CHAIRMAN SNYDER: I think that it would be wise to defer additional questions until the discussion after the next paper. Thank you very much, Pieter, for a very excellent discussion on junipers from cuttings.

The record of D. Hill Nursery Company in the production of narrow-leaved evergreens is, alone, sufficient to recommend someone from that organization to discuss the grafting of junipers. We are glad to welcome Mr. Jack Hill to our meeting and are anxious to hear his discussion of grafting junipers.

MR. JACK HILL: Mr. President, Mr. Chairman, and assembled propagators: In the paper which I have prepared, I have not attempted to go into the history of grafting at all. There are repeated references in the literature to grafting that was done many hundreds of years ago. I believe there are actual references of it in ancient China where it was practiced on fruit trees. It was a recognized science at that time.

I have also concerted the efforts of this paper on the methods which are employed most generally throughout the United States, for example, I have not gone into trick bottle grafting nor the out-door grafting practice.

Mr. J. B. Hill presented his paper, entitled "Juniper Grafting–Practical and Technical Aspects." (Applause)

Juniper Grafting—Practical and Technical Aspects

J. B. Hill
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The intent of this paper shall be, not to restate those basic fundamentals found in available literature, but to relate experiences from the standpoint of a commercial propagation effort. Special emphasis will be afforded those deviations from the standard procedures outlined in the literature. These deviations we have proven practical, and useful.

It should not be necessary to define a graft, let alone a juniper graft, but for the purposes of this paper, it shall be considered as "An organic union of two plants, as when a bud, or shoot containing a bud, is mechanically combined with another plant in such a manner that it lives and develops upon the food and nutrients supplied by the other."

The reasons for producing junipers by the grafting method are to enable the reproduction of those species and varieties that do not "come true" from seed, nor root readily as cuttings, and to insure vigorous shoot growth and plant development with those varieties proven to root so poorly as cuttings that this process is impractical from a commercial growers view.

The simple elements of a juniper graft are: the understock, the scion, the equipment, and the technique. These will be further enlarged upon in this order.

Understocks suitable for juniper grafting need to be selected on the basis of variety, age, size, apparent vigor, and, of course, availability Many varieties of juniper have been used for grafting understocks, but it is generally conceded in all the literature that two, J. *virginiana* and *J. chinensis*, are best. If an exclusive choice were to be made between these two varieties, most experiences would indicate that *J. virginiana* is the most suitable understock for the varieties of ornamental juniper most commonly reproduced by grafting. The principal disadvantage of this variety lies in difficulty of producing it consistently under nursery conditions. *J. virginiana* is susceptible to a form of foliage blight known technically as *Phomopsis Juniperivera,* but familiar to us all as just "the blight." Our records at Hill's show that we have been able to grow *J virginiana* for the requisite two or three years, less than 60% of the time, and we feel certain that even in those years where there was not enough blight evident in the seed beds to condemn the production, high bench losses followed if the disease was present at all. This consideration of the blight problem has led us to the production of *J. chinensis* for understock purposes, and to date, only the availability of suitable seed has limited this program. Experiments conducted by our firm many years ago indicated that we did not wish to produce or sell juniper grafts employing Biota, *J. excelsa stricta,* or *J. plumosa* as the understock. Latent incompatability would appear the limiting factor with the first two and simple lack of subsequent vigorous growth reason for eliminating the third. Prof. Chadwick has indicated in his studies of understock suitability, notable exceptions to the objections outlined, but for the purposes of commercial production, it is far better to plan an understock that is universally acceptable with all the varieties found in the grafting list. It is for this reason we have chosen to concentrate our efforts upon understocks of *J. virginiana and J. chinensis.* Both of these varieties are produced in Dundee, Illinois, by fall sowing upon a "well prepared bed." Most are of suitable grafting size at the end of two growing seasons and are selectively dug for potting in late October or November. The residual quantities left in the seedling beds are fertilized well and left to grow another year.

