRMAN FILLMORE: That is what we tried to do with our potting and it worked out well enough. I think now, from what you gentlemen have said, if we had dropped our storage temperature from 35 or 40 down to 25 or 30, that we would have had a great deal better success, and if I had an opportunity to experiment with this again that is one of the things I would do, just drop the temperature and see if that wouldn't help solve the problem.

DR. J. R. KAMP (University of Illinois): I want to make a comment about Mr. Hancock's suggestion about nutrients in the rooting medium. We have found on a number of things that we get better results if we apply nutrients to the rooting medium about 10 days before we are going to take the cuttings out. This would be especially good in the case of your leaving them in to get some secondary roots. If you apply the nutrients about 10 days before you take them out, they are ready to send out some extensions of their roots in about 10 days. That means just at the time you are getting them into the pot they are sending out new roots, so you don't have a stoppage in root growth and it really works quite well.

I had a question about this Perlite. Just what grade? What size particles are those?

CHAIRMAN FILLMORE: It is a comparatively fine particle size. It would be about like No. 7 silica sand or a little finer.

Any other comments or questions?

DR. HENRY T. SKINNER, (National Arboretum, Washington, D. C.): Your remarks about *Viburnum Carlesi* reminds me of a little experiment we did at Cornell a few years ago with *Viburnum Carlesi* when the growth substances were just coming out. We rooted quite a batch of *Carlesi* and carried them through the winter, as I remember, all the ones that were rooted with growth substances came through the winter and all those rooted without treatment we lost just about 100 per cent. It was a little interesting then on the basis of the growth substances. Since then it has occurred to me it is probably connected with the point Mr. Kern brought out, the ones with growth substances rooted a little early. Those were probably early July cuttings and they became established and made a rather better root development, and as a result, those plants carried through the winter, whereas, the others didn't.

Of course, in the matter of azaleas, with which I am a little more familiar than viburnums, I always say that azaleas of difficult types should be rooted early. If there is a little top growth in the winter in the greenhouse, you will have no losses. I think the same principle applies with viburnum except you may get by with extra root development instead of top growth. I think that growth is very important, and once you get that, I don't think you have trouble over-wintering.

CHAIRMAN FILLMORE: I would just like to comment on that very briefly. I can see there might be very great value indeed in having a heavier root system. As far as the development of tops on these viburnum cuttings is concerned, on the basis of this little test of mine, it doesn't make any difference. The plants which did not develop new growth came through just as well as the plants which did. Now it is entirely possible that the more heavily rooted ones survived better than the more lightly rooted ones. I didn't attempt to separate on the basis of light rooting and heavier rooting. Some of them were cuttings potted before rooting and we didn't have an opportunity to examine them. Any other comments or questions?

MR. DeGROOT (Sheridan Nurseries, Ontario): A few years back, it must have been in the twenties, we tried *Viburnum Carlesi* from cuttings. They were all lost, which was discouraging, but afterward we left them two years outside in the frames where they were first planted and there was a bigger percentage for transplanting.

MR. JACK BLAUW: I did the same and we planted them for one year in the frame and they grew very well. We made the cuttings in the greenhouse and planted them in the cold frame and left them there for a full year and the next spring dug them out.

CHAIRMAN FILLMORE: These cuttings were made up in the greenhouse, planted in the frame and left there for one full year, following which they could be field-planted without losses. Any other comment?

PRESIDENT WELLS: Dick, I would like to make a comment, if I may. I think that Carl Kern has got something really important in this secondary root system. It is wrong perhaps to consider what viburnum will do in the light of how other plants behave because every plant is an individual, but we have found in other forms of plant propagation that if we can obtain a secondary root system, that is small branch roots from the soft primary roots which emerge from the cutting in the first instance that

those cuttings with the secondary root system will stand much rougher treatment, will go ahead more vigorously and generally are far less difficult to handle and deal with.

Our preoccupation with this problem was directed to machine planting of young material and cuttings coming out with soft roots couldn't be machine-planted. They just wouldn't take it, but get the roots toughened up and get a secondary root system and they will take it very well. I believe that is a very fundamental point.

CHAIRMAN FILLMORE: Are there any other comments on this topic of rooting viburnums with cuttings? If not, we have two other speakers, Mr. Kern and Mr. Hoogendoorn.

PRESIDENT WELLS: This question of viburnums from cuttings is not closed because we pass along to the next subject. If anyone gets a brainstorm and thinks of something, by all means get up and say it. These proceedings are going to be edited and put into some sort of order before they are finally printed. What we want is information, so at any time during the meeting if you have something to say on any topic, please come forward with it.

Now our next speaker is Carl Kern, and probably many of you know him much better than I do, but on a number of occasions I have met him and his wife, whom I am very glad to see here, too. She always comes with him to these meetings. Carl is another one of these real plantsmen. He sent me a magnolia some long time ago. I planted it in my garden and a man came along with a mower and cut the thing to the ground, and that was the end of Magnolia Carl Kern.

MR. CARL KERN: You will get another one.

PRESIDENT WELLS: That is what I had in mind. (Laughter). Without more ado, therefore, I would like to present Carl Kern, Wyoming Nurseries, Cincinnati. (Applause).

MR. CARL KERN: Mr. President, ladies and gentlemen: It gives me great pleasure to appear before you this afternoon and speak to you on the subject of viburnum. You know viburnums and magnolias are two of my pet hobbies. I have played around with those plants all my life. I give magnolias primary choice and viburnum second.

Just a few short remarks to give you some idea of the importance of the viburnums. We know of about 120 species of viburnums which are native of North and Central America, Europe and North Africa and of later years we have received these wonderful comparatively new introductions from eastern Asia which can be enumerated as high as from 54 to 70 Asian species. So you see, we have a tremendous reservoir of plant material to deal with from these viburnums.

All the viburnums are highly valuable shrubs of great plant material value in landscape composition or wherever else they might be used. We have tall species viburnums that will attain a height of 25 to 30 feet, such as *Viburnum rufidulum*, and I think I have another one here *Lentago*, the common inkberry, a native species.

Then, on the opposite side we have *Opulusnanum*—a plant about 18 to 24 inches in height, and the next medium-sized shrub, *cassinoides*, a very valuable plant in any landscape composition.

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All the viburnums are highly valuable shrubs of great plant material value in landscape composition or wherever else they might be used. We have tall species viburnums that will attain a height of 25 to 30 feet, such as *Viburnum rufidulum*, and I think I have another one here *Lentago*, the common inkberry, a native species.

Then, on the opposite side we have *Opulusnanum*—a plant about 18 to 24 inches in height, and the next medium-sized shrub, *cassinoides*, a very valuable plant in any landscape composition.

Among the viburnums, the general public thinks immediately of snowballs. That seems to be the charm of viburnum, the snowball. They all have a picture in their mind of a round, glossy, shiny ball of flowers. Among the snowball types, the flowers are totally sterile so you will never find any seeds on the so-called snowball viburnums.

The oldest known snowball is the European *Viburnum Opulus* and then we have our Japanese viburnum *Viburnum tomentosum, sterile* or *V. plitcatum* as it is sometimes called. The Chinese snowball viburnum, is *Viburnum macrocephalum, sterile*.

The Chinese snowball is perhaps the peer of all the snowballs. It will produce balls eight inches in diameter and the plant is loaded from top to bottom. The range of hardiness of the Chinese snowball is somewhat limited. I don't think it would grow as far north as Boston.

CHAIRMAN FILLMORE: No, not successfully.

QUESTION: What is the Latin name of that Chinese?

MR. KERN: *Viburnum macrocephalum*. That means big head.

MR. HOOGENDOORN: Is it true they have flowers eight to 10 inches across?

MR. KERN: Yes, eight inches across.

MR. KERN: These are just a few short remarks as to the family of viburnums in general, and I would like also to point out to you the value of the gorgeous fall coloring foliage of the viburnums. Some of these are: *Carlesi* is gorgeous. *Bitchuense* is a gorgeous sight with its hard-to-describe orangy-red color. All of our viburnums are very highly attractive subjects in the fall, aside from the evergreen species of which we are able to grow a few, but only one of which I would recommend.

Now, on the subject of seeding. The viburnum family produces most unusually attractive fruits which are at times more attractive than the flower or the foliage of the plant itself—I might say two-thirds of our viburnums are planted and grown for the attractiveness of their fruits. So in order to produce plants, then we go back to seed. That means we usually have seeds to produce plants in large quantities.

One of the first things the propagator concerns himself with in producing viburnum from seed is careful observation of the seed-bearing plants, beginning as early as August. Some of our viburnum species have a habit of maturing the seeds very early and others again are later. In order to acquaint ourselves with the habits and nature of these various maturing viburnums we have to watch them carefully.

One of the earliest to mature is *lantana rugosum*. They mature about the earliest. I have made it a practice to observe these plants carefully. As you are fully aware, viburnum seeds are of the bony hard shell type. A tough customer to handle, as far as germination is concerned.

I have made it a practice to clean the seeds early, just as soon as the first signs of approaching maturity appear. That is the time to get them. If you permit these seeds to remain on the mother plant until they reach full maturity, that seed coat becomes tougher and tougher. It will, therefore, take that much more time to germinate the seed. That is one theory I have followed consistently.

I might illustrate to you. You all know *Viburnum lantana* seed will remain on the bush until the seeds shrivel up, become black and hard, almost dry. You gather that seed and proceed to plant it and you will find that late harvested seed will lay over at least two years until it germinates. If you plant it in the fall, nothing happens the following spring. It lays over until the following summer and comes up the year after. You should gather your *lantana* seed early, when it just has reached about the transition point from green to red and a few berries here and there will already have shown that bluish-black color. I bring them in and let them mature on a tray for a week or 10 days. I always clean any seeds, especially the seeds of these fleshy viburnums. It is essential to wash these seeds clean, due to the fact that you can't handle the sticky gummy masses. You have to clean them. After the seeds are clean, I never permit them to dry too much. I let them dry so I can handle them. That is only a matter of six or eight hours or a day.

As soon as they have been thoroughly cleaned we stratify these seeds immediately in pure sand and, as the viburnum varieties come in we eventually reach the point at the middle of October or end of October when we plant everything out in seed beds at once, with a few exceptions. I would recommend fall planting of all viburnum seeds with a few exceptions which I will mention to you later.

A viburnum seed bed should be a well-prepared one, consisting of a sandy loam, perhaps a liberal amount of peat chopped in with it.

The method of planting seeds is optional. You may broadcast them if you want to. I prefer to plant them in drills. I use a strip of sheathing, I think about 4½ or 5 inches wide, draw the drill, and insert the seed. That does away with the laborious job of stripping the seed bed, sowing the seeds and then covering afterwards. By sowing in drills, we move backwards, push back beyond the seeds and we are always done. Incidentally, when the seedlings first appear, it gives us a chance to do a little cultivating, if necessary.

Now, the stratification of seeds, as I will mention at times, is quite an essential thing, especially of seeds of your old pet which has been mentioned so often, *Viburnum Carlesi* and the leather leaf viburnum. These two species have a funny habit. They never will germinate in the spring months. I don't care how I have handled these seeds, they will only germinate and the seedlings will appear late summer, July and August.

I brought with me here a sample of *Viburnum Carlesi*. It appeared about the middle of August. We potted them immediately. A plant like this would never carry over winter out of doors in an open seed bed. There would be 100 per cent loss.

At the end of one year, we have this. Now this is an average size plant. Sometimes we get them two feet high in one year. This plant is ready to be bedded this coming spring.

At the end of another year we have a *Viburnum Carlesi* of this type. Look at the root system. This plant is ready to go into the field now. You still see the remains of the old pot ball.

Now here we have a *Viburnum Carlesi* on its own roots, which I prefer to any grafted on *dentatum* or *lantana*. This is absolutely on its own roots, and incidentally, you will find a seedling *Viburnum Carlesi* is a better plant than any ever grafted or even a cutting.

Some of my friends say these viburnum seedlings won't bloom. Who said so? *Viburnum Carlesi* is a true species. It blooms certainly in the field after the second year. We have bushes in full bloom. You will find that plant really grows. This plant is only 30 months old from seed.

I brought a specimen of *Viburnum rhytidophyllum*. (Showing specimen of plant). *Rhytidophyllum* seed behaves like *Carlesi*. It will not germinate until late summer. We carry it over one year, transplant it in a bed and this is the resulting one year transplant of *Viburnum rhytidophyllum*.

I have selected types of these *Viburnum rhytidophyllum*, I am a great believer in the selection of types. Nature is a great selector of types when it comes to hardiness. We grow these seedlings from plants that I have known have survived for the last 30 years in the Cincinnati area, bloomed and had fruit in the last 30 years. In other words, they have become the survivors of the fittest. There is a great deal in the selection of types.

Among other things, I brought you here the result of seedlings of the Chinese tea viburnum, *Viburnum setigerum*. Here I believe we have one of the most gorgeous of all fruiting viburnums. It took these fellows two years and they sprouted this spring. It is a very rapid-growing thing. Incidentally, it is one of the best to grow from cuttings.

Among the other specimens, I have *Viburnum rufidulum*, the so-called rusty-black Haw, a native which I think has been overlooked much too long. You see it still carries its leaf. We have had several frosts and it still has a beautifully thick, glossy foliage resembling a laurel. *Viburnum rufidulum* lends itself to pruning in all forms. If you care to grow them up into pyramids or grow them in a standard manner, or a globe—head, you can do so. All these things are possible. As a foliage plant and for fruit, it cannot be excelled. It has always been a mystery to me that this native has never found its way into the nursery trade. The fruit starts in as a dark olive green fruit and turns—how could I describe it—to a sort of a plum-blue color, with a plum blush. Later, it goes over into blue-black in large heavy clusters. *Viburnum rufidulum* should be planted as a single specimen. When it is in fruit, it beats anything I could picture to you, even in the flowering shrubs.

Here are a few seedlings, one of *Viburnum lantana rugosum*. I know you are familiar with the *lantana*. This is *rugosum* or the so-called crinkly leaf viburnum. There again, we have a viburnum of exceptional value as far as its fruit is concerned,—great big, gorgeous clusters of berries three times as large as the common *lantana* and as a specimen plant it cannot be excelled.

Then I have a few more. It won't do for me to mention *Viburnum dilatatum*. It is not a novelty any more, but one of our best red-fruited viburnums in the business.

Among the commoner native viburnum are *Viburnum prunifolium*, which is next to a flowering dogwood. When that is in bloom it makes a nice plant. It can go 30 feet high, usually 10 or 15 feet. When in bloom it is a very showy, gorgeous plant.

Then among our common native species *Viburnum trilobum*, or common cranberry, need not be overlooked.

We also, of course, in every list have *Viburnum dentatum*. I use

Viburnum molle, the Kentucky viburnum in preference to *dentatum*. It is a much heavier, broader leaf, thicker foliage, and a heavier structural shrub which does a great deal more good as far as foliage effect is concerned than *dentatum*. Both shrubs are valuable adjuncts for shady plants and things of that type.

I am going to tell you something else about seeding other than viburnum. I would like to show you something in cherry. Here we have a seedling, a one year's seedling of *Prunus subhirtella pendula*, the weeping cherry. This plant has grown from a seed smaller than a small half-size pea, since the end of March, to a three-foot plant. It is unbelievable. You will notice the tendency of these little branches to become pendulous.

Now it is amazing that in two years' time I can grow a weeping cherry to four or five feet height, and the *Prunus subhirtella* in the market are standard grafts on a common sweet cherry which seems to have a dwarfing effect of the weeping cherry. E. W. Wilson (Chinese Wilson) from the Arnold Arboretum, with whom I have talked many a time, used to tell me he had seen *Prunus subhirtella pendula* 80 feet high. He mentioned that in his book, "Natural Things Weren't Grafted." They grew on their own roots from seeds, and I have been doing that.

I gather these seeds from a grafted specimen of *pendula*. I know it is a good pink. They may vary from blush pink to pink. Look at a plant like that. You can get trees 40 or 50 feet high of weeping cherry.

MR. HOOGENDOORN: Is that the single flower?

MR. KERN: The single type. There is no seed on the double.

MR. HOOGENDOORN: The stem of the single flower—is that not called "Higan Cherry?"

MR. KERN: I believe that is what it is. The double never seeds, of course. The only trick is to gather the seed of these cherries. Sometimes we have a late spring treeze and the seed of these flowers is lost. It takes a lot of time and patience and observation to gather these seeds and most important of all, we have got to beat the birds to the punch. The birds wait for these cherries. They are gone in one day. Maybe that is the reason things like that are never listed.

Now I have very nearly reached the conclusion of my talk on viburnums. Here I brought also a seedling of *Cedrela sinensis*, a tree that has been overlooked too long, big compound foliage in summer creamy white, bluish-black berries in the fall. It is a tree of China. This plant grew in one year.

If any of you care to look over these specimens later on, I will take them to the table and we will do our best to answer questions.

MR. HOOGENDOORN: Those little seedlings you showed us, how do you keep them over winter?

M. KERN: We carry them over in a cold deep frame. They come through 100 per cent.

MR. HOOGENDOORN: Don't you have trouble with damping off?

MR. KERN: We cover with glass, carry them air-tight. They come through.

MR. PIETER G. ZORG (Fairview, Pa.): We have trouble when we buy our seeds of viburnum. The seeds come up in about September or October and then when they come up they stay just above the ground and in the cold they freeze and we may many times lose them. What do we do in a case like that?

MR. KERN: Like I showed you, I pot them.

MR. ZORG: Where you have thousands and thousands, it takes a lot of space.

MR. KERN: You might try covering with pine needles or sawdust.

MR. ZORG: Wheat straw is used and then in the spring we always check them and we find some of these varieties coming up already.

MR. KERN: I wouldn't use common wheat straw. Wheat straw carries too much moisture. It becomes supersaturated. You should use pine needles or sawdust, which is fluffy.

MR. ZORG: Is there any method known to you to hasten germination?

MR. KERN: I might tell you this: I started to experiment with these sulphuric acid solutions, 1 and 2 and 5 per cent solutions. I have subjected the seeds to the action of sulphuric acid. So far I haven't gotten anywhere. It is too early to say anything about it, but I think eventually I will be able to break these seeds so they will germinate in April and May instead of three months later. When we do that, we can grow this thing the first year.

MR. HUGH STEAVENSON (Forest Keeling Nursery, Elsberry, Missouri): I would like to comment on that dormancy of the shoot that you referred to. All types of viburnums have two kinds of dormancy—hypocotyl and epicotyl, which is shoot dormancy. The roots start growing in the first summer and if you will dig in your seed bed you will find a very extensive root system by fall, but the shoot is still dormant and it has to go through the second cold period to break dormancy and it shoots up the following spring. I think where you get them early you no doubt get that root growth the first fall, when normally it occurs the following summer.

MR. KERN: That is right.

MR. STEAVENSON: Viburnums are nearly always a two-year proposition.

MR. KERN: In closing my remarks, I have made a list here of the specimens of viburnum which I would recommend for mass production from seed:

Viburnum acerifolium. It is a native, low-growing, excellent for shade plan.

Viburnum alnifolium, a great big, enormous, broad-leafed viburnum, a very valuable plant, also a native.

Viburnum Carlesi.

Viburnum dilatatum, the Chinese red species.

Viburnum molle.

Viburnum nudum, with laurel-like foliage, shiny and very beautiful. This viburnum should be grown more.

Viburnum trilobum, the high-bush cranberry.

Viburnum prunifolium or so-called black haw.

Viburnum rhytidophyllum, the leather-leaf viburnum.

Viburnum rufidulum, the rusty black haw.

Viburnum setigerum, Chinese tea viburnum.

Viburnum tomentosum can be grown from seed very successfully. There again, you must be on the trigger when the seed is exactly right, red. You might be two days too late. You have to catch it right at the right moment.

Viburnum Wrighti, another red fruiting viburnum.

Viburnum dentatum, the old arrow wood.

And *Viburnum Sieboldi*, another one of our tall-growing Asiatics. Speaking of *Viburnum Sieboldi*, there is one of the trickiest things. I have stratified *Viburnum Sieboldi* seed and tried to hold it over until the middle of March. Invariably, I lost it. It must be fall planted. *Viburnum Sieboldi* in one year will grow 15 or 18 inches high.

This is a list of viburnum species, the clones of which I would recommend for seed production in large quantities. Any other question?

MR. HOOGENDOORN: Do you find *Viburnum Wrighti* comes true from seed?

MR. KERN: Yes, we get good seed.

MR. HOOGENDOORN: Does it come true?

MR. KERN: Yes, it is an original species, not a clone. Often my friends say *Viburnum Carlesi* seedlings won't bloom. I say, "How come? Who said it won't bloom? We proved that long ago." It is an original botanical species and will bloom.

I will say this, in these seeding operations and handling thousands of seedlings we ran across quite a few outstanding variations. I have some crosses from seeds gathered from *Viburnum Carlesi* and *Viburnum Burkwoodi* which I grew side by side. I obtain crosses. Some will hold foliage, yet they bloom like *Carlesi*. I am watching these things carefully. Maybe some day we will stumble across something.

Another thing you might hear about, in the next two or three years—we are about to introduce a pink Japanese snowball. Now that may sound pretty fishy to some of you men, but we were fortunate enough to observe a twig on *Viburnum plicatum*. The foliage was deeper and greener. It just was different from the rest of the plant. That twig attracted my attention and I thought it might be something valuable. I was able to get a piece of wood and made three buds. I happened to have *tomentosum* in the field, and I budded it. The following year the buds stood very well. Last year, I was able to get the first bloom on these buds and I have appleblossom pink viburnum. I am now in the second generation to prove whether this thing is constant. You know they can reverse themselves. I may wind up

with a pure white one, like the original plant. However, I think possibly a pink snowball is in the offing.

MR. HOWARD SCARFF (W. N. Scarff & Sons, New Carlisle, Ohio): What has been your experience with *Viburnum Burkwoodi*?

MR. KERN: That is a clone.

MR. SCARFF: Will it revert?

MR. KERN: You get all sorts of types. That *Viburnum Burkwoodi* is a hybrid of *utile*, an evergreen viburnum and *Viburnum Juddii*, which is a hybrid clone (*V. carlesi* and *V. bitchuense*). We have *Juddii* growing from seed. It is not the real thing.