The seedling junipers that we select for understock purposes, are chosen mainly upon the basis of their stem diameter, and apparent vigor of top growth. Optimum stem diameter, for our purposes, falls between that of a thick and thin pencil and needs be straight without obvious cambium imperfections. Apparent vigor of the selected understocks is felt to be of great importance, for only the most vigorous plants of this relative small size can have stored the abundance of carbohydrate and starch requisite for the production of ample callus, essential to the healing process. After being dug from the beds, these selected understocks are again graded to assure uniformity, their roots trimmed lightly to facilitate potting, and the plants having extra long tops are cut back to a length that will enable the ultimate graft to be benched conveniently. These graded and prepared seedlings are then potted off into 2½″ rose pots in a suitable, well mixed potting soil--this year into John Innes Compost--and plunged to pot level in a bench of peat. The houses in which these understocks are

held will be kept cool and moderately dry for approximately thirty days, or until the last week of November or early December. Incidentally, this time can be shortened to ten or fifteen days under some circumstances. It is preferred that this initial thirty day period be thought of as one of rest, even though the stocks had probably received several sharp frosts before they were dug. This short rest can be considered the equivalent of a "winter" in the regions to the south of Illinois where the *J. virginiana* is so much at home. Following this period of rest, an "artificial spring" condition is simulated by the application of both moderate heat and water . . . heat to the level of 65° in the bench and sufficient water that all the plunged pots are adequately moist. Adequate moisture is difficult to describe or define accurately, but for this paper it may be considered that level where it is just possible to squeeze a few drops of free water from the peat plunging medium. Within seven to twelve days after the heat and water are applied, evidence of root action should become apparent, and within another week, most of the understocks should be at the level of activity considered by most, suitable for grafting. There is, in all honesty, a dearth of information upon this technical point in the literature, but recollections of conversations with other growers seem to indicate that most feel as we do at Hill's that the optimum level of plant activity for grafting is indicated by the presence of white root caps ¼ to ½ inch long. There appears to be a definite advantage to grafting junipers at this stage of understock activity, whether secured by the methods outlined early or late in the grafting season—December to March. Grafting percentages would seem to suffer somewhat if the time of grafting is delayed until the understock is in full flush of growth and the roots extended in white and secondary growth to the length of several inches. It would be useful perhaps, to note at this time, that it is considered best by most growers in this country to have understocks established in the pots at least six months before the grafting season. We at Hill's, quite frankly, have had no extensive experience with this method, as our results would appear to be satisfactory without the additional time of the understocks in pots. Tests are planned however to check with certainty for an advantage to one method over the other. Since early experience with juniper grafting was obtained many years before my own activity in the firm, a question about this method of potting in the fall before grafting, rather than the spring preceding, reveals that the former method was outlined as best by several Boskoop growers, and has been followed in Dundee without deviation until this time.

Selection of "suitable" scions has always been looked upon by propagators as having an equal bearing upon the success of a grafting operation as preparation of the understock. Certainly no exception can be taken to this holding save that when all the facets of juniper grafting for commercial trade are considered, it is impossible to overemphasize the need for careful, discriminating selection. Need it be pointed up that to produce ample callous, quick healing, and union firmly to the stock, the best scion will need to be selected from a parent plant that is in the very highest bloom of health and vigor; let alone one of exactly the strain

within the variety that is to be reproduced? The juniper scion which would be considered ideal at Hill's is 9 to 12 inches long, of growth in the current season, and approximately the same diameter at the base as that of the understock to which it is to be grafted. If there is to be a variation in this scion base understock diameter, it has always been felt best to put the smaller scion upon a larger understock than the reverse. Save to indicate again the greatest necessity for careful selection of this scion from a parent plant free from disease, free from harmful insects, and in the very burst of healthy vigor, only one more factor need be considered, and that is the time of removing the scion from the parent plant in preparation for grafting. In pure theory, everything would point to the advantages of attaching the scion to the understock at the earliest moment possible following its detachment, and there can be no argument against this hypothesis Unfortunately, there are many factors which enter into this consideration when juniper grafting is done on anything approaching a commercial scale. In Dundee we are often faced with cutting much scion material when outdoor temperatures are at or below freezing, and these scions need to be stored for periods of two to twenty days before they are actually united with the understock. There would appear to us to be no difference whatsoever between the results secured with scions, thus stored, over those placed on the understock within hours of removal from the parent plant. The storage facility which is used for this necessary interval is attached to the greenhouse work areas, and during our months of use provides temperatures from 30° to 40°. The scions are supported off the floor on simple racks having an open wire mesh bottom and all are thoroughly watered down so that the humidity within this storage remains near 100%, regardless of the slight variations in temperature.

The mechanics of making the actual graft itself are quite simple, requiring as tools only a sharp knife, thread, and rubber or tape with which to bind the scion to the stock. The type of graft most commonly used with junipers is the veneer or flap graft

In making this style of graft, the understock is cut for 1½ inches parallel to the axis of the stem, about one third of the way through the diameter, and to approximately one inch above the pot soil line This cut leaves the veneer or flap somewhat more flexible than the remaining stem of the understock. The scion bark and cambium is sliced away on two sides for a length of 1½ inches at the base which is either left or recut to a blunt chisel shape. This cut portion of the scion is inserted into the cut made in the understock, and the blunt end of the scion pressed as far as possible into the bottom of this incision. The flap and scion are then bound tightly to the stock with whatever material for tying has been selected. It is thought that most propagators now prefer the flat rubber strips marketed for the purpose, though some are using paper grafting tape or the still older linen thread. In any event, the points requiring close attention are the juxtaposition of the cambium layers scion understock, and the security of the tie or wrap. This tying needs be done with accuracy and strength so that under no conditions can the scion

move about within the cut made in the understock. Any movement at this point during the healing process delays that time when an actually physical union will be established and scion growth enabled with plant nutrients supplied by the understock. Any extension in the period necessary to establish this union is detrimental and should be avoided if optimum results are to be obtained. In the past, much attention has been given in literature to the necessity of "matching" exactly the two bands of cambium exposed by the cuts on the scion and understock. While we have conducted no scientific tests enabling direct comparison, it would appear that there are many factors having greater bearing upon success than this . . . we simply get them near to matched on one side at least and depend almost entirely upon that volume of callous produced at the blunt end of the scion to affect early and adequate union with the understock. The understock, having obviously a greater supply of stored carbohydrate, invariably produces a greater mass of callous than does the scion and it is this greater mass that more or less enfolds the scion along the major line of the graft Union along this major line is essential to the production of a strong graft that will have the greatest exchange of food and nutrients between scion and understock Many years ago it was standard practice with most propagators to paint or in one way or another, cover this entire union area with grafting wax. At Hill's we no longer use wax of any kind, though, again, no direct comparison tests have been made within time of recall and perhaps we would find it fruitful to conduct a test of this sort.

After the mechanical processes of making the graft have been completed, there are two accepted methods of handling which will enable healing and establishment of the union. They are: placing the graft vertical in a bench, plunged to above the union in moist peat, or laying the graft in the plunging peat at an angle of approximately 45° and covering the bench with a tight fitting sash. In either event, the temperature of the plunging medium should be kept constant at that temperature which will promote rapid and continuous healing of both understock and scion The advantages of the open bench method are obvious. A greater number of pots in any given size can be accommodated, day to day appearance of the plants can be more readily checked, and there is far less likelihood of invasion by pathogenic fungi or virus since the interval assured by the placing of the pots does not allow the tops of the plants to touch. The double glass or sweat box method needs far less daily attention since the complete restriction of air circulation negates the need for additional water to replace that lost through evaporation and transpiration. A close watch needs be kept however, for the first appearance of any mold or fungi, since under the conditions within the sweat box, these organisms spread with surprising rapidity. Any graft showing the slightest disease, must be taken from the bench immediately and either isolated away from the rest of the crop or destroyed. Failure to observe the first indications of this problem has cost us many plants in the past, as we have used the double glass method of healing almost entirely until this date. Trials have been made, however, with the open