Another viburnum is *Viburnum Chenaulti*, another coming viburnum. It is a pink bloomer, seeds very heavily. It is hardly mentioned yet, but a very fine plant.

MR. A. SHAMMARELLO (South Euclid, Ohio): In a block of *Viburnum tomentosum*, I found one form resembles arbor vitae. Will you tell me what it is. I don't think it is anything new.

MR. KERN: In the trade there is a *Viburnum tomentosum* Hessei, a compact form that the Hessei Nursery in Germany propagated. That might be one of these sprouts. Hang onto it.

MR. SHAMMARELLO: I have never seen it in bloom.

MR. KERN: It may bloom eventually. I would hang onto it. There is one variety, called, "Hessei."

MR. LADDIE J. MITISKA (Mitiska Nurseries, Amherst, O.): I wish to comment on the flowering qualities of *Viburnum Carlesi*. We have about 15 plants. We gathered the seeds and picked out 15 pounds of clean seed. I think that shows they bloom nicely.

MR. KERN: Again I might tell you, we are never sure what seeds will do from year to year. There is no fixed rule. The maturity of seed is variable, just as variable as the weather. One year you may have a tremendous crop, 100 per cent germination results, another year you come out zero, nothing doing, so you have to have a lot of perseverance, patience and "stick-to-it-ive-ness," and that is the only way you will get results. There is no cure-all for everything.

In closing my remarks, I might say that we love this work in our Plant Propagators Society. We love the activity as a whole. We propose to plant propagators to disseminate good practical knowledge and we propose to pursue the science of plant propagation along scientific lines. Let us first of all be propagators and not "profitgators." (Applause).

PRESIDENT WELLS: I am glad to see everyone so heartily endorses that last remark.

Just a couple of comments before Dick introduces the next speaker. We don't want to be pedantically difficult about getting these records down, but would you please be very careful when you get up to speak clearly and speak loudly? The essence of this meeting is in what this lady is doing down below here and she needs to hear what your name is and what you have to say. So speak slowly, clearly, distinctly, enunciate your name so she knows what to put down.

The second thing, a number of people have brought plant material and at the end of the afternoon meeting we will try to get some tables set up here and get this material lined out so for this evening's meeting we can have the material on hand and it will, no doubt, form a basis for much discussion. If anyone has anything with him, will he please bring it along after the meeting is over this afternoon, so we can set it up?

CHAIRMAN FILLMORE: Now I would like to make a couple of comments also. The first one is that Mr. Kern's discussion of green seed or nearly green seed interests me a good deal. I don't know of a single instance where, if the embryo is excised from the seed at the proper time, that embryo will fail to grow. In other words, the embryo begins to develop and it goes on developing and at some time in its development dormancy is usually imposed upon it by the fruit. If the fruit matures very fully, the depth of dormancy may be very great; if the fruit is relatively immature, dormancy may be relatively short. If the embryo is excised early and grown under sterile conditions, dormancy may not be present at all. There is, therefore, a very great deal of advantage sometimes in handling seeds in the green condition.

There is another thing, too, not all viburnums have dormancy. For example, I once got a collection of *Viburnum nudum* from the Carolinas in which there was no dormancy whatever. We simply sowed cleaned seeds in a warm greenhouse. They germinated like tomatoes. The Boyce Thompson Institute has reported *Viburnum scabrellum* which behaves the same way. I have never been able to find *scabrellum*. I understand that southern *scabrellum* and northern *dentatum* are related. There is a complex, beginning with *dentatum* in the north and going south into *pubescens* and *scabrellum*. At the southern extreme you have seeds which will germinate freely and don't exhibit dormancy and in the north with the *Viburnum dentatum* you may have the double type of dormancy which was mentioned earlier in the afternoon.

Now I should like to introduce Case Hoogendoorn of Newport, Rhode Island, whom I have known for a number of years. Mr. Hoogendoorn is one of the most competent and successful plant propagators in the east. I have frequently visited his greenhouses. His latchstring is always out and I would certainly urge any of you folks who find yourselves in the vicinity of Newport to try to call around on his birthday because that is always a festive occasion and he is particularly happy and glad to greet visitors at that time. (Applause).

MR. CASE HOOGENDOORN (Newport, R. I.): Mr. Chairman, ladies and gentlemen: They selected me to speak on "The Grafting of *Viburnum*" which to me has a lot of advantages.

I didn't bring any sample or demonstrations. All I brought was some paper and what I am going to read to you is only our experience with grafting viburnums, and as you will notice, we still have problems. Most viburnums are easy to graft, and the one we have most trouble with is *Carlesi*. That is why I want to tell you our experience. After I get through, maybe somebody can straighten me out with some of these problems.

. . . Mr. Case Hoogendoorn read his paper on "The Grafting of *Viburnum*" . . .

The Grafting of Viburnum

C. HOOGENDOORN, NURSERYMAN

Turner Road, Newport, R. I.

We graft Viburnum and do both winter and summer grafting and will start to discuss the understock we use for grafting.

We graft Viburnum and use nothing but Viburnum Dentatum for understock and only use Viburnum Lantana when we cannot get enough Dentatum.

However, in the past we experienced considerable trouble with black spot and leaf drop in the foliage of Viburnum Carlesi.

Years ago in Holland we used nothing else but Viburnum Lantana for understock so after I came over, continued to use Lantana for understock.

Finally about 1930 we tried Dentatum as an understock and discovered that we were getting just as good a growth and were not bothered half as much with black spot and leaf drop.

Since then we have always used Viburnum Dentatum as an understock except when we cannot get enough Dentatum.

I know that a lot of people object to grafted Viburnum and complain about suckering and they are fully justified in a good many cases. In order to overcome that, we use nothing but nursery grown Viburnum Dentatum, one or two years old and de-eye all understock (especially around the neck of the root) before potting. We have never used collected Viburnum Dentatum. We've looked into that when nursery grown seedlings were sometimes unavailable but the samples we received at various times showed they were mostly suckers and loaded with sucker eyes all the way through the roots. We have skipped grafting Viburnum in some years rather than graft on collected stock:

No doubt, a lot of people have a good reason to complain about suckers on grafted or budded Viburnum if they bought them from a careless propagator or grower who did not go to the trouble of de-eying his understock.

We take most of our grafted Viburnum and plant them in a bed for one year before we sell or line them over the field. When we dig them from the bed, we look them over very carefully again for suckers. We may find a few small suckers (and it is only a few) which were too small to see or were skipped in the de-eying process. After that we line them over the field to grow into saleable plants and whether we have them for two or three years or more in the block, we very rarely find any more suckers. I hope that this explanation will do away with a lot of the prejudice many people have against grafted Viburnum. Just buy them from a conscientious nurseryman and you will be alright.

I realize that I have gone way ahead of myself as I still have not told you anything about grafting.

We pot all of our understock in good potting soil with some sand and peat mixed in it to prevent the soil from getting sour in the pot.

About the middle of October we pot up our understock for winter

grafting. If you can keep the foliage on for some time, they will reroot very readily which is preferred. If you do it too late or too early, the leaves will drop soon after potting and then they will not start rerooting until February when you get action again in the tops.

When we graft them we leave the tops on and use a side graft and then put them in the sweat bench with the unions buried in damp peat moss. As you all know, a sweat bench or just as often called a grafting bench in a greenhouse is covered with sash on top of the bench.

After the grafts are in this grafting bench, they have to be watched very carefully. Viburnums do not like excessive humidity so the first thing we do every morning is to hang up the sashes and drain off all the excess humidity which collects on the glass. Then we leave them open for ten or fifteen minutes and as they progress, we extend this airing period. During the hottest part of the day when the sun is out, we roll thin linen over the glass for shading.

Viburnums react very quickly under glass and in about ten days we put a two inch stick under each sash and carry air on them continuously. We have learned through sad experience that Viburnums do not like too much heat and the more they progress, the more air we give them. That way they are well hardened off by the time they are fully united and ready to be taken out of the bench. We have had a lot of trouble while they were in the grafting bench because after a while, we got a swelling at the terminal of the scion and they would split right down. This, in turn, dried out the scion and just killed that graft.

At first when we did not know this, we had severe losses that way especially when we grafted them in March when the greenhouses were getting pretty hot. So after that we have always grafted them in our first batch of grafts around New Year which is the coolest part of the winter in the greenhouse. We have overcome this splitting pretty well by careful watching.

One thing I would like to mention now is that we have never experienced as much trouble with splitting in *Viburnum Wrightii*, *Burkwoodi* or *Setigerum* as we have in *Carlesi*. We find that *Viburnum Carlesi* is the most troublesome with this splitting.

Since we have found out that Viburnums do not like too much heat and moisture, we started to experiment with grafting them on an open bench. We bury the union under peat and just throw some papers over them for the first two weeks. Every morning we take these papers off and fog them with a fine spray nozzle and then put the papers back again.

In about two weeks we get considerable action and most of the scions are breaking by that time. Then we take the papers off altogether. On sunny days we keep fogging them once or twice a day.

Just as soon as most of them are well calloused and united, we set them over and at this time put them on top of the peat in order to harden the callous. We bury again the ones which are not fully united until they are finished up.

The reason for setting these grafts over is a very important one. We have found that once your graft is united and you leave that graft buried in the peat, the callous starts to get watery and turns black and you can lose your grafts just as fast. So you see that no matter whether you

graft in a grafting bench or open bench, your grafts always need careful watching.

Well, that is our experience with winter grafting of *Viburnum* and as I mentioned in the beginning, we also do summer grafting. This has several advantages which you will notice as I go along.

The plants we graft in the summer are potted up in the spring in April and plunged outside in an open bed. This potted stock is left there until the time we graft them.

We generally graft toward the end of August or in the beginning of September. This depends on when our scions are ready since this is the dominating factor in summer grafting. We have to wait until we find branches which have stopped growing and are sufficiently hardened off. We have found that branches which are growing will wilt and do not callous and will fungus very easily.

I would like to mention now that fungus is your biggest danger in summer grafting and so we take all the precautions we know of to avoid this.

After we plant out all our stock from the greenhouse, we clean them out by carrying out all peat and sand and even cleaning underneath the benches. Then we give them a thorough washing and let them dry out as much as possible. We open all the doors and ventilators in order to get as much air and sun in there as we can. When they are thoroughly aired out we apply a coat of cuprinol to all the benches and leave these houses to air and dry out until we start making cuttings and grafting again. Then we bring in all new sand and peatmoss again and start off a new season. We also put on a coat of whitewash on the glass and shades to try to hold the temperature down as much as possible.

When we bring in our *Viburnum* stock which we are going to graft from outside, we take a cloth and wipe off all our pots and also the base of the stem. Of course, by the time we graft these summer grafts, the stems are potbound so we cut them off about an inch or more above the pot; just enough so that we can graft on the stub. We take these grafts and put them in our grafting bench under glass and bury the union under damp peatmoss.

Every morning we open up our sashes to drain off all excess moisture and air them for ten or fifteen minutes and again this is increased as the grafts progress. On sunny days we roll the linen over the glass as well.

While we have the bench open, we go over these grafts very thoroughly looking for fungus and also remove any bad leaves we may find. As I mentioned before, in summer grafting fungus is your biggest danger as it will wipe out a batch of grafts in no time. You must always remember that a greenhouse in the summer is hot and humid and this is the ideal condition for fungus growth. But before you get that far, your grafts are a constant worry.

These summer grafts also have their advantages. In the first place, you do not need any fuel. In the second place, a summer graft which has been lined out for one year is a much stronger plant and a freer grower than a winter graft which has been lined out for one year.

The reason for that is, of course, very easy to explain. Your winter

graft has been forced into growth during the winter while you were grafting it and carried in the greenhouse until spring. After it is planted out, it will take time out to rest and will rest for a considerable time before it starts to grow again.

Now you take your summer grafts. It has not been forced into growth while it was grafted. After it was united and ready to get out of the grafting bench, it was taken to an outside cold frame and sash put over it. Then we start to air them again and as time goes along, give them more and more air to harden them off again to get them in shape to withstand the winter.

By late fall they will drop their leaves and go to sleep and rest all winter. When these grafts are planted out in the spring, they will start to grow and grow continuously all summer long as they have had their rest period during the winter. Consequently, you get a stronger growing plant.

Here is one more reason where summer grafting has an advantage. We have grown *Viburnum Carlesi* from seed for about twenty years (that is, whenever we were able to obtain the seed). Right now we have a considerable number of stock plants anywhere from three to five feet.

Naturally, anything grown from seed will almost always show some variations in foliage and habit of growth, etc. and this is also the case with *Viburnum Carlesi*.

Since a lot of our stock plants are coming into maturity, we noticed a couple of years ago that there were some outstanding plants among them. By grafting in late summer we have an excellent chance to select these plants to cut scions from.

For instance, we noted that some plants will hold their foliage much better than others. Some will have nicer foliage than others. There are some that will have larger flowers and some will hold the pink in the flower longer than others. Then again some plants will show a better plant structure and form a better bush. And last, but not least, some plants form flower buds more readily than others and are more persistent budders.

So what we are after now is to gradually get a selective type of *Viburnum Carlesi* which is a good grower, has good lasting foliage, large flowers and is a persistent budder.

I know this is a mouthful and that is why it will take quite some time before we will be able to work up a stock but I think it is worth the effort.

But what I mainly tried to bring out is that you cannot select scions for foliage in the winter. So here is one more advantage to summer grafting.

CHAIRMAN FILLMORE: Do we have any comments or questions for Mr. Hoogendoorn on "The Grafting of Viburnums?"

DR. HENRY SKINNER (National Arboretum, Washington, D. C.): This may be beside the point. Mr. Hoogendoorn starts from grafting. I wonder if this isn't the logical time to bring up the point as to whether one actually should graft or shouldn't graft *Carlesi*. That is, on the kinds of stock generally used. The suckering is one point which you made. It seems to me it is logical we might be able to find a non-

suckering stock on which Carlesi should grow as vigorously as it does as a seedling, as was pointed out earlier this afternoon.

I might cite an experience in Philadelphia with a Carlesi which as far as we can tell is up to 30 years old. It was up to 4 feet high once. It was a grafted plant. Now that plant, had it been a seedling at 30 years, I believe should have been possibly in the neighborhood of 10 feet high at least.

MR. HOOGENDOORN: Not necessarily. We have also found slow-growing types among the seedlings. In fact, we have one now. I found it a couple of year ago, which I have called "compact," which is a very compact growing one and makes a beautiful bush and has a large flower.

DR. SKINNER: You will get all variations from possibly dwarfs. You may get vigorous ones and the good types you mentioned. The good types should by all means be selected. I am wondering whether we hadn't better propagate on an improved stock or try some other method.

MR. HOOGENDOORN: Some prefer softwood cuttings in order to reproduce the selected types and we have done that, too. We have grown viburnums grown from soft wood but the cuttings haven't much boost to them. They are very slow-growing plants. So from a commercial point of view, it wouldn't pay us to grow them and we went to grafting where we get a vigorous plant faster.

DR. SKINNER: You have assurance that that plant will be as vigorous.

MR. HOOGENDOORN: Absolutely.

DR. SKINNER: That is the question that is always raised, and I am just wondering how true it is.

MR. HOOGENDOORN: Naturally, if you take a graft from a vigorous plant you will reproduce that vigorous plant, and I have talked with other people at the convention last summer and I passed the same remark. In the first place, it is a battle to root and winter Carlesi from cuttings, and once you have them and they don't grow, it isn't worth the effort. I was talking to a few nurserymen and they had the same experience and they were going to quit just on account of its being so slow-growing. We can grow them faster, so we will stick to grafting.

DR. SKINNER: I might mention just during the past week I received a letter from a European nurseryman coming over this summer, whose main object was to open a market for special types of grafted azaleas and I told him I would be glad to help all I could. I know the gentleman well. I said, "First off, think of a really good reason why you want to sell grafted azaleas in the United States, because that is one question that is going to be asked you."

MR. HOOGENDOORN: That is the hybrid type. If you want to reproduce the same varieties, the only way to reproduce them is graft. He isn't going to have much success trying to graft them in this country.

DR. SKINNER: They have an idea hybrids will only occasionally come from cuttings.

MR. HOOGENDOORN: The trouble we have found with

azaleas is that it is too hot and dry here in July for summer grafting, you think you are cutting a good scion. You put it in the bench and graft it and two days later it will be hard as a rock.

MR. HANCOCK (Cooksville, Ontario): Mr. Chairman and Mr. Speaker, without questioning your judgment that the strong growing variety should be the source for your propagating material, I would like to raise the question whether some of those variations or apparent variations you see in your grafted plants are not due to some special compatibility with that particular seedling which you used for that plant, and if you didn't have it on that stock it would return to just the straight line material. I think you should take into account that when you graft any plant the influence of the stock on the scion is considerable, so you get variations due to the understock, just as in growing a dwarf apple you will get considerable variation because of the understock. This variation would hold good in ornamentals. I would question whether you get anything permanent if you select variable stock.

MR. HOOGENDOORN: Those were selected seedlings.

MR. HANCOCK: I thought you were speaking of the graft material.

MR. HOWARD BURTON (Hill Top Nurseries, Casstown, O): I wish to voice a minority report on your understock and it may be due to the different climate but *Carlesi* grafted or budded on *lantana* makes a vigorous growth and a better plant than on *dentatum* or *molle*, and with no more suckering, really, I don't believe as much suckering. We much prefer *lantana* to *dentatum*. We gave up *dentatum* after a few years' trial.

MR. HOOGENDOORN: We have found *dentatum* is every bit as good. We found when we were grafting *lantana* we had considerable trouble with black spots and leaf spot. With *dentatum* we didn't have half as much. We are using today *dentatum*.

MR. BURTON: The plants side by side would be half the size.

MR. HOOGENDOORN: Again, that might be a question due to soil or climatic conditions. In our neck of the woods we found it the other way, and that is why, after all, you may tell the other fellow how to do a thing or your experience, but that doesn't mean you can go home and do the same thing, where you have a variation in climate and soil.

MR. MARTIN van HOF (Rhode Island Nurseries, Newport, R. I.): To answer that question about the understock, about *dentatum* and *lantana* understock, I could say in our section we are surrounded by salt water. Newport, Rhode Island juts right out. We have black spot not only in the *Carlesi* but we have black spot in the *lantana*, so we dropped the *lantana* in order to overcome the black spot in our *Carlesi*, so we used *dentatum* exclusively. Our growth on *dentatum*, as Case said, is really No. 1. We grow a four-year *Carlesi* that size and that broad. (three feet by three feet).

MR. KERN: I have heard the remarks made here about black spot with *Viburnum Carlesi*. I don't believe I have ever seen it. One of the most hazardous agents that might come in contact with *viburnum* is sulphur, sulphur dust in any form. Keep sulphur away from any viburnums.

Even the slightest whiff of sulphur dust and black spot shows up in 24 hours.

MR. HOOGENDOORN: What would you use for black spot on viburnum?

MR. KERN: I never had any.

MR. HOOGENDORN: Wonderful. Lucky. (Laughter)

MR. R. M. FISHER (C. R. Burr & Co. Inc., Manchester, Conn.): I think from the plantsman's standpoint, who ultimately uses the plant, *dentatum* is much better. For the ordinary layman it is pretty hard to see the suckers on *lantana* and the first thing you know they have a plant that is all reverted and they will come and ask what it is. Sorry, you got the wrong plant, whereas, in *dentatum* they can at least see the suckers quite readily and take them out.

Another thing about vigor, I think you get the same vigor, in fact I have had the same experience you have had, more vigor with *dentatum*, and of course, we have suckers because we bud ours. I would rather bud them than graft them. We bud them on *dentatum* and the vigor is there.

MR. HOOGENDORN: Don't you de-eye your stock before budding?

MR. FISHER: No. If you get too much soil up around the stock, it seems to want to sprout under the ground surface.

MR. HOOGENDOORN: That is why I prefer grafting, because you can't control your suckers.

MR. FISHER: That is the difficulty with budding.

MR. JACK BLAUW: On your winter grafting, is it necessary to wax the understocks?

MR. HOOGENDOORN: That is what we did in Europe.

MR. BLAUW: We dip them in wax.

MR. HOOGENDOORN: We don't. We tried that, too, but we are getting away from wax inside the greenhouse. We used to wax maples and blue spruce and even then we found you have quite some losses again at the end of March and during April while they were in the greenhouse because the wax draws the heat and I have seen a lot of them dying. We tried waxing magnolias and they would still die at the end of March and April. When it is hot in the greenhouse the wax draws the heat. That is what kills them, so we are getting away from waxing.

MR. BLAUW: We don't have any trouble.

PRESIDENT WELLS: What do you use instead of wax?

MR. HOOGENDOORN: Nothing.

PRESIDENT WELLS: Just bury the union in the peat?

CHAIRMAN FILLMORE: I would like to comment on that. I think a good many people who are waxing and that might include Case, are using too much. If you heat the wax to between 160 and 170 degrees and keep it there and just dip your plant in and out, you will be all right.

If the wax gets any colder and particularly if you have real cold material going in, you are going to get too much wax on. Most of the waxing I see, the plants have been waxed too heavily. I have had splendid results with maples and magnolias by waxing them all over with Parowax. I think you have to control the temperature of the wax or you get too much on.

DR. FRED J. NISBET (Musser Forests, Indiana, Pa.): I wonder if anyone has used any of these compounds made from the Goodrich Latex, such as Plantex, to get away from the dipping of the paraffine and yet holding the moisture within the plant. It would seem like a good opportunity to get something that would go on easier and give you less trouble.

MR. HOOGENDOORN: I don't know.

CHAIRMAN FILLMORE: Any comments on the use of Latex for grafting?

MR. JAMES ILGENFRITZ (Ilgenfritz Nurseries, Inc., Monroe, Michigan): We do have a product which we call Plantex, which is the Goodrich VL600 with a wetting agent. That is what all of them are comprised of.

I would not recommend Plantex for grafting because I believe the preparation is very penetrating and it will enter into the joint, the union, to such an extent that I would hesitate very much to use it.

PRESIDENT WELLS: We had a member of the company come to our nursery a little while ago and suggested to us that we could use that Latex compound and spray it on the grafts after they were completed in flats before they went into the greenhouse as it is sprayed onto the plants out in the open field. We haven't tried it. I felt very doubtful about it. It didn't seem to me that would cover the plant as it should, but maybe we are not right. I think perhaps we should try it. We have tried it; we are trying it at this moment on cuttings, and it does seem to have a place there. That is rather getting off the point of viburnums but it seems to help on rhododendron cuttings.

CHAIRMAN FILLMORE: Any other comments?

MR. MARTIN VAN HOF (Rhode Island Nurseries, Newport): As usual, Case was very thorough in explaining the graft, as he does everything. Whatever he does has to be just so. There is one thing I don't think he brought out in that summary of grafting, and that is the preparation of the peat. I think he skipped that.

MR. HOOGENDOORN: No, I mentioned the viburnum and peat.

MR. VAN HOF: I mean the moisture content of the peat, especially in summer.

MR. HOOGENDOORN: The moisture content should be very, very light, again to fight the fungus.

MR. VAN HOF: Another thing, when he brings them out of the greenhouse—I don't think he mentioned that—in what sort of a frame.

MR. HOOGENDOORN: We put them in a frame with high sides.

CHAIRMAN FILLMORE: Any other comments or questions?

Well, you have heard me speak very briefly about one possible means of rooting and of wintering viburnums. You have heard numerous comments to the effect that not disturbing the plants and permitting them to make secondary root systems will encourage better survival.

You have heard Mr. Kern say that collecting seeds somewhat on the green side will help to ensure quick production of seedlings, especially in the species. Clones, of course, will have to be propagated by some vegetative method. Mr. Hoogendoorn has suggested grafting viburnums both in winter and in summer as a possible means of perpetuating these clones, so one can be assured of having dwarf plants or plants with superior flowers or more flowers, as the case may be.

I would like to say frankly that I have no prejudice against grafted plants. I don't think that we should even work toward trying to produce every plant from cuttings. In many cases, plants on their own roots will be disadvantageous, as in the case of certain commercial peaches in nematode-infested soil, and there are many other similar instances. I think the grafting technique is here to stay.

I believe *Viburnum dentatum* stocks, either from seeds, cuttings, or layers, when properly de-eyed and properly grafted or budded make comparatively satisfactory stocks for *Viburnum Carlesi*. By the time the plants attain two or three feet, at which point they would normally go on the home grounds, if they have been properly handled in the meantime, the chances for serious suckering or deterioration at the union or any other difficulty is relatively slight. I think that concludes the discussion of viburnums unless there are further questions or comments, in which case we would be very glad to have them.

PRESIDENT WELLS: Didn't you want to say something, Mr. Bosley?

MR. PAUL R. BOSLEY (Bosley Nursery, Mentor, Ohio): I was rising to make comment on the use of wax and on the use of the Goodrich spray material. Last year, we used it on azalea. On one group we sprayed the Goodrich material and another group we dipped in wax that I am sure was satisfactorily warm and we got a thin covering. With the wax-dipped material we had probably a 98 or 99 per cent stand that made excellent growth in the field. With the Goodrich material we had noticeable losses, but the losses in the case of the Goodrich material were not nearly as great as the losses we had by the old method of grafting in a closed frame with fungus and other things overtaking the graft, so the Goodrich material stood intermediate between the closed frame and the wax-dipping. That will answer two questions here. We conducted the experiment very carefully.

I would like to ask Mr. Ilgenfritz a question. You made a statement that the Goodrich material had a penetrating effect and that all wax materials being offered were basically Goodrich material. Did I understand you correctly?

MR. ILGENFRITZ: No sir. Goodrich VL-600 is not penetrating of itself but to make it effective in the work where we use it, we put a wetting agent in it. That is true of Plantcoat. It is true of Wiltpruf and Plantex, the three products being offered right now. I believe the wetting agent, such as Santomerse S, will convey some of the material in the cleavages of the joints. That is why I feel outside of experimentation it

should not be attempted for grafting. We had a little experience in our own greenhouse which bears out that feeling. I shouldn't condemn it.

MR. BOSLEY: We used the Goodrich material straight without wetting agents.

MR. ILGENFRITZ: Certainly, you shouldn't have that effect.

MR. Bosley: We used paraffine as a dip.

MR. ILGENFRITZ: If you felt that I said there was any connection between wax dip and Goodrich VL600, I didn't mean to convey that.

MR. BOSLEY: I wanted to know whether you meant to say Goodrich material penetrated the tissues by reason—

MR. ILGENFRITZ (Interrupting): No.

CHAIRMAN FILLMORE: Any other comment? We shall adjourn for this session, then. (Applause)

. . . President Wells resumed the chair . . .

PRESIDENT WELLS: Don't go away, gentlemen. We are not adjourning the meeting.

There seems to be a lot of controversy over this, and Charlie Hess is here and he is "agin" wax for the same reason that Case is "agin" it. Maybe these Dutchmen have got together, but we are using wax and we are using it very successfully, and certainly we get a few losses as recorded in grafting maples. They apparently grow together quite well and make initial growth and then the young growth dies, but nevertheless, it is the best method we have found yet and we are getting much higher percentages than when we were putting the plants in sweat boxes and other confined quarters. We have found that in general the further we can get away from confined quarters the better we get on. Now that is a sweeping generality, and of course, there are exceptions to it, but maybe this evening if we have time—I brought a few slides along to show some experiments we made this summer, propagating right out in the open without any protecting whatever. That is on the other end of the pendulum as against the sweat box, but there is more in this than meets the eye. Just because it sounds a bit hard we shouldn't discard a suggestion. We should try it out because you get some rather astonishing results sometimes.

Well now we come to the second main speaker this afternoon. You all know Chad. No need to introduce him in the normal sense of the word.

I remember the first time I came in contact with Dr. Chadwick I think it was in Philadelphia in 1949 and I heard him give a talk which showed conclusively no matter what we did, if we took a crop of B and B plants off the ground we never could recoup what we lost. He worked it all out in a most remarkable manner, I thought, at the time, a sort of profit and loss account and even if you piled manure on and ground crops you still had a definite loss.

I said to somebody at the meeting, "Who is Dr. Chadwick?"

"Oh," they said, "he is a damn fine fellow. Even if he does work for

a university he is a man of the land and he calls a spade a spade." That was my introduction to him, and I found it a very sound appraisal of him. So, with that, I would like to call upon Dr. Chadwick to give his address. (Applause)

. . . Brief recess . . .

DR. L. C. CHADWICK (Ohio State University): I might say first I am happy to be here and see such a large crowd. I think when we organized this group or meeting last year we had no anticipation that it would increase to such proportions in one year's time.

. . . Dr. Chadwick presented his paper on "The Importance of the Selection of Propagating Wood." (Applause)

The Importance of Uniformity and Timeliness In the Selection of Propagating Wood

DR. L. C. CHADWICK

Department of Horticulture, Ohio State University

Much has been written in the past denoting the importance of uniformity and timeliness in the selection of propagating wood and perhaps little that is new can be added at this time. However, it seems to me that the subject is of sufficient importance to warrant discussion. Those who have had an opportunity to visit the commercial nurseries at Boskoop, Holland, surely left impressed with the uniformity of the nursery stock propagated in that region.

In the commercial propagation of plants interest centers around two things primarily, (1) quantity production and (2) the quality of the plants produced. During the past few years, with the scarcity of nursery stock, emphasis seems to have been more on quantity than quality in many of our nurseries. Quality of young propagated stock and quality of larger saleable stock seems worthy of considerable emphasis in the U. S. nursery circles today. Poor quality propagating stock results in poor rooting percentages, or the rooting may be slow and the growth weak. Such slow or weak growth seldom responds to give good finished plants.

In the discussion of this subject it must be emphasized that uniformity and timeliness in the selection of propagating wood are not the only factors responsible for successful propagation. Undoubtedly there are others of equal or even greater importance, but it is my intention to limit this discussion to these factors and others closely correlated with them. What I hope to do in this discussion is to stress the importance of careful selection and if I can get you to think a little more about it, I will have accomplished my purpose.

Causes of Variability. Many causes of variability in propagation and in growth of young plants can be enumerated. Among the most important may be listed (1) lack of typical or uniform stock plants, (2) carbohydrate-nitrogen relationship, (3) morphological relationship, (4) flowering vs. vegetative wood, (5) position on the plant from which propagating wood is taken, (6) sex, and (7) prevalence of disease and insects.

Lack of Typical or Uniform Stock Plants. In the cutting of propagating wood, especially cutting wood, there has been a common tendency to select this wood from row-run plants. This tendency has developed because of the quantity of propagating wood desired and to the ease of taking. Quantity production and the saving of labor have appeared more important than high quality stock. Surely, the care and time involved in the selection of uniform propagating wood will pay dividends in the end. A plea might well be made for the establishment of stock blocks for propagating purposes, a practice quite common several years ago. In such blocks the propagator can establish true-to-name plants and varietal uniformity. Inferior plants and those not true to name can be rogued from the blocks leaving only those of exceptional quality for propagating purposes. All of us, I am sure, have noticed on many occasions the lack of uniformity in growth habit of nursery stock supposed to be of the same variety or species.

State nurserymen's associations might well aid the colleges, universities, and

experiment stations in establishing trials leading to trueness-to-name and trueness-to-type in many kinds of nursery stock.

In making the comments above I am not overlooking the possibility of developing new plants by propagating those with variable characteristics. That phase of production does not come within the realm of this discussion.

Carbohydrate-Nitrogen Relationship. Propagators have long emphasized the importance of selecting the "right condition" of propagating wood for softwood cuttings. A simple rule followed with softwood cuttings is to take the wood when it will snap and not crush when bent. The snapping or crushing actually is of no importance, but the physiological and morphological make-up of the twig is important. The snapping is a manifestation of the correct physiological-morphological conditions. It is apparent from the literature and commercial practice, that the condition of the wood may be right for successful rooting for only a short time in some plant species and varieties and extends over a considerable period with other plants, if air, moisture, and temperature are satisfactorily regulated during the rooting period. *Philadelphus coronarius aureus*, the Golden *Philadelphus*, and *Syringa vulgaris*, the Common Lilac, are noted examples of the "short-period" type of plant, whereas many examples, such as the privets and most narrowleaf evergreens could be cited where cuttings can be taken over a long period of time and rooted successfully.

The timeliness factor is tied up with quality production as well as quantity production. Cuttings taken at the right time root readily and continue to develop rapidly and uniformly, if other conditions are satisfactory, while cuttings taken "out-of-season" often root slowly, if at all, and the plants develop irregularly and often do not attain saleable quality. It might also be mentioned that the timeliness factor in the successful rooting of cuttings may be tied up with the period of rest in the stem tissues as well as the carbohydrate-nitrogen relationship.

It is not my intention to give here a complete review of the literature pertaining to these phases of propagation, but refer to a sufficient number to emphasize their importance.

Time of Taking Cuttings. Batson (1) (1933) working on the propagation of *Camellia japonica* stated that December through February were the best months for taking cuttings of this plant. Durham (7) (1933) showed that the best season for taking cuttings of some evergreens was variable. Some of these were rather specific in their requirements and others not. He stated that cuttings of Junipers and Arborvitae would root readily when taken from mid February to mid March. He further stated that cuttings of *Euonymus latifolius* and *Ilex opaca* should be taken in the spring and those of *Azalea mollis* and *Kalmia latifolia* in October and November respectively. Several propagators would not agree on these dates since success is obtained with several species and varieties of Junipers and Arborvitae by taking them in early winter (December to January) and handling them in the greenhouse or taking the cuttings in March and April or in August and rooting them in frames. All methods are satisfactory, depending on location and equipment available.

The variation existing between species was noted by Zimmerman and Hitchcock (30) (1933) as they found that late August was the best time to take cuttings of *Ilex opaca* but cuttings of *Ilex cornuta* could be taken and rooted successfully at any time of the year. Lindberg (13) (1952)

reported that *Ilex opaca* cuttings rooted nearly 100% in less than two months when taken in mid August and handled under conditions of high temperature and humidity. Cuttings taken in December rooted satisfactorily but were much slower in attaining a high percentage of rooting. It might be mentioned that while these statements are usually considered correct, cuttings of *Ilex opaca* taken at Ohio State University the week of November 3, 1952, and handled under conditions of high temperature and humidity are now well rooted. On the basis of this experiment and those of *Ilex* reported above, the time of taking American Holly cuttings may not be as critical as formerly supposed.

Farrar and Grace (9) (1941) took cuttings of Norway Spruce throughout the year but a good percentage of rooting was attained only with those taken during September and October. Stoutemyer (24) (1942) reported that the period for successful rooting of *Chionanthus retusus* was limited to the first week in May at Washington, D. C., Wells (28) (1949) in his series of articles on the propagation and production of hybrid Rhododendrons in the American Nurseryman recommended late June through August as the best time for taking cuttings of this plant.

At the recent International Horticultural Congress two papers were presented which emphasize the importance of the time of taking cuttings or the condition of the wood. Miss S. de Boer (4) of the Boskoop Nursery Research Station, Boskoop, Holland, in her paper entitled "Some Aspects of Propagation by Cuttings of Ornamental Trees and Shrubs" stated that one of the most important factors in propagation was the proper ripeness of the shoots used for cuttings. If the shoot is too soft it will frequently rot and if it is too hard excessive callus and few roots often results. F. E. W. Hanger (11) of the Royal Horticultural Society's Wisley Gardens stressed the importance of careful selection of propagating wood stating it was the most important factor determining uniformity of growth after rooting as well as rooting.

Carbohydrates. The importance of carbohydrates in the development of roots was emphasized by Starring (21) (1923) and Schrader (18) (1924) but Reid (17) (1926) was perhaps the first to show the relationship of the content of carbohydrates and nitrogenous compounds to the development of root and shoot growth on cuttings. Reid pointed out that a high carbohydrate content plus a fair amount or reasonable quantity of nitrogenous compounds in the tissues was best for good root and shoot production on cuttings. While Winkler (29) (1927) has shown that the correct carbohydrate content for good root production can be fairly easily determined, it is doubtful if many nurserymen will go to the trouble of making these determinations. Tukey and Green (26) (1934) have indicated the importance of selecting certain portions of long canes if the quickest and best rooting is to be obtained. Working with *Rosa multiflora* they pointed out that long canes showed an increasing gradient of carbohydrates and a decreasing gradient of nitrogenous compounds from tip to base. The best portions of the cane for cuttings was dependent upon the carbohydrate-nitrogen relationship of those portions. While it varied somewhat with the season, the best results with softwood cuttings were usually obtained when the cutting wood was taken from the section eight and sixteen inches back from the tip.

Rest. Rest influences to a considerable extent the rate of rooting of cuttings and it requires correct manipulation of the environmental conditions for good success. Chadwick (3) (1933) reported that cuttings of

Taxus taken in February would root in much shorter time than similar cuttings taken in November or early December. If evergreen cuttings are taken before cold temperatures have broken the rest in the buds, shoot growth, and correspondingly rooting, will take place slowly. If the cuttings are taken after the rest period is broken, the buds will become active and root growth will develop rapidly. Environmental conditions, especially temperature, must be much more closely regulated with cuttings taken after the rest period is broken.

The correct manipulation of environmental factors, especially temperature, is important in the storage of hardwood cuttings of deciduous shrubs. Best practices vary depending upon the extent of the rest in the buds when the cuttings are taken. Chadwick (2) (1931) reported that best results were obtained with hardwood cuttings if they were stored at temperatures of 65-70°F. for two to three weeks previous to storing at 40°F. for the remainder of the storage period. Such a practice can be followed, however, only if the cuttings are taken previous to the breaking of the rest in the buds. If the plants had been exposed to considerable cold temperature before the cuttings are taken, the rest will be broken and with such cuttings the warm period of storage should be eliminated, and the cuttings placed directly at the 40°F. temperature.

The references given above are adequate to show the importance of the time factor, carbohydrate supply, and rest in the successful rooting of cuttings. It may be well to emphasize again the point that while the propagator may get a fair percentage of rooting when cuttings are taken other than at the best time or wood condition, growth will often be slow and irregular and the resulting quality of the finished plant unsatisfactory. Keep the growth of rooted cuttings continuously active.

Morphological Relationships. There is little doubt that the morphological structure of the tissues influences the rate of rooting, the amount of roots produced, and the quality and uniformity of the plants produced. A few points will be mentioned in this category.

The factor of juvenility has been shown to influence the rooting ability of cuttings. Stoutemyer (23) (1937) showed its importance in the rooting of apple cuttings. Thimann and DeLisle (25) (1939), Passecker (16) (1940), and Kemp (12) (1948) have likewise noted the importance of this factor. Snow (19) (1941) reported that cuttings of Sugar Maple taken from three to five year seedlings rooted better than cuttings taken from older plants. Since O'Rourke (15) (1951) discussed this factor rather thoroughly at the Plant Propagators Society meeting last year, I do not need to dwell on it longer at this time.

The position of the basal cut was first shown to be of importance by Van der Lek (26) in 1925 when he pointed out the difference between what he termed wound roots and morphological roots. He pointed out that preformed root initials or the formation of root initials were most abundant in the first one-half inch below the node. These so-called morphological roots were stronger, more capable of supporting the cuttings and resulted, at least initially, in more uniform plants than those supported by wound roots.

Chadwick (3) (1933) classified cuttings of various plants into several groups based on the patterns displayed by the morphological roots and also emphasized their importance to successful rooting and management practices. It was further pointed out that very large calluses characteristic with cuttings of Weigela Eva Rathke could be prevented by using tip cut-

tings with the basal cut made about $\frac{1}{4}$ to $\frac{1}{2}$ inch below the node. Such cuttings produced a smaller callous and rooted better than those made with the basal cut just below the node. Kemp (12) (194) points out that the basal cut should not be made through the node but at the base of the visible swelling associated with leaf insertion.

Stewart (22) (1927) suggested that cuttings of *Rhododendron* often root poorly because of the large pith. He suggested cutting off the tip of developing shoots, forcing side shoots which have comparatively more wood in comparison with pith and better food supply. These side shoots will root more readily than the terminals. Kemp (12) (1948) has also pointed out that with softwood cuttings in general, lateral shoots should be chosen in preference to leaders. Hanger (11) (1925) reported that *Ericas* have a deep seated cambium and for successful rooting, tip cuttings, $\frac{1}{2}$ inch long, should be taken before cork forms and stuck three-fourths their length in the rooting medium.

Lindberg (13) (1952) stressed the importance of taking a particular type of cutting, a short tip cutting, with *Hydrangea petiolaris*, if good results are obtained. Such cuttings set deep root well. Undoubtedly, morphological factors are influenced here. Hanger (11) (1952) stated that plants containing abundant fibers in the wood seldom respond from cuttings and cited *Fagus* as an example of this condition.

Many additional references could be cited wherein the importance of anatomical and morphological factors are influential in the rooting of cuttings but those given are sufficient to denote the importance of these factors.

Flowering vs. Vegetative Wood. Whether or not the presence of flower buds retards rooting has been the subject of considerable debate. Plant physiologists infer that respiration in flower buds takes place at a higher rate than in leaf buds. If this is the case, greater amounts of stored or manufactured food in the cuttings bearing flower buds would be used leaving less for rooting. We might expect under such conditions poorer rooting and poorer growth after rooting.

O'Rourke (14) (1944) pointed out that vegetative cuttings of blueberry rooted better than cuttings bearing flower buds. DeBoer (4) (1952) reported, as an example of this phenomenon, that *Rhododendron* cuttings root much better if the flower buds are removed. She further reported that the removal of leaf buds reduced rooting and root growth.

It is the opinion of the writer that with many easy rooting species the selection of flowering wood for cuttings is of little importance in their rooting. With difficult to root subjects, the selection of vegetative wood for cuttings is preferred.

Position on the Plant from Which Cutting Wood is Taken. Factors associated with rooting in this category are no doubt closely aligned with those discussed in parts two and three above and perhaps the same fundamental factors are operative. However, as closely associated as they may be, I have elected to separate them for sake of discussion. A few references will be cited noting the importance of the part of the plant from which the cuttings are taken but time does not allow discussion of the reasons back of these findings.

All propagators are familiar with the fact that only cuttings of erect terminals or erect side shoots of *Taxus cuspidata capitata* will result in

good uniform, upright plants, even though lateral or horizontal side shoots will root as well or better than the others. DeFrance (5) (1936) reported that multiple stem cuttings of *Arctostaphylos uva-ursi* rooted better than single terminals. Grace (10) (1939) pointed out that cuttings of Norway Spruce taken from the lower portions of the plant rooted better (86%) than those from the upper region (48%). Deuber (6) (1924) also reported this tendency when he pointed out that he was able to obtain some rooting from lateral twigs from the lower branches of Norway Spruce but no rooting from cuttings taken from other regions. O'Rourke (14) (1944) reported that basal cuttings of blueberries rooted better than terminals.

With many of the easy rooting subjects, the position on the plant from which the cuttings are taken is of no importance. With some plants, as indicated, the position is important and for the sake of satisfactory and uniform results, cutting wood should be selected properly.

Influence of Sex. Undoubtedly, considered on the basis of successful rooting only, this factor is of minor importance. The value or importance of male or female trees for landscape use is not a part of this discussion. Only two references to the factor of sex and its influence on rooting of cuttings will be cited.

Snow (14) (1942) reported that, in general, cuttings from male trees root better than those taken from female trees. Edgerton (8) (1944) has also pointed out that cuttings of Red Maple from the upper part of the crown of male trees, or female trees producing little seed, rooted most readily.

This factor may also be tied up with the respiration rate as brought out in the discussion of flowering wood vs. vegetative wood, since it has been reported that the respiration rate of female flowers may be somewhat higher than that of male flowers.

Prevalence of Diseases and Insects. The importance of disease and insect free stock to satisfactory and uniform results is too well known to require discussion here. It may be pointed out, however, that it is not always easy to detect disease or insect infected wood when cuttings are taken. Because of infestations growth may have become stunted or sufficient fungus may be present, which, under propagating conditions, develops rapidly and the cuttings are either lost, root poorly, or growth of the resulting plants become stunted. Infestations of *Phytophthora* blight on lilacs is one example of the above.

In conclusion, the following points can be emphasized:

(1) Many factors influence the uniformity of rooting and the growth of resulting plants.

(2) Keep in mind the various factors that can affect uniformity and try to select propagating wood accordingly.