bench and we are quite certain that this newer method, with humidification equipment, will prove best. With mention of the word "humidification" it should be indicated that the temperatures which we have found best for rapid healing is a constant 75° with all junipers. The humidity of the sweat box takes care of itself from the reserve within the plunging peat, but the humidity of the entire house when employing the open bench method, requires close attention to be held at not less than 85% relative. Free air temperatures in a normal grafting house may vary considerably without ill effects so long as the humidity is controlled. Serious and irreparable damage to the scion can occur if it is allowed to transpirate too much moisture in a house of low humidity. Perhaps it is not necessary to mention that the amount of water vapor present in a house on a cool morning may be entirely inadequate in that same house when the diurnal temperature fluctuation has raised the free air level on a sunny afternoon. Surely, the best method of insuring against losses owing to this cause is the investment in some sort of humidity control system—I shall not become embroiled in a controversy over which proprietary system is best, but it should at once be simple, reliable, and inexpensive, to operate.

The time interval under the conditions described above that is required for a juniper graft to heal adequately, varies considerably with many factors, including variety. There is no hard and fast rule that will dictate a minimum or maximum number of days, save that it should fall somewhere between fifteen and fifty.

When the union of the graft has healed sufficiently, and this can be determined by inspection for abundant callous surrounding the incision and apparent firm attachment of the scion to the understock, the humidity of the holding house can be gradually lowered over a period of one to two weeks, and the bench temperature reduced to approximately 60° by the same time. The graft is now ready for the final step in production; the understock shoot can be cut away above the union and the scion left to grow upon the roots of the understock. The method of this "cutting back" practiced currently at Hill's is to do it all in one cut, for tests conducted here revealed that there was very little, if indeed any, advantage to making this operation in two or three steps. The classic Boskoop method at the time we sought grafting instructions from them, was to trim the shoot of the understock back to the graft union in three separate operations approximately six days apart. While this method provided additional time for the scion to heal more securely to the understock, it did involve just three times the actual hand labor of the method we now use. It is beyond question a shock to the roots of the understock when they find themselves entirely dependent for their food supply on that manufactured by the leaves of the scion, but our overall percentages of success would indicate that this shock is not too great for most to survive when all the small factors have been given adequate attention.

Following this cutting back, the finished grafts can be arranged in either a greenhouse bench or a protected outdoor frame, to await plant-

ing early in the spring season. No special care need be given over that normally felt necessary for any greenhouse crop.

It will be noted that no attempt has been made here to go into the many factors which lie between the production of a graft in the greenhouse and the finishing of the juniper in beds, containers, or field rows, for, into this matter, enters the all important matter of scion rooting. This, of course, infers that the entire described process, is only one of "nurse" function, and that when the finished juniper graft is planted to a level below the union for growing on, the scion will strike roots of its own and ultimately become independent of the understock nurse. Professor Chadwick has dealt at length with these aspects in his *Nursery Notes* of January 1951, and for me to repeat them here would be redundant.

Investigation of literature after I was asked to prepare this paper, quickly revealed that there has been very little truly scientific research into the problems of juniper grafting, and that most of the writings are deplorable for their lack of completely definitive descriptions. None of us can learn anything by statements such as "make the graft when the understock is ready," and yet this verbatim sentence was lifted from one of our recognized propagation texts! We all stand to gain much by exercising great care in our writing and being most critical in our reading, for exacting technical subjects, need to be described in accurate, discriminating language, if they are to have any value.

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MR. HILL: During the past twenty-four hours, I have made several notes about things that have come up in the discussions—obvious points which I have overlooked. I will attempt to deal with them now.

It was evident I made no mention of shade on the greenhouse for grafting. There again, I think that has to be pretty much a rule of experience. Dundee is west of the Great Lakes, therefore, we often get bright sunshine with a great deal of solar radiation, and it has been found to our advantage to have at least light shading most days. In some cases we will put on double or triple covering, to avoid burn of soft understocks of juniper grafts.