(3) Good strong rooted cuttings will give uniform plants of good quality.

(4) Propagate for quality as well as quantity.

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PRESIDENT WELLS: Do we have any questions for Dr. Chadwick?

MR. JOHN B. ROLLER (Verhalen Nursery Co., Scottsville, Tex.): Dr. Chadwick, I would like to ask you about excessive callus on *Juniperus sylvestris*. Is there some way it can be prevented.

DR. CHADWICK. I can't answer that question as it applies to *Juniperus sylvestris* since we haven't propagated it very much, but I would suggest this as a trial, that you regulate rather carefully the pH of the rooting medium and carry it on the dry side. We have found with *Andorra Juniper*, which is a good example of a type often developing a large callus, that a pH of around 6.9 to 6.95 will materially reduce the size of the callus. If the pH is over 7, it will be larger and if it is below pH 6.2-6.5 it also may be larger.

PRESIDENT WELLS: Any other question?

MR. MARTIN VAN HOF (Newport, R. I.): What kind of wood do you prefer on Greek juniper?

DR. CHADWICK: I think you can root the Greek juniper rather successfully, taking the cuttings at least three different times of the year. Hardwood cuttings may be taken about this time of the year on up to the middle of February and rooted in sand or sand and peat in a greenhouse. Hardwood cuttings can be taken the latter part of March and rooted satisfactorily in outside frames. Also, semi-mature cuttings of Greek

juniper can be taken in August and rooted in outside frames. I don't think that the type of wood on Spiny Greek juniper is too important.

MR. VAN HOF: I have to disagree with you there. We have found that hardwood cuttings taken from the top of the plant won't root with us.

DR. CHADWICK: You take the cuttings, then, from side shoots, not top.

MR. VAN HOF: The bottom of the plant.

DR. CHADWICK: I haven't observed that difference in them.

MR. VAN HOF: I wonder if anyone else has.

MR. LOUIS VANDERBROOK (Manchester, Conn.): We have had exactly the same experience in Connecticut. Bottom cuttings root practically 90 per cent.

DR. CHADWICK: I am glad to have those comments.

MR. VAN HOF: Cuttings taken from the bottom of the plant show the start of air roots. If such cuttings are stuck in sand at a temperature around 68°F., they root in about a month's time.

DR. CHADWICK: Taken at what time of year?

MR. VAN HOF: About this time of year.

MR. VANDERBROOK: We have had this experience with most types of Junipers. We have found that cuttings taken about the first of October and handled in a greenhouse give good results.

DR. CHADWICK: That comment illustrates one point I mentioned. Cuttings of several evergreens can be taken over a fairly wide period of time. With *Taxus*, for instance, it doesn't make too much difference when the cuttings are taken as far as the percentage of rooting is concerned. They will root much faster if taken about the 15th of February than if taken about the 15th of November, but the percentage of rooting may be no better, maybe not as good unless you manage the environmental conditions within the greenhouse very, very carefully.

PRESIDENT WELLS: Any other questions?

MR. MAURICE WILSEY (Wilsey Evergreen Nursery, Corfu, New York): I wonder if you would answer a question as to the temperature and the time of day most beneficial for taking cuttings.

DR. CHADWICK: What kind of cuttings are you referring to?

MR. WILSEY: The evergreen line—*Arbor-vitae*, Yew, etc

DR. CHADWICK: Are you bringing into the picture the condition of frozen wood? If you are—

MR. WILSEY (Interrupting): As to the condition of the wood and the outside temperature. If it is below freezing, would it be better to wait until it warms up?

DR. CHADWICK: We have taken cuttings of *Taxus* when they were frozen hard and still had good results, but we thawed the cuttings out gradually before they were made up and stuck in the rooting medium. I wouldn't advise it, however, because if the cuttings are frozen you are

going to knock off a lot of the foliage in just the manual operation of taking the cutting.

MR. WILSEY: When you obtain a large number of cuttings, what is the proper way to hold them until you can get all of them made up?

DR. CHADWICK: I would hold them in a cool place, sprinkling them down and covering them with moist burlap.

PRESIDENT WELLS: Do we have any more questions?

Thank you very much, Chad, for your talk. It was an excellent one. (Applause) I have no doubt that Chad will be on hand later on this evening if you have thought up some more questions.

We are adjourned until 8:30 this evening when we will meet in this room again.

. . . The first session recessed at 5:15 o'clock . . .

RECESSED
BUSINESS SESSION

Friday evening, December 12, 1952

The business meeting convened at 8:30 o'clock, in the Ballroom, Wade Park Manor, Cleveland, Ohio, President James S. Wells, Koster Nursery, Bridgeton, New Jersey, presiding.

PRESIDENT WELLS: Can we come to order, please?

The first purpose of the meeting tonight is to explain to you briefly what has happened since the meeting last year. Those of you who were in this city at our first meeting will perhaps remember the controversy which arose over basic principles governing our society and it was finally left to a committee of nine to try to thrash these points out.

At that meeting in Cleveland, I expressed a few ideas which met with a mixed reception, but when we got down to examining those ideas we found there wasn't such a wide difference really in our thinking; it was mainly in how to achieve what we had in mind.

What we had in mind was a society of skilled people, a society of craftsmen, a society of men, and women if any wish to join, who were skilled craftsmen in plant propagation. We felt that we needed to establish a reservoir of knowledge and, to tap that reservoir to help ourselves and other people coming on in the business.

We had the mistakes of the past to look back upon because there had been a society which had failed way back in 1932 or '33, and one of the main reasons for its failure, as I understand it, was that the people who knew finally got tired of giving information to others who didn't know and who had no intention of doing anything but extract all they could from the organization. In such an atmosphere those people who were prepared to give naturally dried up, so we felt it was necessary to establish ourselves this time in such a manner that such an atmosphere could not recur.

Collecting, Storage and Germination of Maple Seed

By ROY M. NORDINE

The Morton Arboretum, Lisle, Ill.

Bailey's Encyclopedia list 110 species of maples, all are found in the northern hemisphere. They range from the northern tree zone to the semi-tropics of northern India. Rehder's Manual of Trees and Shrubs 2nd edition lists 87 species and many hybrids as being hardy in the various zones of this country.

Maple seeds vary in size from less than one half inch long to nearly three inches. All are winged and the seed coats vary from a very thin covering to a hard nut that must be cracked open with a hammer.

Two species, namely *rubrum* and *saccharinum* (*dasycarpum*) ripen their seeds in late May—all other maples ripen their seed in the fall.

Maple seeds have only an embryo, they do not have an endosperm or stored food in the seed. The embryos are green to yellow in color. This makes a cutting test a quick and easy method to determine the value of a lot of seeds. Seeds will vary from a high percentage of filled seeds to 50% in the case of *saccharum* where only half the seeds are ever filled. In old seeds the green color of the embryo will change to white or the embryo retains its good green color but it become very brittle, breaking into many small pieces upon cutting the seed.

A few maples have fairly good records for seed crops each year. Other maples may produce good crops only every 2-3-4 or more years. A number of the exotic maples in this country produce good seeds infrequently. In the intervening years only empty seeds are produced.

Germination is dependent on the moisture content in the seed, therefore the seed should be dried only enough for storage purposes. Too much drying of the seeds will kill the embryo rather than cause a delayed germination.

Seeds should be allowed to ripen on the tree and gathered when the stems are drying or have become completely dried. Seeds can be either hand picked from trees or beaten onto canvas on days when there is no movement of air. They are easy to gather from street trees by sweeping them up from the pavement.

Maple seeds range from those that must be sown soon after gathering to those that must be stratified. I have no work on the proper temperature or length of time to hold stratified maple seeds nor can I find any literature on this subject. I stratify seeds in sand, and keep them moist for a year.

The two species ripening in the spring, *saccharinum* (*dasycarpum*) and *rubrum*, must be sown at that time. Altho, *rubrum*, if it becomes too dry either before sowing or in the ground will lay over until the following year, or the seed can be stored in tight containers and sown in the fall.

Macrophyllum, a fall ripening species must be sown very soon after harvesting.

All maple seeds except *saccharinum* (*dasycarpum*) *macrophyllum*, and *spicatum* can be stored favorably for a year in a cool moist condition or tight containers at a temperature range of 32°-50°.

Fall ripened seed should be sown in the fall, germination takes place in the spring. Seed that cannot be sown in the fall should be stratified for two months or more before spring sowing. When I receive seeds after Feb. 1st, too late for a brief stratification they are stored in a second hand refrigerator, maintained at its highest temperature of 42° until the following fall. The year's growth is lost but we save the seed.

Seed of *ginnala*, *tataricum*, *spicatum* and *pennsylvanica* apparently require an early fall sowing. When *saccharum* (Hard Maple) and Norway Maple is stratified prior to sowing it must be watched, sometimes it begins to germinate in the medium.

The many listed hybrids prove that maples hybridize very easily and produce new forms not true to either parent. A common one is *rubrum* crossed with *saccharinum* (soft) producing in *rubrum* a fast growing tree with very poor fall coloring. The colored and dissected leaf forms of *palmatum* and *japonicum* come quite true from seed.

In securing seed from other sources it is wise to get seed from areas as near your latitude as possible. Seed from southern sources when grown in the north may retain their longer growing season and fail to ripen without frost damage in the fall. Species with purple leaved forms are hardier than their green leaved forms. Schwedler Maple can be well grown in areas where the common Norway Maple freezes out.

It should not be necessary to mention to this group about the preparation of seed beds or good soil conditions for cultural conditions as maples grow well in a range of good soils.

Seeds sown and grown outside are quite free from damping off. However seeds sown and growing in a greenhouse can be severely affected.

Maple seeds requiring stratification for a year are:

campestre
Diabolicum
griseum
mandshuricum
monspessulanum
nikoense
opalus
triflorum

Maple seeds suspected of requiring stratification:

Francheti
Heldrichi
hyrcanum
Trautvetteri

Maple seeds that should be sown in the fall after ripening are:

<i>argutum</i>	<i>Maximowiczii</i>
<i>barbinerve</i>	<i>Miyabei</i>
<i>Buergerianum</i>	<i>mono</i>
<i>capillipes</i>	<i>negundo</i>
<i>cappadocicum</i>	<i>Oliverianum</i>
<i>carpinifolium</i>	<i>palmatum</i>
<i>caudatum</i>	<i>pennsylvanicum</i>
<i>circinatum</i>	<i>platanoides</i>
<i>cissifolium</i>	<i>Pseudo-platanus</i>

Davidii
divergens
Ginnala
glabrum
grandidentatum
Grosseri
Henryi
japonicum
leucoderme
macrophyllum

Pseudo-Sieboldianum
rufinerve
saccharum
Sieboldianum
spicatum
tataricum
tegmentosum
tetramerum
truncatum
Tschonoskii

Chairman Nordine: The next topic on the program involves two individuals, one that you are perhaps well-known with in the nursery trade, and he is Wayne McGill. Unfortunately, he could not be here, but he has prepared this paper on the budding of maples, which is certainly an interesting thing and something in which everyone is interested.

Dr. Snyder of Cornell University, will read this paper and the Plant Propagation Society or plant propagators in the country are certainly most fortunate in having Professor Snyder. It is the first time that a plant physiologist is working in conjunction with the problems of plant propagation, and plants in general. So we are very happy to introduce to you Professor Snyder from Cornell, to read this paper by Wayne McGill.

DR. SNYDER: This paper, as Mr. Nordine has said, was prepared by Wayne McGill, and the title is, "The Selection of Maple Understock, Budwood and the Timing and Placement of Buds."

. . . Mr. Snyder read the paper . . . (Applause)

The Selection of Maple Understock, Budwood and the Timing and Placement of Buds

By WAYNE MCGILL
A McGill & Son, Fairview, Oregon

Mr. Chairman, Ladies and Gentlemen:

I was greatly honored indeed when asked to prepare this paper on the selection of Maple understock, budwood and the timing and placement of buds. When Mr. Nordine asked me to present this paper I did not know that it was going to be a Round Table discussion and in preparing it I find it is much more difficult to prepare a paper which is going to be read than if one were going to read it himself. When reading it himself, any mistakes can be corrected as he goes along. However, as it is a Round Table discussion, possibly it is better that I am not here to present myself, for at least, I cannot be asked questions which I cannot answer. I feel certain that in the group there are many propagators with more experience than myself and a good many of them can answer any question that I have left unanswered.

The experiences and details as outlined in the paper are from our own growing experience and of course, references are made to the growing conditions on the West Coast. The Field Superintendent of our firm,

Davidii
divergens
Ginnala
glabrum
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Grosseri
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japonicum
leucoderme
macrophyllum

Pseudo-Sieboldianum
rufinerve
saccharum
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The experiences and details as outlined in the paper are from our own growing experience and of course, references are made to the growing conditions on the West Coast. The Field Superintendent of our firm,

Mr. John McIntyre, has helped in the preparation of this paper and many of the practices we employ have been developed by him and certainly have gone far toward any success that we may have in the propagation of Maples.

References are going to be made principally to the propagation of *Acer Platanoides*, Norway Maple, and its types such as Crimson King Maple, Schwedleri Maple, Pyramidal Norway Maple and some special forms of Norway Maple that have been introduced by our good friend, Ed Scanlon. We have had little experience with propagation of any forms of the Sugar Maple or any other of the Maples. We probably should be experimenting more with the propagation of special types as they are certainly in demand at the present time but have been concentrating on the Norway Maple types as they do grow so well on the West Coast and we must say that the Sugar Maple does not do nearly as well and is much more difficult to grow.



Mr. McGill in a field of 1-year Budded Crimson King Maples (Acer Platanoides var.)

Mr. Nordine has talked about the collecting, care and sowing of Maple seed and while I do not wish to conflict in any way with what he has said, I would like to give a few side-lights on some of our practices in the collection and handling of our Norway Maple seed. We do not make any selection of seed from special trees for type, but of course, try to get seed that is well filled at harvest time. As possibly some of you know, the Pacific Northwest, especially in the section west of the Cascade Mountains, is affected with the *Verticillium* Wilt of Maple, which as we call it locally, is Maple blight. This is dependent considerably on weather conditions and is much worse in a season that has been too wet. In gathering seed we try very hard to eliminate any possibility of collecting seed from the parent trees that are affected with blight. This is very easily discernible

as the tree loses its leaves early and has many dead branches where the blight has killed them.

We have been experimenting lately with planting some Maple seed in the spring, as well as the fall. Customary practice in the past was always fall planting but sometimes weather conditions in the spring were such that it was very hard to get the seedlings through the ground. Late Spring frosts also took their toll in many cases of fall planted seed. For an insurance purpose we now plant part of our seed in the fall and about as much again in the spring. The spring seed is not stratified and we have just as good success with either fall or spring planting as far as germination is concerned. Even the growth is as much in the spring planting and we are very satisfied with having this insurance against a failure of the fall planting. At the present time we are using Norway Maple seed from two sources. We gather some locally from the section west of the Cascade Mountains but also get some from the section east of the Cascade Mountains. This is also used as an insurance proposition in case one of the crops of seed is not as good as the other.

From a commercial viewpoint the only selection that we make in the type of seedling that we use is to try to plant as large a seedling as we are able to raise in the one year from seed. To get a good growth after budding, it is essential that you have a good large seedling in which to bud as it takes a heavy root system to push up the strong, straight growth of a one year old Whip as is necessary for the basis of a good branched tree.

When it comes to giving the reasons for a good and successful stand of buds, there are several matters to be taken into consideration including the time of budding, condition of the understock, condition of the budwood and the human angle of the ability of the budder himself. I think it is quite difficult to place any of these in the most important position as it means a combination of all of them to make a success of the operation. There are certain points in each of the operations which might be stressed a little bit more than others and it probably would be better to take them up one at a time for clarification purposes.

Speaking of the time for the budding operation, reference will have to be made to the time that is used in the Pacific Northwest areas. We find that this usually is from the last week in July to the middle of August and we always try to place all of our Maple buds within that period of time, if at all possible. This is dependent, of course, somewhat on the season and weather conditions as to whether the seedlings are ready and also whether the budwood itself is in the proper condition. Year in and year out the dates given above will average out pretty closely in our area. Budding can be done up to the last week in August under some conditions but we have never found a successful stand of buds to be had if the buds were placed during the month of September or later.

The condition of the understock itself is, I believe, of the least importance as long as it is making a good growth and there is plenty of sap so that the bud will slip well under the bark. In our area we get a very small growth on our seedlings during the first part of the Summer but they usually start a second growth about the middle of July and are in full growth during the time that we bud them. They usually grow also until the first or second week in September in this rapid manner and it is at that time that the buds are uniting with the seedling and there must be this growth to cause this uniting process. It is needless to say that any seedlings

that are not growing or have dried up will never produce a stand of buds as there is no sap available for the purpose.

If there is any of the above mentioned items the most important, it might be the budwood itself. We have found that a budstick a little on the soft, growing side is much better than the type that has matured into hard wood and on which the terminal has formed. We like it hard enough so that when bent it will snap and not bend but also soft enough so that the top one-third of the stick is too soft and has to be thrown away. We find that the buds are better developed on this type of a budstick and will give us much better success in the long run. It might be mentioned here that a good, plump bud will give a much better tree in the long run, with a better stand and better growth than a small, weak bud which is often found on some of the well matured sticks of one year growth.

As you probably know, the Maple has a milky sap and it is our contention that this has a tendency to sour if allowed to stand too long. For that reason we think it very adviseable to use the wood almost immediately after it has been cut. If the wood is kept for four or five days, it begins to turn brown and is definitely not good for use under normal conditions. We try to use our budwood within a period of forty eight hours after it is cut from the parent plants. In preparing the budsticks for use our former practice was to tear the leaves from the stick, leaving no leaf stem at all. We have recently found that by cutting the leaves off and leaving a very short portion of a leaf stem to cover the bud, that the bud is protected, is easier to insert under the bark and this small portion of the leaf stem protects the bud from burning in the hot sun and also keeps the bark of the tree from growing over the bud as much as it did if there was no leaf stem on there. This latter situation may sound peculiar as you would think that the bark would grow over the leaf stem, too, but it seems to have a tendency to hold it open and give the bud a better chance to grow out in the Spring.

Under the title of the Human Element of the budder himself, it is our contention that a budder of many years experience will have no better stand of buds than a new budder with only one or two years experience. Of course, this depends a lot on the training that he has had but in the case of Maple budding, there is another factor that makes the above statement true. In budding Maple, we always dewood the buds, inserting only the bark and eye itself. When the propagation of Maple by budding started in the Pacific Northwest years ago, it was done by cutting the usual bud with a part of the wood in it. Poor stands results in most cases from this and if anyone got a fifty percent stand of Maple buds in this way, it was considered exceptionally good. Our own experience one year gave us a stand of only five percent and made Maple budding most unprofitable. We do not claim the discovery from experience of dewooding buds but it is a customary practice in the Pacific Northwest at the present time and we are able to get stands from eighty five to ninety five percent as a common occurrence. It is much simpler for a budder to cut a bud that is to be dewooded as the exact depth of the bud does not make so much difference. In some other items if too much wood is cut it is impossible for the bud to grow in properly but when the wood is removed, the bud sheath is usually cut quite deep anyway so that much of the bark will go under the bark of the seedling.

The buds are tied in with rubber as is customary in practically all budding operations these days and it is our practice not to cut these rubbers

as the rubber will deteriorate in due time and we have had practically no loss from them cutting into the tree as growth continues throughout the rest of the Summer. With this comparatively early budding and late growth, there is a tendency for some of the buds to start out and form a growth of three to four inches long but this is not harmful at all and these are merely cut back and started all over again the following Spring.

While the matter of cutting off the seedling in the Spring does not actually come under the subject matter of budding, a word might be said about this. It is our practice not to do this too early. We want to have practically all danger of severe cold weather to be past and the time period close enough to the growing season so that there will not be too much tendency for the seedling to dry back into the bud itself. We usually cut them from two to three inches above the bud and after they have started, cut them back close to the bud. This stub, in that way, gives them some protection during the early parts of the Spring.

In requesting some information as to what I wished to talk about, it was suggested that something might be said about the cultural procedures used in the first year or two of growing the tree after budding. This definitely does not come under the subject matter of the paper but I might give a few items of our practices which have proven very satisfactory.

The main object in growing a Maple after budding is to get a good, straight Whip which is suitable as a trunk for the finished branched tree in your customers planting. With us the growth is extremely rapid during the first part of the growing season in the early Spring and Summer. At that time the tree is extremely soft and has a tendency to form crooks, due to wind and rain and it is one of the "musts" that something be done to overcome these crooks that would show up in the finished product. This rapid growth is strongest during the first two to three feet growth of the tree from the bud. To eliminate the possible crooks, it was a cultural practice to use a six foot stake on every tree and keep tying them to the stake until they reached a height of five or six feet. This entailed constant work and much more expense than we felt necessary. Our method now is to use a four foot stake with one foot in the ground and three feet out. The growing tree is tied to this until it reaches the top of the stake with ties every foot and these ties are raised as the tree grows. When the tree reaches the top of the stake all ties are removed and if time permits, the stakes are then removed from the field.

A little explanation of our reason for this might be of interest to you. Referring again to the extremely rapid growth the tree is making in the early Spring, we have found that when the winds come, the tree has a tendency to bend six to eight inches from the terminal, causing the crooks mentioned. It is growing so fast and is so soft that within a day or two these crooks will harden and cause trouble if they are not staked. Therefore by tying the trees to a three foot stake these early bends are eliminated. When the tree reaches a height of three to three and one-half feet it is a little harder all the way through and any windstorm then has a tendency to bend the tree from the bottom instead of just the tip and the general condition of the tree then is of swaying from the bottom instead of bending from the tip. This may seem a little complicated but has certainly worked with us and has saved us many thousands of dollars in staking expense.

Getting back to the propagation matter itself, there are two other methods that might be mentioned. One of these is field grafting which is

practiced extensively in the Pacific Northwest. Dormant one year scion wood is used and the grafting done with a tongue graft on the seedling in the field. Frankly, we have never tried this ourselves but understand that some of our neighbors in the Pacific Northwest have tried it with fair success. The growth is not nearly as heavy as from a bud and of course is a much more expensive operation.