The other point which I tried to find out from Mr. Swingle was the time he considered optimum for the removal of the tie from the graft. I haven't gone into that. Our method at Dundee is quite simple. We tie the rubber grafting strip around the stock end with a simple knot—just one tie as you would start to tie your shoes. The tension and flexibility of the rubber keeps that knot in place until we are ready to remove it, at which time either end of the knot can be juggled and the rubber will remove itself from the graft. Our timing on that has not been critical at all. We would like to do it at time of shipping, if we could. As most of you know, we ship grafts in a little different way from most other firms in that we insert a stake in the pot at time of shipping. Before it is taken out of the pot we remove the tie and encircle both the stake and the complete union with two layers of grafting cane and secure the top of

the graft to the stake, wrap it from the pot, and ship it that way. It gives a good bit of additional security in the shipping process.

I must confess I don't know when the right time to remove that tie should be. Mr. Swingle indicated there were numerous instances in his experiences where grafts had been inhibited by the tie. He seemed to think that was either the time to replace the tie or at least loosen it.

The other point which I overlooked completely, and it was discussed by Pieter Zorg, was the fact that as we learn more and more about the rooting of cuttings, the need for grafting is evidently going to become less and less. We are continuing to find a number of plants grown from cuttings which we always thought had to be grafted. I noticed several in the list Mr. Zorg read, which he rooted with apparent ease, that we always considered had to be grafted for proper development. That may be due to the fact that with his methods of rooting he gets a plant which grows vigorously.

We discovered in years past that we were able to root a great many plants, however it was not practical to plant on a commercial basis because the subsequent top growth was not vigorous enough to justify it. We fell back to the laborious method of grafting which does produce results I thank you.

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CHAIRMAN SNYDER: Thank you, Jack, for an interesting account of juniper grafting. I am sure Mr. Hill has made a number of points which will not pass without questions from the floor, so we will now open the discussion for questions.

MR. RICHARD H. FILLMORE (Shenandoah-Lakes Nursery, Shenandoah, Iowa): Have you had any experience with cutting the entire understock off in the beginning, previous to grafting, and then putting on the scion?

MR HILL: I do not believe we have ever cut it back exactly so far as we would consider normal in the regular cutting back process, that is, to the point just immediately above the union. We have experimented somewhat more with stubbing the understock so there was a projection of maybe two inches above the point of union and those two inches contained only a little foliage. I don't think we have tried without leaving some foliage on the understock.

MR. HERBERT TRAUTMAN: In a talk with your cousin, David Hill, he mentioned that he did try cutting off the entire top with very good results. Now, whether that was done before your presence there, I don't remember. It was quite sometime ago.

MR. HILL: Those experiments were one and the same. The stocks were not cut back to the point of union. A stub of two or three inches was left. The results of that work were quite satisfactory. We seemed to think the grafts healed a bit slower, which is always a disadvantage, but in turn it gives more bench space and less suceptibility of *Phomopsis*,

which thrives in the sweat box. Phomopsis is almost always carried by the understock rather than the scion.

MR. CHARLES HESS (Hess Nursery, Mountain View, N.J.): In an experimental way we have cut off the understock at the time of grafting with very good results. We have only done a few at a time, and we are a little hesitant about doing it on a full scale.

MR. RICHARD FILLMORE: I think that with a well-established understock and a properly prepared scion, meaning one which has already gone through its normal period of dormancy, that you could probably cut the understock off an inch and a half or so above the top and graft it on the stock with just as good results as with the other procedure. I think that it is something which ought to be gone into much more fully before it is taken into commercial practice however. We are streamlining the grafting process and in a general sense the less fussing one does with grafts, the better they will be.

MR. HILL: It appears to resolve itself into how much stored food is essential for the understock to form the callus requisite for healing. If the understock has enough food stored in the roots and the stem piece to carry out that healing process without delay, then certainly there should be every advantage to it.