Another method is Spring budding. Dormant scion wood is cut during the Winter and placed in cold storage and just as soon as enough sap is flowing in the seedling understock to permit the insertion of the bud, the operation can be performed. With us this is usually sometime about the first of May. Of course, with wood in dormant condition such as being used in this case the bud cannot be dewooded and the stand is very problematical and usually poor. The growth also is much smaller than from a bud inserted the Summer before but this method can be used to increase the production of a scarce item a little faster.

This seems like a very simple report to present to a propagation society but I do hope the information that I have been able to tell you is about what was wanted. I sincerely wish that I could have been present in person to meet you all and talk over our joint problems but the pressure of work at home made this impossible.

I again wish to express my thanks for the honor and opportunity of giving you what little information I have about the propagation of Maple by budding.

MR. JOHN VERMEULEN (Neshanic, N. J.): Has anybody had any experience with budding maples in our section of New Jersey? Can you plant them in the spring and bud them in the same year or should they be potted and left over before they are budded?

MR. WILLIAM FLEMER (Princeton Nurseries, Princeton, N.J.): We bud a lot of maples in Princeton and we found you can fall plant the seedlings and have them in sufficient growth for budding the following summer, but spring-planted seedlings usually are well enough if you dig them and plant immediately and they bud satisfactorily in the summer. I might say under eastern conditions this rapid growth in the spring is much more important than it is on the west coast. If you don't get a strong growth at first flush in the eastern condition what we call rosette sets in and it peters out in the tiny branches and weak buds so it is important to fertilize either the fall before or very early in the spring to get a terrific surge of growth before a hot summer condition and mildew and leafspot will set in.

QUESTION: How large are the one year?

MR. FLEMER: We get six footers without much trouble if we get that early growth. If they are not in strong enough ground and they don't make that growth during the month of June, then you might as well give up.

CHAIRMAN NORDINE: Might I ask Mr. Flemer, is your reference only to Norway maple varieties?

MR. FLEMER: That applies to all the maples, all except silver which can be budded and will grow right through the summer. Red maples, sugar and Norways all seem under New Jersey conditions to get the rosette and they peter out into a number of tiny branches and weak terminal and

you have to cut them down to a strong eye, and that makes a crook in the tree.

CHAIRMAN NORDINE: We might ask, all your budding is summer budding or June budding?

MR. FLEMER: Summer budding—July. August is too late with us because the budwood on the older trees has already started to harden and the buds are stringy and they won't peel properly and won't unite. We have had no success with wood budding at all. If they won't peel like an apple you might as well give it up for that year.

CHAIRMAN NORDINE: Your experience, then, with so-called wood buds is the same as the west coast experience. They will not grow with wood buds; they must grow with peeled bud?

MR. FLEMER: That is right.

CHAIRMAN NORDINE: I am sorry to say I am not personally acquainted with Mr. Burton, but it is always a pleasure to introduce a good man. Now all of us in the nursery business have always known of Burton's Hilltop Nurseries at Casstown, Ohio. It has always been a good name, a reputable name. They have always had good stock. It is a pleasure to introduce someone with a good foundation and a good name. We present to you Mr. Howard Burton who will speak on "The Grafting of Some Maples." (Applause)



The Grafting of Some Maples

By J. HOWARD BURTON

Hill Top Nurseries

Casstown, Ohio

The experience upon which I base the following conclusions regarding the grafting of Maple varieties has accrued over a thirty year period. I apologize rather than boast of that because in that time much more definite data should have accrued than I have available to present to you.

My Maple grafting experience has been largely with Japanese Maple varieties, select types of *Acer Rubrum*, Special forms of Sugar Maple and attempts to graft *Acer Nigra* on Sugar understocks. (The less said about the latter the better). Although if successful they would have little commercial value.

Japanese Maples are often injured in our section by early Fall freezes like the one in October that killed back our Weigelas. Hence securing good and un-injured scion wood is sometimes a problem in winter grafting. However as a rule Maples graft quite readily and offer no insurmountable problems.

To follow them in an orderly manner we should perhaps discuss the understocks first. It has always been our preference to have our understock of slow rooting or coarse rooted deciduous items established one year prior to grafting, as we feel there is less loss of valuable scions and labor. In summer grafts, this of course, is a necessity. Speaking of summer grafts that was at first the only time we grafted Maples. July or early August and outside in frames under glass with canvass shade in the same type frames we use for soft wood cuttings plunging the pots and union in sand at the usual angle. Our results were satisfactory if we syringed the grafts for a few days to prevent excessive wilting of the scion foliage. Good shade is essential. If, after a few days the leaves have not dropped off the scions the critical period is over. However, some of the scions may be ripe enough to hold up, knit and start new leaves the same season, even though the original foliage on the scion does not hold on. Plants left in the frames over winter can be planted out the following spring. Just a comment however, that they are better bedded out where they can be given a little protection than given full exposure. Such resulting grafts are almost a year ahead of winter made grafts.

A modification of the above is bench grafting in the greenhouse in the summer. The biggest problem with us is to keep down the frame temperature by ventilating the houses and shading them heavily enough to prevent wilting of the scion during the previously mentioned early critical period.

After talking with Jim Wells in Detroit last summer I made up a hundred each Jap Maple and *Viburnum Carlesi* grafts as a controlled experiment on which to report at this meeting, with some exhibits. Grafts were made in late July. We had the house shaded with camouflage cloth. In re-glazing an adjoining house the contractor's took off all the shading cloth over the house containing the grafts which were also in a glass covered sweat box. With daily temperatures in the high nineties they cooked quickly. At that a few survived and yesterday I took out several good plants which were heavily calloused, and which had sprouted from eyes

at the peat level or below. Before that accident they were coming along nicely. Also a much higher percentage of *Viburnum Carlesi* survived than did the more tender Japanese Maples.

In regular winter grafting, if the understocks are established it is better to graft before foliage starts, although I always like to see a little root action starting. Otherwise, the scion may pop out in leaf and wilt for lack of any sustenance from the root. This is much more likely to happen if the understocks are fall potted before winter grafting.

Fall Potted Understocks

We always like to put our Maples in a cool house both to root up, and when grafted. About this cool house, we use one in which night temperature may run as low as 40° house temperature.

As to technique, there is nothing unusual—we use a Veneer graft and plunge, but not pack, just cover the graft with Peat Moss in a grafting case. Laying the whole plant at an angle.

For some years we have been dipping our scions in another waterproofing compound to try to avoid the deteriorating effects of wet media. This year I am going back to paraffin or try Howard Taylor's plastic to coat the scions.

Much of our loss in Jap Maples particularly, can be attributed to the factor of too much moisture, often times this area of the scion covered by the grafting media will soften up and die. The reason we gave up dipping scions in paraffin or wax mixtures was that it slowed up grafting. The same goes for waxing with a brush but we may have to come back to it.

Nearly equal results to plunging in a grafting case can be obtained by doing the same thing on an open bench with peat or sand and peat mixture. Results are slower but there is less likelihood of damping off of leaves. I can't get by with just waxing the whole scion and union and setting them on the bench to "hatch" as some good propagators say they do, although if we had our Binks system of humidification working it might do the trick.

In standing the grafts upright in a deep case in peat the percentage results were off due to air space around the union which allowed too much drying. This result was not peculiar to the Maples, but was universal, I might say in all the grafts handled in that manner, Junipers, etc.

The disadvantage of Case grafting of the *Acer palmatum* varieties is the difficulty of preventing mold on the new soft leaves before they are ready to have the covering sash completely removed. We ventilate the frames and keep the understocks well cut back. The only thing other than ventilation which we have tried to control this fungus on leaves, was a rather sparing trial of "Sterile Lamps." I am not prepared to say that they helped too much in the control. I believe we were too afraid of injury to the soft growth. These same trials and tribulations occur to a limited extent with other Maples. However these leaves seem to be sturdier and less susceptible to mold.

We use only *Palmatum* Understock for Jap Maple varieties. For Sugar Maple type, of course only sugar Maple stocks. We have used Silver Maples for *Acer rubrum*, when *rubrum* understocks were not avail-

able. Sugar Maple stocks were used for grafting Black Maple (*Acer Nigrum*), but in two attempts I have never had any success.

Let me summarize the points which I believe lead to success in grafting Maples.

1. Select un-injured scions.
2. Wax the scion.
3. Plunge in a damp, but not too wet media, just covering the union, but not packing tightly around it.
4. Ventilate the grafting cases frequently, especially as the buds start breaking.
5. Cut back the understocks to prevent crowding.
6. Get the grafts standing up on the open bench at the earliest moment, even syringing frequently to keep from wilting. After a few days they harden up and require only routine attention.

We normally throw some newspapers over our grafts just as a little additional protection from shade when they first stand up. That little foliage is very tender.

Summer grafting gives a completed and dormant plant to handle the following spring as against one in leaf resulting from the winter grafting operation. One can also be sure in summer that the scion is alive and uninjured. You do have to be a little more careful of it. You can't knock it around like you can the dormant scion in the winter and you can't store them. I believe the percentage of good grafts should be about the same from either of these methods. Thank you. (Applause).

MR. HOOGENDOORN: Mr. Burton, do you wax your scions when you put them in the grafting case?

MR. BURTON: Yes, we do it beforehand. I dip the scions in wax before we even make the cut. We haven't painted the union afterward.

MR. HOOGENDOORN: Why do you graft in a frame in the summer, because it is too hot in the greenhouse for your maples?

MR. BURTON: We do it both ways, Case. As I said, we started and grafted outside in frames, and I would just as leave do that, but since the greenhouse's are open in the summer we are not doing any other grafting in there. We just use them and put our maples in.

MR. HOOGENDOORN: Do you have much trouble?

MR. BURTON: Not as much in the summer as in the winter.

MR. HOOGENDOORN: Is it easier to control your temperature in the frame than in a greenhouse. The temperature is much higher in a greenhouse than a frame.

MR. BURTON: To answer your first question, the only reason I can give you why we use our frame is that ventilating it to keep the temperature down you get an awful circulation of air over your newly-set scions, whereas in the sweat box they are protected from that wind or air circulating over them and causing quick wilting. We think if we protect just a few days until they get hardened up, they are safe. They usually are.

MR. HOOGENDOORN: Do you also bury your union in the sand in the summer?

MR. BURTON: Yes, the union is covered by the grafting media whether it is peat, sand or a mixture of both.

PRESIDENT WELLS: We wax all ours and, incidentally, in that waxing we don't paint the wax on. We made a little tin gadget which is a circular piece of tin with a V-shaped cut in it and a handle down, which slips over the top of the plant so the plant comes through the V and we can insert the whole thing over a bucket of wax and dunk it. The plant doesn't fall into the wax and we can do it quite quickly, as fast as you can put one in and out.

What I wanted to ask you was this: When we have united our grafts and they have made their first growth, they make a vigorous first growth in the greenhouse and no matter what we do they stop. They don't make any further growth until the end of the summer. Do you think there would be any value in passing the shrubs once they have grown and come to this dormant condition through a cold temperature of 35 or 40 degrees for a couple of weeks? Do you think that might break that dormancy and when they go out they might start growing again?

MR. BURTON: That is not a simple question to answer. It is my thought, Jim, that these Maples, when they come out of the grafting case are so tender that any cold sufficient to break the dormancy would also be fatal to them. It is an interesting thing to think about, and might merit some experimental work.

MR. FLEMER: We tried that with just a few and it killed them.

MR. FILLMORE: I was just going to comment on Mr. Burton's remark that waxed thread was as good or better than rubber bands.

MR. BURTON: These rubber bands do cause a lot of injury by cutting in, because when you put rubber bands on plants that are dormant you get an immediate expansion of growth as soon as that plant starts to grow and they start choking. I think there is a lot more damage done to grafts in that manner than we have ever thought.

PRESIDENT WELLS: Jack Blauw suggested that we use a rather coarse grade of cotton twine, the type they use in the drug stores to wrap up packages. It has a very low tensile strength. We do not wax that thread beyond dipping it into the molten parafin wax, so the ball doesn't unravel in use. It usually holds together long enough for the graft to go through the bench out into the open ground and we don't have to cut it, loosen it or do anything to it. As the wax breaks and the stem expands, moisture gets in and this cotton thread rots and we get no girdling whatsoever.

MR. LOUIS VANDERBROOK: (Manchester, Conn.): I would like to ask the number of that thread he uses.

PRESIDENT WELLS: No. 3 cotton twine.

CHAIRMAN NORDINE: The question has been alive in the nursery for sometime. What about fall coloring which is the principal asset and prime value in any form of *Acer rubrum*. I have been grafting forms of *Acer rubrum* for seven or eight years on soft maple and I find that the soft maple has absolutely no influence whatsoever on the ability

of *Acer rubrum* to color in the fall of the year. In fact, one form of columnar *Acer rubrum* ripened and showed excellent fall color earlier this year than it formerly did on its own root stock, the fall color is not lost on a different understock

MR. JOHN SIEBENTHALER (Dayton, O.): I wanted to ask you if you have had any experience in observing older trees of *Acer rubrum* that had been budded or grafted on soft maple?

CHAIRMAN NORDINE: No, I am sorry.

MR. SIEBENTHALER: I am sorry, too. We had several hundred beautiful trees budded on soft maple. When they reached four and five inch diameter, they broke off at the union. There was a beautiful design there where the union was, a crystallized effect and that was the end of a good-sized investment, so it is something to consider.

MR. VANDERBROOK: Getting back to the waxing problems. If you use a high-melting wax, your wax peels off. You have to use a low-melting wax, about 128°.

MR. CHARLIE HESS: Has anyone experience in growing Japanese maples from cuttings?

CHAIRMAN NORDINE: Of all the books on nursery propagation, there is only one book that mentions growing maples from cuttings. That is an English book by a Mr. Sheat. It is "Propagation of Trees, Shrubs and Conifers," he says. "*Acer cappadocium* of half ripened wood from forced plants under glass and the cuttings in a closed case rooted very well in three weeks." Otherwise, all of these references are brief, but it is just to give you some thought to think about and go home with.

There is a little bit of information in some works in regard to the experimenting of maple cutting in the early days of root hormone, those reports are of such little value that I passed them over, but it is the beginning of work on growing maples from cuttings.

The most interesting of all is by C. C. Thomas who did his work at Beltsville under the Federal Department, and he records his work in the National Horticultural Magazine for 1936, Volume 15, page 103 to 107. He used in this particular case this method: He placed his cuttings in glass cases that were 24 inches high with sliding doors. The benches were heated with lead cable to 72 degrees. The sand temperature varies two to three degrees. Air temperature was about five degrees less, meaning 67 degrees. Sharp, washed sand was used that had a pH of 6.2. He made hardwood cuttings and stuck them into this glass case and he used *Acer barbinerve*, *caudatum*, *cissifolium*, *rufinerve*, and *Tschonoskii*. These cuttings were made on February 27, and the time period extended up to the first week in April. The rooting, for instance, on *A. caudatum* that was taken in late February, rooted in 28 days with a percentage of 89 per cent rooting. Other cuttings required longer periods, up to 40 days. From some of them he got 89 per cent rooted, others only 20 per cent.

Then as the new growth developed to four or five leaves about one inch long, they were pulled from these cuttings. These short green wood cuttings were pulled off with the heel and put back in the case with the hardwood cuttings and then similar material was pulled from plants outside and in that case all the leaves were left on.

Now in this particular work, he used 17 different species of maple as follows:

Acer barbinerve
carpinifolium
cissifolium
Ginnala
palmatum
pictum mono
Pseudo-Sieboldianum
rufinerve
Tschonoskii
negundo
rubrum
argutum
caudatum ukurunduense
mandshuricum
micranthum
triflorum

The cuttings were taken from February to July, cuttings were rooted from 18 days to 55 days. He had all the way from 100 per cent with *A. caudatum* to the *A. Palmatum* taken on May 11, rooted in 21 days with 65 per cent results.

The poorest results were cuttings taken on the first day of June, rooting in 37 days and the variety was *A. Miyabei*. They rooted 50 per cent. There are many others. *A. Argutum* is another one with 50 per cent results. Many of them rooted 75, 80, 85 and 90 per cent up to 100 per cent in this particular work.

And answering this question on Japanese maples, he used nine different varieties. The plants were potted and in the greenhouse, and by the way, these were plants that had been imported that spring from Europe. The cuttings were made as early as March 13. In that case, it took 140 days to root. Other cuttings were taken throughout the month of April. They took from 37 days to almost 60 days to root and in all cases these cuttings rooted very well. Cuttings were taken as late as on June 3 and June 15. Cuttings taken on June 3 rooted in 65 days, cuttings taken on June 19 rooted in but 35 days. All of this was in that particular closed case.

CHAIRMAN NORDINE: Now, the most interesting of all was some work done by Steve O'Rourke. His paper, his work, his records, and so forth, are not available, so it came to me second-hand from a man who quoted from memory. This is by the new method of mist propagation.

They used cuttings of wood which had grown to a full season length but which had not yet passed from the soft stage into the hard stage. These were used under mist, in a greenhouse under ordinary cultural conditions, sand being the medium. Norway maple rooted well and were planted out in late summer and they wintered well. *A. Buergerianum* rooted well but it did not winter. *Acer campestre* rooted very well but it did not winter. *Acer nikoense* failed entirely. Many more maples were used but Mr. Morris quoted these to me; he did not remember what the others were.

MR. CHARLES HESS: I happened to be out at the Greenbrier farms a year ago last summer and they had about 10,000 Jap maples in the greenhouse. They had a beautiful stand. They just tried it and it worked.

Now we did some work last winter with forest types of maples and they rooted in open bed, no bench, just open house bed, shaded, that was all. We now have those outside. We don't know whether they will winter. They made beautiful growth this summer and they are now outside.

MR. FLEMER: We have fussed with Jap maples from cuttings for years. At times we have stuck as many as 10,000 when we thought it could be done and we have never had any trouble getting a good stand rooting, but we have never succeeded getting them through the winter. They were planted outside in cold frames, potted up, rooted in boxes of peat, and left. The roots start to go bad around the callus and the tip of the root will still be alive, but the thing is dead.

MR. KERN: In regard to rooting Jap maples from cuttings, I have mostly concerned myself with the production of the green type of *Acer palmatum*.

I have been bringing full plants into the greenhouse, usually beginning in January, and forced them into growth, took off the soft wood cuttings, usually about the 15th of February, and from 18 to 21 days we have them rooted. We put them in an open sand bench with lead cable underneath carrying a temperature of about 70°. As soon as they are rooted we pot them in a two and a quarter inch pot and in that same current season we are able to produce a maple understock the size of a pencil, which we can use for grafting material.

Last year, I brought in a plant of *Acer Japonicum aureum*. We forced the plant in growth and took the cuttings off like we did with the palmatum, green form. I could not get any results from the Japonicum cuttings. That perhaps was due to the lack of chlorophyl content in the foliage of that plant. The rooting of the green form is highly successful and I recommend it. To grow a good *Acer palmatum* from seed usually takes about two years' time. In this case, we were able to do it in one year.

MR. KERN: I also mentioned I dipped these cuttings in Hormone No. 10.

PRESIDENT WELLS: This batch of cuttings of Greenbrier seems to have bitten a lot of people, because I have heard about this half a dozen times. However, I did call in at Westbury Rose Company on Long Island, Mr. Vosburg is the manager.

Mr. Vosburg is a good propagator. He had a bench of Japanese maples there which I saw, which were beautifully rooted. He told me he had done it for a number of years. He had wintered them quite satisfactorily in frames. The cuttings were put in early. It was early June. We did pull up a couple of cuttings and he does grow them without any callus or practically no callus, and I don't know how he does it, and he does it on magnolias, too.

QUESTION: What was the rooting medium?

PRESIDENT WELLS: Plain sand. He has a mist system there somewhat different to the orthodox one. He has a sheet of burlap at the

side of the greenhouse with jets that spray on the burlap and soak it and he saturates that every hour or so during the summer.

MR. PIETER ZORG: I have had a little bit of experience of rooting Japanese maples from cuttings. About three years ago I started out with a very small amount, put them in a mixture of fine peat moss and one sand. They seemed to root pretty good. I put them during the winter in a frame and in the spring I had nothing left. They were all gone. Last year, I tried it again and this time I put them into three peat moss and one sand, used Hormone No. 3, and I put them right away in pots. During the winter I kept them this time in a cold greenhouse. When the temperature goes very low, I open up a door between the heat house and the cold house, so they don't freeze too hard in there. I had that time about 50 per cent of those cuttings survive the winter.

MR. J. RAVESTEIN (Mentor, Ohio): I made 800 cuttings of Japanese maples. I started out with a mixture of three peat moss and one sand. Excuse me for the language yet, but is $2\frac{3}{4}$ " pots right? (A voice: Yes). Put sand in and put five holes in there with a pencil, put my cuttings in, this No. 3 hormone powder, and put them in the sweat box, and let it be real warm. They can have a lot of temperature but be careful with the sun. We had white cement under the greenhouse and burlaps hanging in the greenhouse and still they burn up. I had to put newspaper or cloth over the glass. They couldn't have any sunshine and they root in about 10 days, most of them.

I think rooting Japanese maples is easy if you take the right time and the right strength cuttings. You can't go down to the field with a shears and go ahead and cut them off. It takes you about a morning to take 1500 or 2000 cuttings. Keep them moist and bring them in and cut them off.

Most of the time you are supposed to cut them off about a quarter inch below the node, but I found out when you cut them off on top of the node, about an inch they grow faster than the other ones.

I make them around the 10th of June and had them in the sweat box for about five months and took them out and potted them. The ones that were not rooted, I stuck them in again in the sand medium, but no powder on them any more. As I can see so far, they are living. I had them in the greenhouse with a temperature of 50° . I am going to turn the heat off and give them a little rest.

Mr. Zorg was over to my place a week ago. (Dec. 1st). He can tell you the rooting is starting again. I don't think I will lose one of them. We have little cuttings in the frame from last year. They are that high, with four or five side branches.

It is not difficult to make Japanese maples under the right conditions. It took us three weeks to make these cuttings and the last week it was too late. You have to do it, I believe, in five or six days. It depends on what temperature you have.