PRESIDENT WELLS: I have only been at D. Hill a little over a month, but we have discussed the problems of juniper propagation at some length. They get much better results by pulling two-year old seedlings from seed beds, trimming the roots to an extent that I consider to be drastic, putting the seedlings in pots, and grafting at once, following the procedure outlined by Jack. I have always understood that if you could establish an understock a year ahead that better results are obtained. There might be secondary problems of the understock becoming pot-bound, but that is another problem which is not difficult to solve. I would like to know if anyone else here has had any experience with seedlings which have been potted in the fall or spring, six to twelve months, before grafting.

MR. AART VUYK (Musser Forest, Inc., Indiana, Pa.): Last year I grafted about two thousand junipers in January which had been potted the previous April. It so happened that rabbits had chewed some of the understocks off, consequently we cut the stem off about two inches above the soil. These did just as well as the grafts following the usual procedure.

MR. HILL: That is very interesting. I wonder if Mr. Hess has had any direct comparisons between the grafting of understocks potted in the fall and those potted in the spring.

MR. CHARLES HESS: We raise our junipers from seed, transplant the seedlings to the field in the spring, and then pot them in the fall. Most of the seedlings are used that fall for grafting, however some are kept until the following summer for summer grafting. In other words, we

are getting more and more to an all-season production. In the past we only grafted during the winter.

PRESIDENT WELLS: Is there any difference in the percentage of stand between understocks potted in the fall and those established for six to twelve months before grafting?

MR. HESS: No difference that I can see. The stand is just as good.

MR. HILL: At the time of potting these understocks in the fall, did you ever feel it was necessary to cut the roots back more severely than was absolutely necessary for easy potting?

MR. HESS: We trim them back very severely. We have found that when the customer gets the plant in the spring it has a much better root system and it makes a better ball as time goes on.

MR. ZORG: I have grafted junipers on different kinds of two-year old understock. When those plants come out of the beds they have very good roots. They have one big root and many small ones. You have to trim the big root back in order to get it properly potted. I have found that I got losses on the understock before grafting. Consequently I prefer transplanted understock. It takes two years to obtain a two-year transplanted understock.

MR. HILL: Our experience on that has been just exactly the opposite. We have always preferred a seedling understock to a transplanted understock. Perhaps one of the reasons is that we crowd the plants in the beds in order to get a portion of clean, straight stem into which we can graft conveniently. However, with our transplanted stocks, frequently they are not exactly as straight as we would like and also there tends to be foliage rather low on the stock which needs to be trimmed away at the time it is potted. Perhaps for that reason we have used seedling understock directly from the beds.

MR. HOWARD BURTON (Hill Top Nurseries, Casstown, Ohio): Have you ever tried fertilizing the understock in order to stimulate callus formation or have you ever used any root-inducing chemicals applied to the wound?

MR. HILL: No, quite frankly we have not. I can see a wide open field in that direction. However, the potting soil which we use for our understock has always contained quite a generous amount of a complete fertilizer. This year, as I explained, we put in a compost which contained a completely balanced plant food in abundance. Now we could supplement with either liquid fertilizer or perhaps even foliar feeding, but we have not had any experience along these lines. We have not had any experience in the use of hormones to stimulate or improve the healing of the graft union.

MR. FRANK TURNER (Berryhill Nursery Co., Springfield, Ohio): We have had understocks established over a year. They do not perform as well as newly potted stocks. On the matter of the short cut-off, there

are a few very old junipers in our area which were cleft grafted. It was done many, many years ago and I don't think there is any way of finding out the rate of success they had.

MR. HILL: The point is that obviously it would work because there are large established plantings produced by that method.

MR. HUGH STEAVENSON (Forrest Keeling Nursery, Elsberry, Mo.): Has anyone had experience with silica sand of the various grades as against ordinary river sand?

DR. CHADWICK (Ohio State University, Columbus, Ohio): We have used silica sand in the rooting of a good many cuttings for several years now. One point in particular that I like about silica sand is the fact that you can get a uniform grade. You can buy it by number and every year it is the same. If you use bank sand, or lake sand, it does vary from year to year.

CHAIRMAN SNYDER: I might add that we have found the same. Bank sand coming from the same firm and obtained from the same pit may vary from one load to another. We, too, use silica sand for much of our work. I would like to point out in connection with rooting of cuttings that you cannot use various media, handled in the same manner, and expect the same results.

MR. HILL: Are there any striking correlations in rooting of cuttings between the obvious acid nature of the silica sand and the tendency to be alkaline on the part of the bank sand we get in the Chicago area?

DR. CHADWICK: The silica sand that we use runs about pH 6.8. Several years ago we found differences in the effect of pH on callus formation, particularly in connection with Andorra juniper. Those tests were run almost thirty years ago. They showed at that time that a pH of about 6.9 to 6.95 was ideal as far as Andorra juniper was concerned. If the pH was on the alkaline side (above 7) a tremendously large callus and very few roots were formed. If the pH was around 4 to 4.5 there was little rooting and no callus formation. We feel that a pH of 6.9 or somewhere in that vicinity is about ideal. I would say as far as our experiments were concerned, the main difference was with Andorra Juniper. We have not seen this difference on Pfitzer's juniper. The pH was lowered by the use of sulfuric acid.

MR. STEAVENSON: With mist propagation, we had a considerable amount of drainage trouble with crematic sand. I wonder if silica sand would overcome that drainage problem?

PRESIDENT WELLS: I would think so. We have run into some similar trouble this summer in the use of mist out in the open. I think that all we have done indicates the necessity for a coarse grade sand through which there is good drainage.

CHAIRMAN SNYDER: Almost without exception, the evidence of both commercial and theoretical propagation indicates that coarse sand is better than fine sand. Aeration and drainage are both involved.

MR. WILLIAM D. COLE (The Cole Nursery Co., Painesville, Ohio): Does anyone know of a suitable injector for adding acid to water for watering purposes? We have water which is alkaline and sometimes causes trouble.

MR. CHARLES HESS: All that is necessary is to put a tank in the house and pump out of the tank. The acid and water are mixed in the tank, the same as with fertilizer.

MR. TEMPLETON: On a long-time commercial basis, in injecting any acidifying agent into the water, the logical apparatus would be the displaced water plant or swimming pool, and the use of aluminum sulphate in the water.

MR. EDWARD H. SCANLON (Cleveland, Ohio): Why couldn't that be done the same as nitrogen is injected into irrigation water in southern California? The nitrogen is contained in a large tank, such as an oxygen tank, put under pressure, and released into the irrigation water.

MR. GABE SIMON (Medina, Ohio): We had a little experience with adding bromine to swimming pool water. There is a device on the market now, manufactured by the Hallogen Supply Company, that costs about $300, with which as little as one part per million can be added to a supply of water.

MR. CHARLES E. HESS (Cornell University, Ithaca, N.Y.): On a recent trip to Ball Seed Company, I saw a device for injecting fertilizer into the water. They watered and fertilized at the same time, however their unit was quite expensive. There is quite a bit of work along this line, particularly in connection with growing established plants under mist. Under continuous mist, there is considerable leaching of the soil, and attempts are being made to incorporate fertilizer, as well as fungicides, etc., into the mist.

MR. HARVEY GRAY (Long Island Agricultural Institute, Farmingdale, New York): In one of our areas at the Agricultural Institute at Farmingdale, we have a series of small Monark nozzles designed to apply mist to ericaceous seedlings. The nozzles give a little over one gallon of water per hour and are set three feet apart. A water pressure of about 200 pounds is used. The water to the mist lines comes from a 30-gallon tank. We have applied both urea and fungicides in the mist simply by adding the material to the water in the tank. The application of nitrogenous material in this manner has been most satisfactory and there has been no evidence of nitrogen deficiency.

CHAIRMAN SNYDER: Thank you, Harvey. Since it is slightly after 12:00 o'clock and this afternoon's panel on magnolias is scheduled to start at 1:15, I think that perhaps we had better adjourn this panel of the propagation of junipers.

President Wells resumed the chair and adjourned the session.