MR. HANCOCK (Cooksville, Ontario): I have had no actual experience in rooting Japanese maples but I think that something is being missed by some of the propagators. There is no trouble to root them, but they don't grow. Now you rooted them in peat and you have the roots and you say you can't winter them. Anything that will root theoretically

will grow. If you watch the old plants all through the country, where do you get the most vigorous Japanese maples? Always where you have an alkaline pH or less or a neutral or alkaline. It doesn't make any difference how kind we are, they are not vigorous like the Japanese maples on clay loam.

In my opinion, what you have missed is probably a question of pH in your growing media. That is just an opinion from the floor on why you have lost out in wintering.

MR. RAVESTEIN (Mentor): What do you want me to use, more peat or sand?

MR. HANCOCK: I think the peat moss is an excellent media. I think any plant that is naturally neutral or alkaline association can't be left indefinitely in that said media. You have got a neutral or alkaline change to that as soon as you get it rooted. Do you know what the reaction of your potting media is, whether it is acid or alkaline?

MR. RAVESTEIN: Well, I tell you one thing, the last cuttings we didn't pot. I don't like to pot a plant without any leaves. They started growing again. I think next year I am going to put a little more peat moss in my pots.

MR. HANCOCK: Pardon me, if I speak again. I think they are mixing up aeration with pH. You get plenty of aeration in the peat. It may not be the peat that makes it root but the aeration. Sooner or later you have got to get that acid to slightly alkaline or neutral.

MR. RAVESTEIN: It takes you a while to pick cuttings, the cuttings from the top of a maple don't root, they are too soft, there is too much strength in there.

MR. HOOGENDOORN: Do you take the side branches?

MR. RAVESTEIN: I take side branches and I like to take cuttings from plants transplanted in the spring.

MR. HOOGENDOORN: You will have a better cutting.

MR. RAVESTEIN: I believe that the cutting is harder. If it is two years in the field it is too much strengthened.

MR. RAVESTEIN: You know when a maple will grow twice, wasn't it on the 8th of October, the last one?

MR. ZORG: About that time.

MR. RAVESTEIN: I make 60 cuttings

MR. HOOGENDOORN: That was on second growth?

MR. RAVESTEIN: I don't think there is much use making cuttings from the second growth. I think you should pick them in five or six days and even when you see the tip you know when a maple grows it has two little buds on the top and it stops growing and you see a little red point. Don't take those cuttings.

MR. HOOGENDOORN: They have started again.

MR. RAVESTEIN: They don't grow.

MR. FRANK O. ANDERSON (Erie): When does the sap stop in the maples you mentioned and when does the sap begin again?

MR. ANDERSON: What I mean, I think the maple tree is perhaps the only tree where the sap stops in June.

MR. RAVESTEIN: That is right.

MR. ANDERSON: It begins to slow down in June and the sap begins to come again perhaps the last week in October.

MR. RAVESTEIN: Oh no, sir.

MR. ANDERSON: On sugar maples it will come in October in certain places in the country.

MR. RAVESTEIN: Not on Japanese maples.

MR. ANDERSON: It may have something to do with it.

MR. RAVESTEIN: I think the sap in a Japanese maple never stops, only a little time. When I took cuttings from mine, underneath the ones which were not full grown the top was still growing again.

SATURDAY AFTERNOON SESSION

December 13, 1952

The final session convened at 1:45 o'clock, President Wells presiding. PRESIDENT WELLS: Gentlemen, please come to order. We are 15 minutes behind time. We have to keep up to this British reputation.

I don't know what one Englishman should say about another or perhaps Henry is an American by now. I don't know his present status except that it has recently become a married one, and that Henry is another real good plantsman. Most of you know of his original work on the propagation of rhododendron from leaf-bud cuttings. I think he was the first person to publish any information on that method. Just why he has chosen "The Vegetative Propagation of Oaks and Suggested Research Technique" I don't know. I have never heard him talk about oaks before, so I am going to be very interested in what he has to say.

He has recently changed his position and some indication of the caliber of the man that he is is the fact he is the new Director of the National Arboretum in Washington. Henry Skinner. (Applause).

DR. HENRY SKINNER: Mr. Chairman, ladies and gentlemen: After that introduction I must certainly try to do a good job—even on oaks.

Vegetative Propagation of Oaks and Suggested Research Techniques

HENRY T. SKINNER¹

Botanically, the oaks fall in the family *Fagaceae*, in which are also included both beech and chestnut, with their rather similar propagation problems. In a search of the literature through upwards of 300 propagation references to these plants, the walnuts, *Juglans*, have been included, in that difficulties have been experienced here too so that possible leads to our own problem might be discovered. Within the genus *Quercus* three major taxonomic subdivisions are currently recognized: Subgenus I (Cyclobalanopsis) with its few evergreen representatives is relatively unimportant from our standpoint; subgenus II (Erythrobalanus) comprises the large black oak group including Willow, Shingle, Water, Black-Jack, Scrub, Black, Scarlet, Pin, Red Oaks and several others; subgenus III (Lepidobalanus) includes the white oaks of which Turkey, Cork, Holm, Live, English, White, Post, Burr, Chestnut and Swamp White oaks are among the more familiar. These major divisions between black and white oaks should certainly be kept in mind in considering matters of propagation. Rehder's subdivisions of these major groups may at times have further significance especially in grafting and matters of stock-cion relationships.

From a cytological standpoint the oaks are fortunately simpler than many other plant genera. Present information, as summarized by Duffield (4) indicates that the basic somatic chromosome count for all species is 24 so that at least one cause for possible differences in behavior or response can be written off.

In matters of propagation, seedage is the simple and straightforward method, whenever it can be used. But our topic today is confined to vegetative methods and all of these become relatively difficult with many hardwood trees and with oaks and the oak relatives in particular. Let us review the kind of results that may be expected by employment of the usual techniques, noting where these techniques succeed or fail and where an occasional new avenue of approach may possibly lie.

Cuttings

Until the advent of chemical rooting substances the practical impossibility of propagating oaks by cuttings was so generally recognized that even mention of the method is almost wholly lacking in the older literature. Bailey's *Cyclopedia* is perhaps an exception in stating that "the evergreen species are occasionally increased by layers and sometimes by cuttings"—without further explanation.

With use of growth substances results have continued unpromising with cuttings from mature trees as especially evidenced by the work of Hutchings and Larsen (9) with white oaks and Flory and Brison (6) with the semi-evergreen Ness hybrids of *Q. virginiana* and *Q. lyrata*; the latter being almost a classic example of negative results. Of several thousand cuttings subjected to numerous variations in time of taking, type of wood, kind and concentration of growth substances, propagation media, etc., etc., a number developed callus growths and a few, set in February, produced roots but not one remained alive for longer than two months

¹Director, U. S. National Arboretum, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture.

after the cuttings were taken. The parent trees from which cuttings were secured were 25 to 30 years old.

The last statement becomes important in relation to the juvenility problem discussed by Dr. O'Rourke before this Society last year. Using indoleacetic acid at 400 mg. per liter on February made cuttings, Thimann and Delisle (14) were able to secure 82 per cent rooting of red oak. Without auxin treatment the rooting was 22 per cent. The wood "more than a year old," was from four year old trees. Cuttings from old trees failed to root entirely. Using July cuttings and auxin treatment, Komisarov (10) secured 56 per cent rooting of English oak eight years old and 34 per cent from trees 20 years old. Untreated cuttings failed completely. Other examples could be cited pointing up the desirability of working with young stock plants in all attempts at cutting propagation. Unfortunately our printed references are seldom complete in telling of the success of these cuttings after rooting. Such should be investigated, as also any possibilities inherent in the use of sucker growths, induced by pruning, as a substitute for actual youth of the stock plant.

It would seem that the propagation of oaks by cuttings remains an undertaking for the experimentator rather than, to date, a method to be employed with any certainty of results.

Layering

While a limited amount of layering has occasionally been practiced with the evergreen oaks as with the rather similarly responsive beeches, for the deciduous oak species layering has proved almost wholly unsuccessful. This comment applies not only to conventional methods but also to the more modern system of air layering employing growth substance treatments and the use of polythene film. Of a number of air layers made by myself at the Morris Arboretum, on unusual species of beech and oak, in the spring of 1950, none were successful in producing any suspicion of roots, with or without growth substance treatments. Similar wholly negative results were reported by Wyman (16) regarding fifty-two air layers made in the spring of 1951 and involving *Quercus bebbiana*, *bicolor*, *dentata*, *falcata*, *marylandica*, *mongolica*, *robur*, *robur argenteo-marginata*, *rurcinata*, *stellata* and *variabilis*.

However, to the best of my knowledge, potentialities in the cutting-like relationship of air layering to age of wood and age of parents has not yet been fully explored. More layers should certainly be tried out on very young trees. Furthermore in another difficult genus, the walnuts, very fair success has been obtained by Hatton (7) at the East Malling Experiment Station by use of their traditional stooling methods. The young growths produced by this technique seem much more capable of root formation than top-grown shoots. Adaptations of the stooling method might well be investigated in connection with oaks.

Layering then, like cuttings, must be classed as a field for further experimentation rather than a presently practical technique.

Budding

In budding we have a further propagation method which is excellent for so many other woody plants but which, with oaks, seems to be of indifferent value or wholly useless—and not, certainly, for want of testing. Flory and Brison (6) may again be quoted as furnishing a rather typical

example. Using T-buds from the Ness hybrids mentioned earlier, these workers used young seedlings of several species as understocks, including Burr, Chinese, Live, Overcup, Pin, Post, Spanish, Water, Willow Oaks, etc., and on different years inserted the buds variously in August, May and October. The stocks seemed to slip well and after as long as 4 or 5 weeks many of the buds were plump and green, but apparently there was no union. Soon after this the bark began curling and the buds dropped. Of 376 buds inserted only one united and produced a tree. From personal experience I could describe similar results as doubtless could most propagators of woody plants. While the difficulty cannot be explained without discovered facts to go on, it would seem, nevertheless, that it may possibly involve a somewhat excessive dormancy in the bud and one wonders whether earlier in the spring might not be the time to try budding with a plant of this sort.

In patch budding pecans in the Southern states there has developed a recognized practice of cutting previous years' cion wood while still dormant in February or March, storing the wood in moist sphagnum moss under cool conditions and then seasoning it (still in moist moss) at a warmer temperature to induce slipping of the patch buds at the time of outdoor budding in late April or May. Brison (2) found a temperature of 80 degrees F. for a 10 day period to be about ideal for the seasoning process. If the cambial changes which take place during the seasoning process in pecan and which permit a ready manipulation and subsequent union of the patch bud—would occur similarly in oak, a basis might possibly be found for the development of a more successful budding technique in this genus. This, at least, might bear investigation.

Grafting

In contrast to the above less promising methods of vegetative propagation for oaks, grafting has long proved to be the means of increase next most successful to the use of seed. While the obvious disadvantage of grafting lies in the fact that the rootstock is necessarily of seedling origin, with uncontrolled physiological responses, it is possible that future investigation may produce a means of overcoming this sometimes objectionable feature.

Principal graft methods are of two types: indoor bench grafting as is principally practiced in this country, and outdoor grafting as has been used to a fair extent in Europe, but much less frequently in the United States.

Bench Grafting

Indoor grafting on potted seedling understocks follows the general pattern used for other woody plants. Dormant cions are usually of the previous season's wood and either top or side grafts may be employed. Closed cases are sometimes recommended (Sheat (13) for January-February grafts, the open bench for those done later in February-March. An experienced propagator, with proper selection of his understocks, should secure a reasonably good turn-off in bench grafting.

Outdoor Grafting

This method may merit greater attention than it seems to have currently acquired in this country. Actually it is an old system first apparently described by Nagel (12) in Germany in 1829, for the grafting of chestnuts onto oak understocks. In 1867 we find reference to it again, in a similar connection, by Weber (15) writing in the French *Revue Horticole*, while

in later years it has been used and described by Flory and Brison (6) and a few others in this country.

In essence this method of outdoor grafting of oaks employs the use of dormant 1 year old cions about $\frac{3}{8}$ of an inch in diameter, gathered in February and stored under cool conditions until used. The stocks are outdoor grown seedlings varying usually from $\frac{1}{2}$ inch to 1 inch in diameter and grafting takes place about two weeks after leafing has commenced. Various kinds of grafts may be used—whip grafts inserted slightly below ground level on the smaller stocks, or bark, inlay or cleft grafts placed a foot above ground on larger stocks. Flory and Brison found the whip grafts to be most successful with the Ness hybrid oaks. Grafts are tied with string and the cut surfaces usually protected with wax. Staking of the cion and desuckering of the stocks is necessary as growth proceeds. With proper selection of understocks, 100 per cent takes have been reported with this kind of graft.

In a recent conversation with Mr. Mark Holst (8) the writer learned that outdoor grafting of *Quercus robur* and *Q. sessiliflora* has been successfully practiced for some time by H. Barner of Stalsskovenes Planteavlstation, Humbleback, in Denmark. In describing this particular system Mr. Holst places particular emphasis upon location of the basal cut of the cion in the bud scale region at the junction of the one and two year old wood, upon removal of the large-budded top section of the cion to secure growth from the lower, more dormant buds, and also upon the necessity for grafting only on quiet, cloudy days, the percentage take falling off rapidly under conditions of sun, wind, or rain. The Danish system also employs a low-placed side, rather than top graft and follows with stock restriction 6 to 8 weeks after grafting and continued as the cion develops. Average takes run 60-80 per cent with this method although under ideal conditions it may run as high as 90 or 100 per cent.

Bud Grafting

Of passing interest is the bud grafting of chestnut as described by Clausen (3) in France in 1881. Current season terminal buds were cut to a wedge-shaped base with small piece of wood attached and inserted into the cleft terminal bud of a ripening young shoot of the understock on the 24th of June. The bud was tied in place and shaded by the bunched-up terminal leaves. Takes were apparently good. Bud grafting of oaks might be worthy of at least a serious trial.

Stock-Cion Relations

The relationship of stock and cion is of very real importance in oaks. While considerable latitude sometimes seems to exist as to which species will unite successfully with which others, there is accumulating evidence that the factor of durability is not necessarily correlated with initial take. A century or more ago it was found in Europe that chestnut grafted very easily on *Quercus robur*. Apart, however, from one tree which attained the age of 50 or 60 years in the Botanic Garden of Dijon (and never bore mature fruits) apparently few others survived the stage at which the slower developing stock eventually throttled the fast growing chestnut cion.

Cases have been described by Armstrong and Brison (1) in which *Q. virginiana* apparently united well with *Q. stellata* as a top worked stock, made rapid growth for 16 years only to deteriorate quite suddenly at the point of union and die three years later. Causes for the eventually unsatisfactory union apparently lay in the slower rate of xylem or wood

tissue formation by the cion, resulting in a break which caused a girdling effect temporarily compensated for by increased growth of the cion.

In our American oaks there is ample evidence that in general, species of the black oak group both unite and succeed much better with species of the same group as understocks than with any of the white oaks and vice versa.

Perhaps cork oak (*Q. suber*) is as adaptable as any for it has been cited as a tree 100 years old in the Crimea, grafted upon *Q. pubescens* (Federov (5)), has been reported by another Soviet worker to take 100 per cent upon stump sprouts of *Q. castanaefolia* and make 7 ft. growths the first year, while in California it does well upon the native *Q. chrysolepis* (Mirov (11)) which conveniently comes into leaf so much earlier in the spring that storage of the cork oak cions is unnecessary.

By way of a brief summary we can therefore classify grafting as the most successful present method for the vegetative propagation of oak, whether indoor or outdoor procedures be used. Cuttings are very poor indeed, but merit further trial with emphasis upon the use of wood from quite young plants or sucker shoots from more mature specimens. Layering, generally unsuccessful to the present, also merits experimentation in the use of juvenile plant parts.

The oaks are perhaps outstanding in their ability to demonstrate the pathetic limitations of our knowledge of the basic scientific principles underlying vegetative plant propagation.

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. . . Dr. Skinner presented his paper, making the following interpolation on page 7 of the paper:

No. 1: I didn't mean to imply in the question I asked following that excellent paper of Mr. Hoogendoorn that I am against grafting. Rather, as Mr. Seibenthaler asked this morning, are we getting the end results we want? Having been involved in arboretum work for quite a number of years, I have rather developed the habit of looking at plants not on a 1 to 4 year basis but in terms of the 20 or 50 year results that we can expect with those plants. That has tended to make me a little bit critical of grafting in some groups, particularly in the bush types of plants—things like azaleas and Japanese quinces and lilacs and even *Viburnum Carlesii*—where you have a bush which under arboretum procedure and the procedures of the average home grower needs to be renovated periodically, to be pruned to get good flowers. Even an azalea, we like to cut off occasionally at the bottom. You know what happens. You kill the plant; if you don't kill the plant you get a beautiful lot of understock suckers. It is a picture which has to be faced. I think very often we haven't thought enough about that angle in grafting—the results after a long-time period.

Well, we are not confronted with a bush type in oak. We are thinking of a large growing tree with a single trunk which should normally make a perfectly good plant as a graft but there are none-the-less after effects which we have to watch out for. I want to come to those just a little bit later on in relation to these graft-scion understock relations.

. . . .Dr. Skinner finished reading his paper . . .

PRESIDENT WELLS: Has anyone any questions?

MR. HOOGENDOORN: Dr. Skinner, what are you going to say is the best oak to use in understock for grafting?

DR. SKINNER: That is a problem which depends entirely upon the oak which you intend to graft. In general, I would say by all means graft within the groups I mentioned. If you are grafting oak of the white oak type such as swamp white, use a white oak understock—it may be white oak itself or swamp white or any one of the white oaks. If black oak, use a black oak stock. There may be cases when grafting is successful between these groups. This is an example of the many understock-scion problems which we know so little about. We just do not know which are the best

understocks for our main groups of plants, on a basis of long term performance. I am afraid, frankly that stock selection is largely a matter of trial and error. If you find one that works it will be good to use in the absence of better recommendations.

MR. HOOGENDOORN: What I had in mind was "fastigiata." We used that several years ago on *Quercus robur*, which is the English oak.

DR. SKINNER: I would say by all means put the fastigiata on English oak if you can get English oak seedlings. That is the closest relationship you can find.

MR. HOOGENDOORN: They have very good stands on them.

DR. SKINNER: I think that is certainly the one to use.

MR. HOOGENDOORN: Then I heard you mention about outdoor grafting and you cut the top off the understock after it has leafed out. Is that what you said?

DR. SKINNER: Yes, it is done both ways. One is a top graft with the stock cut off at the time of grafting. In other words, it is the top-working of a small understock, while the other is done much as in greenhouse bench grafting, a restriction of the stock after union of the scion. The latter is the Danish system. In the restriction system it may be 8 or 10 weeks or longer before the stock is completely removed.

MR. HOOGENDOORN: Yes, but I heard you mention that you performed that operation after your own stock is leafed out. Is that what you said?

DR. SKINNER: Just after leafing starts was what I meant to imply, not after they are fully leafed out—after the buds are broken.

MR. HOOGENDOORN: That is right.

DR. SKINNER: It is much the same as in top-working fruit trees where your stock is definitely on the move.

PRESIDENT WELLS: Roy Nordine has a question.

MR. NORDINE: A comment in regard to understock. The primary consideration in all understock, of course, is the ability of the plant to transplant in later years. In work that we have done in the white oak group we find that the English oak (*Q. robur*) as a stock for the entire white group has a good root system which is transplanted very easily and very well. I would never consider using any of our native white oak as an understock. Anybody who has ever transplanted a white oak or burr oak knows what I mean, but the English oak and the English oak group will graft in a case very easily and very well. 80 per cent or 90 per cent should be a reasonable catch and they will grow out easily and well.

In the red oak group, we use only eastern pin oak, which is *Quercus palustris*. It transplants very easily, very well. It makes a fine root system and so this is the only one we ever consider using. In neither case would we substitute any other oak. I would rather forget the grafting if I had to substitute the understock. The entire red oak group is very difficult to graft. The stand is poor. They stand still for years to come and they have to be kept tied for at least two years, possibly three years,

because they will not unite. They will pull away from the union. I have seen them pull away from the union as much as four years after they had been grafted, indicating a difficulty in the red oak group. I have never found any case of the two types intermingling one on the other and there are also no reported hybrids between the red oak and white oak group, indicating there is apparently no compatibility either in the flower or the plant itself.

DR. SKINNER: I am sure Ed Scanlon will congratulate you on having found a use for pin oak.

MR. FLEMER (Princeton): We found the best way to get good understock grafting is to sow the acorns directly in three-inch flower pots so they don't go dormant and become woody. You know the way they behave if you dig up seedlings and try to cut back that long tap root and establish them in a pot!

DR. SKINNER: I think that is an excellent suggestion. Grafting is a pretty slow process in some of the oaks as Mr. Nordine has said. With all the digging and moving you can do to seed bed raised stock you may not get a root system worth a nickel.

MR. JOHN B. ROLLER (Scottsville, Texas): We are at the present time doing hybrid work for Dr. Flory and Brison.

DR. SKINNER: Do you have any information on it?

MR. ROLLER: In a small way. At the time, it fell to my lot to do grafting of these oaks and we used—

DR. SKINNER (Interrupting): Wouldn't you like to come to the microphone? This is first-hand information on grafting of oaks. The main purpose of this paper was to promote discussion and secure information from you as to how oaks are best propagated.

MR. ROLLER: Dr. Brison and Dr. Flory when they started their work with this Ness oak they came up to us and wanted us to work with them, to help them. So my boss—he is a good egg—consented. Naturally, he came up to me and handed me a bunch of scions and said, "Graft these." I knew nothing about it. I wasn't in on the deal, so to speak. All I did was graft them. I was a young kid, about 18 or 20, something like that, but we had a good stand on live oak understock, *Q. ilicifolia*. They grew well. But we got one of our Texas quick freezes. They were beautiful prizes and the next morning the bark was split from top to bottom. We more or less lost interest in it. Of course, I made notes for Dr. Brison on what happened to them. I was just doing the work. Mr. Ravenhaven was making the report. At the same time, you know how young fellows are. I think I had a date that night. I had a little handful of scions left over and I stuck them in the ground out there. I planted a few seed off those trees this fall. They are growing. When I see Dr. Brison I am going to tell him about it.

DR. SKINNER: You mean the scions grew as cuttings?

MR. ROLLER: They had been kept dormant, been stored in cold storage, in fact, they were stored with rose budwood to keep them cold and dormant. As I recall, they were just the current season's growth. They weren't extremely hard and they worked out very well. I am going to report that to Dr. Brison the next time I see him.

DR. SKINNER: Good.

MR. FILLMORE: I would like to ask what species those were.

MR. ROLLER: They were Ness hybrid oak.

DR. SKINNER: It is getting into the group perhaps the easiest to root from cuttings of most of the oaks. Any other comments or suggestions?

MR. J. V. STENSSON (Sheridan Nurseries): The shingle oak is a very handsome oak but, unfortunately, it is almost impossible to get seed. Would it be feasible to graft it on the pin oak?

DR. SKINNER: Mr. Nordine, have you had any experience with that? Would it be feasible to graft shingle on pin?

MR. NORDINE: Yes, but the entire red oak group, in my experience, is not at all satisfactory. It is not satisfactory at the present time for a commercial man to graft red oak because, as I said, they are too slow to grow, too slow to make a tree and unfavorable in their graft union. It would take too long. I would certainly attempt to get seed in that particular case of shingle oak. I would attempt to get the seed by all means.

DR. SKINNER: I would say, incidentally, by all means get on the ball right away. This is one of the best oak seed years and also one of the best beech seed years we have had for some time. Perhaps you can find shingle oak seeds this year when you couldn't previously.

PRESIDENT WELLS: Thank you very much, Henry. (Applause.)

Would you like to have a break before we go into the holly roundtable?

. . . Brief recess . . .

Gentlemen, will you please take your seats again?

We are now about to consider the propagation of holly. I think this is something which is of great interest to everyone of us.

I was out at Paul Bosley's nursery the other day. I came out here a day earlier and if any of you are interested in seeing some beautiful holly, just go out and take a look at some of the trees he has growing in his nursery. I think they were beautifully grown, stiff, dark green leaves, masses of berries. It looked more like Oregon holly. Incidentally, I was out in Oregon a couple of weeks ago and I turned green with envy.

It is not my purpose to talk about holly; we have some experts here to do that. The leader of this roundtable is Mr. H. Gleason Mattoon. I suppose all of us are nuts about some plant or other. Mr. Mattoon is nuts about holly, and he certainly grows some fine stuff. I have been down to his place at Narberth. He astonished me one day by coming to our nursery, and buying a block of *Ilex opaca* seedlings. I wondered what he was going to do with them. He grafted them. I would think he ought to have saturated the market by now. There is no doubt he knows holly. He is intimately connected with the American Holly Society, I understand, and I am sure he can give us some good information. Mr. Gleason Mattoon!

MR. H. GLEASON MATTOON: Thank you, Mr. Wells. Yes, I am sort of a nut on holly.

From what I say here you may gather that I am also posing as an authority on propagation but actually I realize that I know far less now about propagation and growing holly than I did when I started 7 or 8 years ago.

. . . Mr. Mattoon read his paper, making the following interpolations as indicated:



Vegetative Propagation of Holly By Grafting

By H. GLEASON MATTOON

Narberth, Penna.

The current popularity of the several species of *Ilex* that thrive in the United States may be due to improvement in the general run of available stock as a result of vegetative propagation of selected clones, or, on the other hand, perhaps the reverse is true—that vegetative propagation of superior strains has become more general due to public demand for better stock. Whichever came first, there has been a noticeable improvement in the quality of nursery grown hollies.

In some areas wild trees of *Ilex opaca* are still collected to be refurbished in the nursery into attractive specimens through care, cultivation and fertilizing. The practice is dying out, however, due in part to the natural variableness of the species, but more especially because such trees, when sold by the nurseryman, do not receive the care necessary to maintain the compact form and deep green foliage, and without it they revert to typical sparse berried trees with leaves jaundiced yellow or reddish purple.

A few nurserymen still grow their stock from seed, waiting from five to ten years to learn whether they have a preponderance of staminate or pistillate trees, and equally as long to find out whether the form, foliage and fruiting qualities of the block of *Ilex opaca* are good, fair or poor.

In general seedling American hollies whether nursery grown or wildings are not very attractive. Yet they respond so quickly to beauty treatments of humus and fertilizers high in nitrogen and potash, that a fence row runt can be transformed into a beauty queen in a very few years and so long as she is continued on the high life diet her beauty remains. But if cuttings or cions are taken from such a pepped up holly, the resulting plants, if given normal treatment, resemble the runt instead of the reigning queen.

In contrast, if a holly growing under adverse conditions has good color of leaf and berry, the vegetatively produced offspring will also have superior qualities under varied growing conditions. Too often we have been misled by the superior qualities of a holly growing under optimum conditions, into believing such qualities are inherent rather than environmental. Careful examination of existing conditions and the past record should be had before deciding on the value of a particular specimen as a stock plant or for ornamental use.

The methods of reproducing the inherent qualities of the parent plant are several: by soil layering, air layering, cutting and grafting.

Mound and branch layering are useful methods of limited application in the nursery trade. However the owner of a bush type holly who wishes to produce additional ones on a small scale may find either method desirable since no special equipment is needed and care during the rooting process is unnecessary. An adequate root system is slow to develop, usually requiring two growing seasons before the layer can be severed from the parent plant, but the size of the resulting plants compensates for the protracted period required to produce them.

Air layering or marcottage as it was formerly practiced, was a long and exacting process. The tedious daily maintenance of the moisture

content of the sphagnum moss or other material in which the stem was encased, limited its application to tropical and semi-tropical areas and the glass house. With gas pervious and water impervious plastic film now available, maintaining the moisture content of the moss is simple, depending upon properly encasing the ball of moss and correctly binding the film at top and bottom. Air layering has been successful on 14 species and 60 horticultural varieties of red berried persistent leafed hollies. Well branched attractive plants from 12 to 30 inches in length can be produced in from 10 to 14 weeks. On most strains of *Ilex opaca*, *Ilex aquifolium* and *Ilex cornuta* a good root system develops more rapidly on layers made in June and early July than on those applied in April and May.

In earlier days especially in the British Isles and in parts of Europe where gardeners were thoroughly trained and the skills of plant propagation were highly regarded, the ability to reproduce plant life by grafting was a necessity. Today with greater control of environmental conditions and with the use of root inducing hormones, reproduction by cuttings can be carried on by anyone who has simple equipment. Though grafting of hollies is an art employed by only a few, its merits are such in the reproduction of horticultural varieties that it should be more widely employed. Not only is it a sure way of producing strong growing, sturdy hollies, but because of the choice of stock on which to graft, a large, active root system can be selected which will cause the plant to develop rapidly. Grafted hollies, once the union is made, require less care than rooted cuttings. Grafting may be done successfully over a long period of time. In the greenhouse it may be carried on in mid-winter when other work is less pressing.

Criticism of grafted plants is sometimes voiced, because of poor union between cion and stock or because the latter produces suckers. But these are not valid objections to grafting, rather they are indicative of faulty technique. Grafting, the text book tells us, is the technique of inserting a part of one plant into another, so it will grow and produce its kind.

Each proficient holly propagator develops his own method of grafting; there is no right and no wrong way to graft hollies—only successful and unsuccessful ones, the latter invariably the result of poor workmanship.

Ideally the stock and cion should be of the same species, for thus they are entirely compatible. But necessity at times forces the use of various combinations within the genus. In general a union will result, though it is frequently weak. It is especially unwise to use a fast growing stock to which a slower cion is joined, because the tendency of the stock to out-grow the cion is too great. *Ilex aquifolium* for instance, can be grafted on *opaca* stock if need be, but to reverse the relationship is to court trouble, since *aquifolium* grows more rapidly than *opaca*. The first specimen of *Ilex platyphylla* found growing in New York was actually a stock plant on which an *Ilex aquifolium integrifolia* cion had been grafted twenty or thirty years before. When identified, suckers from the stock had developed into a twenty-two foot tree which overtowered the cion by more than ten feet.

Many holly propagators use the side graft, a modification of the veneer graft in which the inch long incision in the stock is made only slightly off the perpendicular. The base of the cion is shaped to fit the incision with both cambiums meeting. The graft is tied with paraffined cotton twine and plunged into peat moss in a greenhouse grafting box. If

the potted stock is in active growth when the graft is made, callusing will start quickly. After callusing is well under way, ventilation should be given daily, lengthening the period each week until the grafts are hardened. In six or seven weeks they may be lifted from the grafting box and placed on the bench.

Recent tests in which the graft is coated with lanolin to stimulate rapid callusing and to protect the union from drying out have produced gratifying results. When lanolin is used there is no necessity for covering the union with peat moss. In both of these methods the top of the stock is not touched until after ventilation has been given for two weeks. At that time, one half the part above the union is removed. The remainder is cut off shortly before the grafts are shifted to the bench.

A modified saddle graft in which the stock is not cut until after the union heals has produced excellent results.

Bench grafting has been successful using the whip or tongue graft when the stock and cion are the same size. These are also carried in the grafting box through callusing and gradual hardening. With wax applied over a lanolin application, such grafts have been successful when placed directly on the bench.

If the stock is in proper growing condition, grafting may be done from September to March in the greenhouse. Field grafting has not been practiced except locally in the deep south. Patch budding is occasionally carried on in July and August, especially to produce a staminate branch on a pistillate tree. Although such an operation is practical, the tree should be examined periodically to maintain a proper balance between the male and female parts. Sometimes a cleft graft is put on one branch of an isolated pistillate tree using staminate cions to improve pollination.

While only *Ilex opaca* has been mentioned in this discussion, the comments apply equally to *Ilex aquifolium*, the *altaclarensis* hybrid group, the native species *vomitaria* and *cassine* and to the oriental species *cornuta*, *pedunculosa* and *pernyi*. It is fortunate that the genus *Ilex* lends itself so readily to vegetative propagation because with its tendency to seed and bud mutation, the new horticultural varieties which so frequently appear, can thus be perpetuated.

PRESIDENT WELLS: Well, gentlemen, do we have any questions?

MR. FILLMORE: I would like to comment on the use of lanolin. I used it quite a few years ago. Like yourself, I think in certain instances it exerts a beneficial effect. It gets more callusing and certainly provides protection for long use.

MR. FRED J. NISBET (Musser Forests, Indiana, Pa.): Is that lanolin purified or raw?

MR. MATTOON: I get it in the drug store in a large can. It must have been slightly purified.

PRESIDENT WELLS: Any other questions? Well, Mr. Mattoon is going to be here, and incidentally, I would like to pass the word along that we would like all the speakers on the program here for the round-up clinic which will follow our next speaker.

Of all the people on the program this afternoon, Roger Pease is the one man I know nothing about at all. I met him once or twice and we have had very pleasant talks on plant propagation. He comes from the University of West Virginia, which is the limit of my knowledge. Maybe that is a rather terrible thing for a person in my position to say, but it is the truth. I think, nevertheless, we are going to have some good information from him, and without more ado I would give you Roger Pease on "Propagation of Holly Cuttings." Mr. Pease:

MR. ROGER W. PEASE: When Ed Scanlon wrote to me about this talk, he said, "Try to make it 15 minutes." It is rather difficult to cover rooting and growing holly in 15 minutes, but even though I shouldn't waste time, I would like to make a short peroration.

I remember long ago, when I was an undergraduate, one of the wisest men, and certainly the best teacher, I ever sat under, called me up after class one day and said something to this effect: One of the strangest characteristics of man is his eternal search after *the* truth or *the* cause. Those were the words he used—*the* cause. He went on from there. When you are dealing with living things, there is never *the* cause. There are many, many causes, some of which you can mention, many of which only God knows.

Now I think that is applicable whether we are propagating plant materials or being doctors.

I think it is especially applicable in scientific pursuits. When we conduct research or an experiment, we try to isolate and control all of the environmental factors except one. There is, therefore, an unconscious tendency to think of that one factor as *the* cause. In the "forties," growth-inducing substances—auxin or hormones—appeared to be *the* cause for rooting many plants. Right now I am guilty about fog nozzles. I have to watch myself to prevent thinking that they are *the* trick.

So in preparing this paper I have jotted down 21 environmental factors which I believe have to do with rooting holly. There may be 150 others. No two of us would put down the same 21.

When six years ago I started to root and grow holly in a manner suitable for a small producer or farmer, I did some reading, listed 21 factors, and tried to supply all of them as well as my facilities and knowledge allowed.

As I improved rooting conditions, the importance of factors varied. Juvenility is an instance. Mr. O'Rourke reported last year from a pamphlet by F. E. Gardner, who had obtained 100 per cent rooting of soft wood cuttings from one year old trees, 60 per cent from two year old trees, and 47 per cent from 3 year old trees. With trees older than 3 years he had reported no success. This year I placed in my cold frame 25 cuttings of American Holly from trees ranging from over 100 years old to 2 years old. The percentages of results for the old trees were: 100, 100, 96, 96, 84. Cuttings from the juvenile trees all rooted 100 per cent. Juvenility was a factor, but it was what I called "masked." My other conditions were desirable enough to make juvenility become relatively unimportant.

Rooting American Holly from Softwood Cuttings Cold Frame Method

ROGER W. PEASE, *Assistant Horticulturist*
West Virginia Agricultural Experiment Station
Morgantown, West Virginia

SOME FACTORS INVOLVED—PROCEDURES

1. *Drainage*

Free drainage—tile drain—18-inch excavation. White, washed, building sand fill if fog nozzles are to be used. Otherwise top four inches one-third peat moss and two-thirds sand.

2. *Soil Cable*

Optional. Not necessary if other conditions are very good. Advised to be installed for emergency. Thermoswitch readily adjustable without removing from soil medium. Easy adjustment of thermoswitch. Cover thermoswitch above ground with inverted plastic bag. Thermoswitch adjustable for temperatures from freezing to at least 70°F.

3. *The Cold Frame*

Cement block construction recommended. Not wood.

4. *Sashes*

Flexoglass more expensive in long run than glass. Hinged or sliding sashes reduce labor. 3 ft. by 4 ft. sashes easy to work under.

5. *Humidity and Water*

Humidity 100%. *Low pressure* fog nozzles recommended. On during day—off at night.

6. *Light Intensity*

Variable. One-fourth to one-third light recommended.

7. *Ventilation*

Open sashes a few minutes each evening *before* fog nozzles are turned off.

8. *Air Temperature*

Up to 90°F. Fluctuations of temperature not desirable. White-painted sashes plus fog nozzles reduce fluctuations and extreme heat.

9. *Type Shade*

Natural shade steadies and reduces air temperature, but roots enter frame and interfere with drainage.

10. *Soil Temperature*

Not less than 70°F. until roots are well formed.

11. *“Rootability” of Parent Tree*

Juvenility a factor but not critical. Vitality a factor but may not be critical. Unknown factors may be lumped under inherited “rootability.”

12. *Type Cutting*

New wood—not soft, curled tips. Stout rather than spindly growth. Not sucker shoots.

13. *Time of Taking Cuttings*

July to February. Middle of August recommended.

14. *Method of Taking Cuttings*

Entire new growth. Place at once in moist sack.

15. *Storing Cuttings*

The less storage the better. Never store in water. A damp sack placed in a dark, moist, cool place.

16. *The "auxin" or "hormone"*

Manufactured products not preferred. Prepare fresh each season. Store, sealed, in refrigerator. To prepare: 3/20 grams indole-3-butyric acid crystals dissolved in a beaker containing 18 cc of 95% alcohol. Add 20 grams talcum powder (unscented). Stir to a paste. Allow to dry several days. Pulverize with mortar and pestle. This powder is a little stronger than Hormodin B-2. Acid crystals may be obtained from: Fisher Scientific Company, Pittsburg, Pa.; or Distillation Products Industries, Rochester 3, New York.

17. *Preparing the Cuttings*

With sharp knife prepare 3 to 4-inch cuttings. Ends, center, and base of new growth may be used. Remove with knife all but 2 or 3 leaves. Don't mutilate bark. Drop each prepared cutting at once in a pail of water.

18. *Application of "Auxin"*

As each cutting is set, dip about 1/2 inch of the base in the powder.

19. *Planting Depth*

Shallow—about 1 1/4 to 1 1/2 inches.

20. *Spacing*

Modify according to needs. Rows 6 in. apart, leaves pointing across the rows, leaves touching neither the sand nor each other.

21. *"Hardening Off"*

Procedure optional. After roots are well developed about middle of October, transplant to light soil (very well drained), reduce water and temperature. Don't let plants freeze during winter.

Will you turn to page two, Item II? I think that it is an important item. Before starting to root holly, select a highly "rootable" parent tree. Some clones root better than others. There is much variability over and above juvenility and vitality. Some trees apparently inherit high "rootability".

To illustrate: In West Virginia, there is a little tree in the wild. We call it the Helvetia holly. The top was taken off by vandals. It has grown under heavy shade. It has poor vigor, judged by the length of annual growth. There isn't any central leader. The tree nearly died two years ago. It has, however, rooted 100% four years in a row. Then there is the Brooks holly, probably more than one hundred years old, which roots 90 to 95% year after year.

The first job, then, is to select a clone that will root.

The twelfth item is the type of cutting to take. I don't think type

is critical, but soft, curled tips are undesirable. I prefer a stout, rather short cutting to a long, spindly one; and I don't take sucker shoots.

Item 13. The time of taking cuttings is not critical—from July to February. Maybe one could root them in May. But I do think that cuttings taken August 15 will root with a high percentage and will have time for the roots to become well established before winter sets in.

Item 14. Method of taking the cuttings. I take the entire new growth, if it looks healthy, and place the cut shoots at once in a moist sack, but not in a pail of water. If shoots stay in a pail of water, the leaves become water-logged. One year I set out about four hundred water-logged cuttings, and they defoliated.

Item 15. Storing of cuttings. The best way to store cuttings is not to store them. In other words, the quicker one can get them off the tree and set, the better. If cuttings must be stored, it is satisfactory to put them in a moist burlap bag and keep the bag in a cool place where there is aeration.

Item 16. The auxin or hormone. I prefer to prepare the hormone powder myself. A commercial company can procure good quality indole butyric acid crystals. This is an advantage. On the other hand, I have asked several chemists about storing the talc mixture. Most of them say that although they don't know how long one can store the powder, it is safest not to carry it from season to season, and that for even short storage it should be kept sealed in glass and under refrigeration. Commercially prepared powder may be old and is sometimes kept in a warm place. Hence, I always prepare my own hormone powder.

When one mixes his own hormone, he also has an opportunity to prepare exactly what strength he wants. The 1—150 mixture I recommend is in no way critical. My objection to a 1—100 mixture is that it may burn the cutting, but I have had stems turn black when I used a 1—200 mixture. This blackening may or may not have been caused by the hormone.

Item 17. Preparing cuttings. I think this is one of the least critical procedures in rooting holly. As an example, a farmer once showed me how he had torn a small limb from a bush, balled the base of the limb with mud, planted it, and produced a healthy plant. This may or may not be good procedure. I, however, prepare my cuttings with a sharp knife and make them three to four inches long. A nice shoot will make two, three, or sometimes four cuttings. I can see no difference in growth habits between terminal and basal cuttings.

Item 18. Application of the hormone. I dip cuttings into the acid powder about half an inch. The cut surface of a newly prepared cutting, when exposed to the air, oxidizes quickly and turns brown. This may be avoided by dropping each cutting, as it is prepared, into a pail of water. Do not store the cuttings in the water but use them at once, dipping each cutting into the powder when the cutting is removed from the pail.

Item 19. Planting depth. Planting depth is important. I set the cuttings about an inch and one-quarter deep.

Item 21. Hardening off. I think that rooted holly cuttings should be given a rest period because nature gives holly trees a rest period. On the other hand, rooted cuttings may be damaged by freezing. As an example, all of my rooted cuttings died of winter injury two years ago.

A deep snow had fallen soon after the cuttings had been hardened. After warming the cold frame, the heavy snow melted quickly, and then the temperature dropped below zero. The bark on the cuttings was split. Cuttings should be kept from severe freezing and from sudden changes of temperature.

Now back to the beginning of the paper. Item 3. Cold frame. I recommend cement block construction of a cold frame and not wood. I tested a wooden frame for three years beside a cement block frame. Consistently the wooden frame rooted holly about 20% lower than the cement block frame. Perhaps it is a matter of ventilation.

Item 4. Sashes. I feel strongly about wasting labor since I have to construct and care for my own cold frames. One of the things which irritates me most is handling a 3x6 ft. sash. I break the panes—lose my temper. Also, under a large sash, one cannot reach the middle of the cold frame and hence damages the cuttings while caring for them. Under a 3x4 ft. sash, on the other hand, I can reach the center of the cold frame even though my arms are short.

Item 5. Humidity and water. In my opinion this item, along with Item 1—Drainage—comes as near to being *the* cause as any one factor listed. Fog nozzles give high humidity and excess water. Therefore, because of the excess water, they should be accompanied by free drainage. They also save labor. When I come to work in the morning, I lift the cold frame sashes and leave them up a few moments. While the sashes are up, the fog nozzles are operated. Then I close the sashes, leave the fog nozzles on, and go about my work. At quitting time I lift the sashes again, wait a few minutes with the fog nozzles on, and then shut both the nozzles and the sashes for the night. This is the only care the cuttings receive, except that I keep trash removed from the cold frame.

I believe that holly and azaleas, and many of the rhododendrons, like water running in and out. Frankly, Jim, I am scared to death of fog nozzles used over very much peat moss. You aren't? Remember, Jim told us that he had to replace peat moss. Why?

PRESIDENT WELLS: Can you tell me?

MR. PEASE: No, I don't think so, but I will try, Jim. May I?

PRESIDENT WELLS: By all means.

MR. PEASE: We don't see that peat moss breaks down rapidly, but it starts breaking down at once. This break-down has two effects: the peat moss packs and causes the water to settle, and the packed peat moss interferes with aeration. My rooting results improved when I changed from one-third peat moss and two-thirds sand (under fog nozzles) to white, washed building sand without any peat moss. I maintain drainage and humidity and excess soil water simultaneously. To obtain the drainage I excavate eighteen inches, lay drain tile, and fill with sand or very light soil—preferably sand.

Another point. I see no advantage in removing the sashes if fog nozzles are used. The nozzles are erratic then, especially in the wind. Because I use low pressure nozzles, each one will cover a circle only three feet across, with the sashes raised. With the sashes closed, however, they cover everything in the cold frame.

To return to my talk. Item 2. The soil cable is not needed except in an emergency. Cuttings set this year on August 15 were inspected after

28 days and had developed root systems. These rooted cuttings could have been carried into the rest period without bottom heat and probably would have developed secondary roots before resting. However, no matter how careful one is, holly cuttings will root slowly in some years, and by October 15 there may be only callous formation. Unless one has bottom heat available such cuttings probably will be lost. Hence, soil cable should be installed for such an emergency.

Item 9. Type of shade. I have mentioned in the outline root interference under natural shade but have not mentioned that natural shade reduces the air temperature. Holly doesn't like extremes of temperature. I like to keep air temperature in the cold frame under 90°F. This is not difficult with the use of fog nozzles, with shade strips and sash frames painted white, and with the cold frame located in natural shade such as is furnished by the north side of a building.

Item 10. Soil temperature. I was once told that indole butyric acid wouldn't work at less than 70°F. Let's leave that to the chemists. That is why I keep soil temperature at a minimum of 70°F.

Thank you very much. (Applause).

PRESIDENT WELLS: Do we have any questions?

MR. H. M. TEMPLETON, JR. (Winchester, Tenn.): I would like to say in Tennessee we are having success with all holly, and incidentally, with *Ilex opaca* we are apparently doing everything wrong, but it works. We root in soil which is clay, a pretty heavy clay, a little sand mixed with it to make it work easier. It is essentially on the surface of the ground, a slightly-raised bed, with a temporary greenhouse erected over it, a very simple, light temporary greenhouse.

We use fog nozzles down the length of the house, which is only 14 feet by 3 feet high.

PRESIDENT WELLS: This gentleman has something quite interesting to say. He was talking to me about it. I think if he cares to describe his method of rooting not *Ilex* but other plants, it would be of interest to all of us. Perhaps you might like to start again, sir.

MR. TEMPLETON: The house is sheet acetate and wooden frames, with beds four feet wide, 48 feet long. The total height of the little V-shaped roof is 3 feet, which gives room to distribute mist underneath. The fog nozzles, well, they are not fog nozzles, they are spray, low pressure operating on 40 pounds, throwing water rather than mist. We put cuttings in in the simplest way, chop up the pieces, treat them with Hormodin No. 3, get the clay dirt nice and muddy and stick them in about an inch deep, turn on the fog nozzles and give them about 50 per cent light, and leave them. They stay there. We put them in in September. We leave a little shelter over and leave the spray nozzles on. The spray nozzles are under automatic control. In September, they will run possibly 2 to 3 hours a day on and off. In the middle of the winter, some days they never run at all, some days a tenth of an hour, sometimes two-tenths. By spring, we remove the whole installation, give them a little shade and just let them grow right where they rooted.

After hearing this excellent talk, it seems I am doing everything wrong with possibly three exceptions. I am giving them plenty of water. I want to have free water left on all the time, if possible. That seems to

be necessary. I am treating them with Hormodin No. 3, which probably isn't quite strong enough, and I am using juvenile wood which I consider of the utmost importance. Other than that, everything is wrong, but by success I mean in the 90 per cent range. It is cheap. It is simple. We don't have to handle them. They grow there and make nice growth the next season. Understand, they freeze in the first winter, sometimes even before they root. They begin to root in 23 days and continue to root all winter and some of them finish rooting the next spring. Thank you. (Applause).

PRESIDENT WELLS: I don't know why there are any nurserymen left up north. These fellows down south seem to be doing impossible things.

MR. FRANK TURNER (Berryhill Nursery Co., Springfield, O.): I would like to ask Mr. Templeton the thickness of polythene 1 mil. or 2 mil.

PRESIDENT WELLS: What is the thickness of polyethylene plastic you use?

MR. TEMPLETON: Four-thousandths.

MR. LOUIS VANDERBROOK (Manchester, Conn.): Jim, I would like to ask if anyone is doing anything about increasing the hardiness of different types of hollies. We tried growing some seedlings in Manchester and out of 10,000 got 15. We gave up raising holly.

PRESIDENT WELLS: Is anyone doing anything about selecting super-hardy strains? Paul, have you any comment to make on that?

MR. PAUL BOSLEY (Mentor, O.): I think you better join the American Holly Society and meet holly people. A lot of work is being done with the selection of forms and types. You will meet people who live in your section of the country and who have trees that are very, very old. From those you should propagate. Most hollies existing in the field are 98 per cent worthless. That is, worthless from the standpoint of using in a garden. Therefore, your propagation should be done from those better two per cent. There are people who have narrowed that figure down to one-hundred thousandths of a per cent. We do have fine, very hardy hollies that in our case I know have gone to 20 below zero in winters of '33 and '34 and stayed zero for six weeks. That is hardy enough for anybody in Connecticut or Ohio, most places in New York.

MR. VANDERBROOK: How do you find the two per cent? Are they registered with the Holly Society?

MR. BOSLEY: The Holly Society, unfortunately, does not have a system of registration. They should have. It is something that is needed. I have advocated it, like the American Rose Society, which has a registration. It doesn't cost much to belong. You will meet a lot of people and gain a lot of holly information. I hope that partially answers.

PRESIDENT WELLS: John Vermeulen?

MR. JOHN VERMEULEN (Nashanic, N. J.): We have grown quite a bit of holly for a number of years. I have had trouble in the greenhouse for two weeks, three weeks and sometimes four weeks with the leaves starting to drop. The callus has started to root but all of a sudden, every leaf disappears. Two years ago we had about 15,000 cuttings and we lost

at least 10,000 that way. I have not been able to find the reason. Last year we had no trouble. This year, so far, we haven't. Three years ago, I also had the trouble on Long Island. I would like to find the cause.

PRESIDENT WELLS: I will make a comment on that and Roger here has one, too.

We found exactly the same thing. The whole gamut of propagation becomes very complicated because, as Roger has pointed out, one factor may mask another and what is important at one time and in a certain set of conditions is no longer important at another time and under different conditions, and one of the values of humidification, in my opinion, is that it tends to eliminate some of the other variable factors. A plant under humidification continues in a healthy state with less variation of conditions and is more likely to root. That I believe.

Now we have found that holly, if taken at the right time and maintained under humidification, does not drop its leaves nearly so promptly or so generally as it does without it, and I think that is one of the factors. I think water as a high state of humidification is an important factor in the rooting of holly.

MR. VERMEULEN: May I ask one more? These particular years when I syringed more, I had more drop-off of leaves. Last year, I kept them the opposite. I kept them dry, and I didn't have the loss I had before. (Laughter)

PRESIDENT WELLS: I will let Roger on that one.

MR. PEASE: I won't try to answer it. I want to ask another question. How close together do you have your holly set?

MR. VERMEULEN: We stick them in rows. The rows are two inches apart or two and a half. It depends on the size of the cutting. In the row they are one inch apart.

MR. PEASE: Do the leaves touch each other?

MR. VERMEULEN: I think so.

MR. PEASE: I was going to say that if you sprinkle your holly in like hair on a dog, you may have good luck one year, but I saw 20,000 that a good commercial man, one of the best, had. Every one defoliated. Now I can't give the cause in your case, but in his case he had them so close together, that there wasn't aeration, fungus got in, and the leaves dropped. When I started using fog nozzles I didn't lose any leaves.

MR. MATTOON: Mr. President, may I comment on that? I am also doing things quite wrong in rooting holly cuttings, because I root them in a closed bench with Plexoglass top, which I lift up once a day. I have no fog nozzles in there but it remains humid because I do syringe them once a day, but I plant them close enough so I get about 100 to the square foot. In other words, they are more than touching; they are overlapping. (Laughter) And we run 90 to 95 per cent on most varieties or strains of *opaca*, English and Chinese.

In respect to holly growing up in Connecticut not being hardy, I wonder where the seed came from that was sown up there?

MR. VERMEULEN: Same region—New England seed.

MR. MATTOON: I have *opaca* growing in southern Vermont doing very well and it has for sometime. They are not seedlings. They are rooted cuttings taken from trees of known hardiness and I have never had any difficulty except the deer which proceed to eat them off unless they are protected.

MR. TED E. FOULKE (Peeper Hollow Farm, Mayfield Heights, Ohio): I had roughly 10,000 *opacas* in the greenhouse this fall, put in in September and about 1500 of them were kept a little on the dry side and the balance were kept quite moist. The trees had some dropping over half of the leaves did fall, a little black stem, and I assumed there was fungus. I went back a month later and picked what I thought was good foliage, free from fungus and put in another couple of thousand. This time I sprayed them with Bordeaux and there isn't one leaf off in 30 days. Well, I don't know what it means. Is it *the* cause?

PRESIDENT WELLS: I believe timing has quite a lot to do with leaf fall. I remember seeing cuttings put in at the end of July and beginning of August, and three weeks later the whole lot was dead. The stems were black and leaves dead. They took them out and put another batch in and they were fine. I believe towards the middle or end of August is the best time. We wound all our cuttings. You have probably seen a few of them. We apply a heavy wound.

The reports in from Boskoop this year in indobutyric acid, which is three times as strong as Merck No. 3 powder, gave 90 per cent or higher rooting in frames, and we put it in and have used two per cent on all our cuttings this year and got pretty good stand. I don't know the exact percentage. Do you know it, Jack?

MR. JACK BLAUW: 80 to 90 per cent.

PRESIDENT WELLS: These cuttings were put in the end of August or September have been lifted out and put into flats to put away for wintering. As a small test, we treated 25 cuttings with the two hormones which we have been playing with on rhododendrons, labeled over there A-5 and A-10. Those two hormones are 15 times as strong as Merck No. 3 from a rooting capacity. The names on them—there isn't much time—are crack-jaw names, I can tell you. We used one per cent powder and on 25 cuttings of *Ilex opaca* we treated with A-10 we got 25 roots. The roots were not abnormal, which you might expect from a strong powder. They were apparently normal root system and a topping good ball. They have been lifted and put in flats for wintering.

MR. PAUL BOSLEY (Mentor, O.): The ability to root I think is determined a year in advance of your rooting and plants. In other words, if your holly is well fed, has the nutrients it needs and if there are no spider mites on your leaves, your chance for success is much greater than it would be with an underfed cutting. Keep your stock plants in top condition, and be sure you have a good variety to start with.

I will say that I have *opacas* completely defoliated at this time of the year under normal years. I judge that would be a very poor holly to propagate. That is the purpose of sexually reproducing fine types. Feeding is a big factor in there, too.

MR. HOOGENDOORN: May I ask the gentleman a question? Isn't the hardiness of your *Ilex opaca* determined a good deal by the location where a plant is planted? After all, *opaca* likes exposure.

PRESIDENT WELLS: The question, in case you didn't hear, is: Is the hardness of *Ilex opaca* affected by the location of the plant?

MR. BOSLEY: It should be very hardy. It should be able to withstand open field conditions. We grow them like a farmer grows corn, open field and no protection whatever. If the variety is good, it should withstand those conditions. If it won't, we don't want any part of that variety.

MR. HOOGENDOORN: In their native haunt you always find them in the woods showing that they prefer shelter. That is why they are growing there. You will never find them exposed.

MR. BOSLEY: That is true, they prefer that. If we are going to propagate, it has to be a variety tough enough to withstand exposure. The Brooks Holly stands on top of a mountain. There is nothing between it and the North Pole. It has withstood it for a number of years. It is trees like that we must propagate from. There is a wide variance.

MR. MATTOON. May I comment? In Chesapeake Bay, there is an island fully exposed to the north and west that has a perfectly beautiful stand of holly. There are over 40 trees more than 24 inches in caliper. The island is three inches above normal high tide. It is frequently washed by brackish water in abnormally high tide. The holly is so dense on that island that no vegetation grows under it. The soil is principally decomposed leaves. Those trees are fully exposed with nothing between them and the North Pole, as Paul Bosley said.

MR. HOOGENDOORN: And they stand all winter.

MR. MATTOON: They have been doing it for 150 years and they are never winter-injured.

DR. SKINNER: Just one little observation. Mr. Pease mentioned the need for drainage in rooting. I just want to mention the fact that we are unorthodox in our little frame at the Morris Arboretum. We keep a constant water level at one inch to one and a half below the base. That frame has rooted more unusual stuff. It even does with holly. We are old-fashioned because using that system we don't have to put in fog nozzles. It is a little trick that works with us. I don't suggest generally you go into subirrigation. Some of you have probably tried it and failed. Whatever technique works for us is the one we like to use.

I might also say generally we put holly in vermiculite and peat about the middle of December in closed cases with watering or spraying more or less when we think of it. Under those conditions about all the hollies will usually root before the end of January. And again, it is a little trick that suits us.

PRESIDENT WELLS: Thank you, Henry.

MR. WILSEY: Mr. Wells, do you find any varieties that root more readily than others?

PRESIDENT WELLS: No. Now, of course, we are at fault here that we haven't any of the recognized *Ilex opaca*. Somebody in the dim past must have gone out into the woods and collected what looked like a good holly. We have 15 trees 15 or 20 feet high, a dozen with good form and glossy leaves and we propagate from them. We have one big male tree. There is certainly no juvenile wood in the cuttings we take. We take

ripened wood from current season's growth and are having quite reasonable success.

MR. FILLMORE: A question for Mr. Pease. I would like to ask if he just uses common talc in preparing hormone powder or does he use a specially fine ground?

MR. PEASE: I just go to the drug store and ask for unscented talc. I am careful when I mix it with the pestle to make it as fine as I can.

PRESIDENT WELLS: We mix up quite a lot of our hormones and we buy our powder from Merck. They won't sell you the hormones but they will the talc.

MR. VANDERBROOK: I would like to ask Mr. Pease if in putting your cutting in the medium you put it in solid or loose?

MR. PEASE: I put them in the medium and press around with my fingers and then before I turn the fog nozzles on, with a hose without a nozzle that is giving a stream perhaps as big as a lead pencil, I flood around and under the leaves.

MR. ARTHUR LANCASTER, JR. (Portsmouth, Va.): I am interested in the dropping of leaves of *Ilex cornuta*. Quite a lot of people are having trouble with that. So are we. Last year, because our temperatures are moderate we don't need much heat in our greenhouse, so we installed gas heaters. We didn't know just what the results were going to be. The hollies callused and were about ready to break, when the leaves turned yellow and dropped. I was under the assumption it was due to the gas. Since others are having the same trouble, I wonder if it was gas.

MR. PEASE: There has been published a very good bulletin at Corvallis on the "Effect of Ethylene Gas on Holly." This gas does make the leaves drop both on English holly and American. You probably had a special case, but there are other things besides that which will cause drop, without question

MR. HENRY B. METZELAAR (W. H. Corning Estate, Mentor, O.): I want to hear about subsequent care of these little hollies after having put them out in frames. How soon can you set them out? Suppose you want to plant them away from where you can take care of them, how soon can you do that after you have set them out in a frame?

MR. WELLS: We root our cuttings from the middle of August to the end of September, when cuttings are lifted, they have a primary and secondary root system. They are lifted and heeled into flats in the same rooting medium and left in the greenhouse until they get established in the flats. Then they are moved outside into deep frames where they have protection of depth sash, where they stay until spring. We plant them out early in the spring, by machine.

MR. PEASE: I would like to make an observation along this line. I think that it should be possible to grow hollies taller, with nice dark green leaves, the first year. The next year a little more, and the third year have a nice plant. I wonder if anybody has tried growing holly under a cheap overhead irrigation.

MR. FRED C. GALLE (Horticultural Department, Ohio State University.) You can get them up 18 to 24 inches under a lath house the

first year under irrigation, then take them out into the field and develop your plants from there.

PRESIDENT WELLS: Did everyone hear that? That is quite an important observation, I would say.

MR. PAUL BOSLEY: One thing I would like to mention, that is, having fresh fruit any place around your hollies. If you cut holly and bring it into storage don't have any fresh fruit in that same storage house or the leaves will be off your holly in a few days.

PRESIDENT WELLS: What kinds of fruit?

MR. BOSLEY: Apples particularly.

MR. PEASE: That goes back to this bulletin I was referring to a minute ago. Any fruit, according to it, will give off just a trace of ethylene gas. It affects the abscission layer. That accounts for your statement, sir. Any fruit will do it.

DR. SNYDER: May I make a point of observation? Apples are not the only thing that produces ethylene gas. They have found in the storage of cut flowers many of the flowers themselves produce enough ethylene gas to cause a complete abscission of all floral parts. That is the biggest problem they have run into with cut flower material. If they put in activated, brominated charcoal it will absorb the ethylene and they do not get the abscission. Likewise, if you store materials with carnations and other materials you will get a lot of abscission. Ethylene apparently, at least one theory is, it stimulates the growth regulator in the floral parts, in leaves and causes abscission. This business of apples and holly fits into the pattern generally known.

PRESIDENT WELLS: Gentlemen, what is your pleasure? We have been sitting here quite a while. We are supposed to have a clinic to wind things up. I don't know whether we should have that or adjourn the meeting or continue this discussion until we all fall on the floor. What is your please?

MR. HESS: I move we adjourn the meeting.

. . . The motion was regularly seconded . . .

PRESIDENT WELLS: Before we adopt the motion, I would like to make one or two closing comments. I think that during these past two days we have seen the spirit of that Plant Propagators Society in action as we had all hoped to see it. We have seen the free and very pleasant and happy exchange of information we had hoped to obtain. I think you will all agree we have had some pretty good meetings and it typifies what all of us had in mind when we started to get together a year ago. It also typifies what we hope to see in the future.

Nothing could be better I think than what we have had yesterday and today, but of course we shall try to make it better. A gentleman came up to me and said, "In your scheme of things, what about the amateur?" Of course, we are not an amateur society. That doesn't preclude a keen and vigorous amateur becoming a member in course of time if he wishes, and I suggested to that gentleman that he should register as a member or as a prospective member and eventually if he had the time and experience he should apply for full membership.

I would like to put another idea before you. We plan to be active, one proposal is that this society shall make it its responsibility for collecting information on a given plant or a given group of plants, considering historical references, making abstracts where it seems advisable to do so, and perhaps eventually publishing a monograph or bulletin, giving all the pertinent information. If we get into it, we are going to have a job finding people to do the work. It is no small job to tackle a thing like that. We might perhaps have to pay someone to do it and finally, we might publish those results either as part of our proceedings or as a separate monograph, if it seems justified.

That seems to me to be something very well worth while. We are not trying to run before we can walk. We are just trying to get ideas and I would like to have your reactions to this suggestion at this time. I do think that such a work would be worth while. Would it be of interest to you?

MR. FLEMER: Since the various groups of plants are taken up year by year, only one or two groups a year, shouldn't the bibliography be limited to just those groups and appended to the proceedings?

PRESIDENT WELLS: That is what we had in mind. We may not be able to tackle this for a year.

What I really wanted to get down to is this: Do you think the idea is really worth while? Would it be what you would like to have as a service from your society?

MR. HUGH STEVENSON (Forest Keeling Nursery, Elsberry, Mo.): Yes, I think so. I don't know of any ready reference on propagation of any of these items. The texts that are available are very old. I know of no recent bibliography as an index to where we could secure written material on any given subject. It seems to me it would be of inestimable value to a propagator. Your committee will have to decide how far we can go with the money available but in so far as any progress can be made or a complete bibliography can be made, when funds are available to make it, it would be valuable to a commercial propagator or professional man.

I would like to speak on one more point. There isn't any real good propagation textbook—that is no reflection on some—that is very complete on propagation matter. Even one of the most useful nursery texts by Chadwick has been out of print for about 15 years and it is about 25 years old, so there isn't anything that has recently been brought together of the form we are talking about, and we need it.

MR. GABE SIMON (Medina, O.): I would like to suggest that since we have several universities and schools represented here that maybe one group of plants could be assigned to each school and these schools endeavor to work up all the information available on one particular group of plants.

PRESIDENT WELLS: We can put that suggestion to our committee and see if there are any high-minded public officials prepared to accept the task.

Might we have, very briefly, some suggestions of what plants you would like information on? If you could choose one, which one would

you choose? Does anyone have any suggestion on what plant they would like to have dealt with first?

MR. C. PAYNE?: I would like to know about grafting Koster spruce.

PRESIDENT WELLS: I will give this gentleman the information direct.

Do we have any further comments?

MR. JIM ILGENFRITZ: I have certainly enjoyed these last two days more than most any meeting that I have ever attended and during the time I have felt that I have been walking with the great and near great in the horticultural world. Why cannot we have immediately after registration at each of these sessions a mimeographed list prepared of those present to be circulated to the whole membership, giving the name, address, principal occupation, business connection, and such other information as is pertinent, so that each of us may more easily seek out the man we want to talk to. I think it would be rather helpful.

I would like to also point out that in all of the discussions here in this room not one single word has been said about hardwood cuttings. That is our bread and butter method of propagation. I would like to hear a lot about that next year.

Finally, I believe there is a lot of enthusiasm here on the part of many of the members to do some good by imparting such information as they have, to have all of those people say all that they have to say in a three-day meeting next year is going to be impossible.

I suggest that those interested prepare papers during the year and submit them to some committee who may pass upon them and either see to it that those papers are published prior to the meeting or are in some manner disposed of as befits their value. (Applause)

PRESIDENT WELLS: That seems to me to be an excellent suggestion and I am quite sure that the executive committee will warmly welcome any papers that anyone may wish to prepare. We are already thinking of next year's program. We have one or two tentative speakers lined up and if anyone has anything that he would like to say, either verbally or in writing, please do let us hear from you.

This brings up one last point. I promise you it is the last. The question of whether we should have a summer meeting. There has been a suggestion that we should have a meeting associated with the A.A.N. in New York. It is suggested that we might arrange a tour in some of the nurseries in New Jersey and perhaps down to Beltsville. Is it your pleasure that we try to organize an auxiliary meeting to coincide with or come just before or after the A.A.N. meeting in New York? What is your pleasure? Hands up, those who would like to have a meeting in New York. (Practically none) I think that settles the question.

Well, gentlemen, I thank you for your forbearance. I am very glad you were able to come. We will look forward to seeing you again next year.

. . . The Second Annual Meeting of Plant Propagators adjourned sine die . . .

ADJOURNMENT