door and we didn't have gravel. Above the coal, we put some vermiculite We propagated many of the same woody plants outside in the mist bed that we carried inside our forced air cooled house, and we had equally great success with them. Some of the roots weren't as tough as the plants that were produced indoors because of the vermiculite and the watering, but they all seemed to grow alright We were well pleased with our outdoor misting and we plan to do more with that

Another thing that could be done to cool propagating houses would be to put water pressure pumps on your intermittent misting system. We used 65 or 85 pounds pressure or whatever we get from our city water. With a pump that would bring the water pressure to 400 or 500 pounds per square inch, you could possibly atomize the water going through nozzles and you would get a lot more cooling.

That is about all I have Thank you.

MODERATOR REISCH: I thank you for this very thorough presentation The next man on our panel will lead off on the topic of the use of plastics for propagating houses It is a pleasure to introduce Mr. Zophar Warner.

Mr. Warner presented his paper entitled, "The Use of Plastic Film in Propagating Houses." (Applause)

THE USE OF PLASTIC FILM IN PROPAGATING HOUSES

MR ZOPHAR WARNER
Warner Nursery
Willoughby, Ohio

We are in an era of very rapid development and change. This applies not only to space travel and sputniks but also to the propagating profession. In a meeting of this kind anything presented on the third day may have become obsolete during the discussions of the first and second days.

The uses of plastic film in propagating houses are so extensive and varied that I have made no attempt to compile their uses, many of which are common knowledge. I will confine my remarks to the uses we have already made of plastic film and what part we expect it to play in our future operations. A few years ago we started using polyethylene film to line the inside of a sash house. Since the sash were removed yearly it was difficult to keep it tight without use of the film. The following things resulted from using the film. (1) heat loss was substantially reduced, (2) constant humidity and soil moisture were easier to maintain, (3) the air space between the film and the glass acted as an insulator against sudden heat variations caused on partially cloudy days, and (4) the film acted as a slight shade. We have since used polyethylene film to line the inside of two 10 x 50 foot propagating houses This is very easy to do as there are no inside braces, only ribs. We merely start at the ridge and run the film the long way of the house. Any ordinary, heavy duty stapler is used to staple it to the ribs. I would like to emphasize here the desirability of placing the film on the inside of the house. If placed on the outside the film is subjected to the wind and

snow will press it directly against the glass, eliminating most of the insulating effect. If the film must be used outside, not less than four mil weight should be used. I think two mil would be heavy enough to use on the inside.

Many plants can be rooted in closed frames or in frames under mist and be well rooted before cold weather There is a wide range of deciduous and broadleaf plants that do not properly mature until August and September, too late to root in the frames but too early to stand the heat of the greenhouse. This year, we started sticking azalea cuttings in the plastic lined house early in September. The ventilators were covered over and even with some shade it became too hot on sunny days. An additional sheet of polyethylene film was rolled over the benches on top of the cuttings and left on for a week at a time The film was removed weekly for inspection and to remove any condensed water. We have used the same procedure on rhododendron cuttings and results have been satisfactory. I believe the very limited air space under the film is a good feature, however, I would not argue with anyone who wished to build a framework to make a more conventional type sweatbox If it is undesirable, due to loss of light or ultra violet rays, to have the cuttings under a layer of glass and two layers of polyethylene these disadvantages are offset by being able to maintain the proper humidity. Where the proper humidity is maintained, it is best to use a dryer, looser, rooting medium and if the common practice of drenching the cuttings is avoided, more effective use of concentrated hormone solutions can be made.

It has been the custom of many propagators to fill the greenhouse during the late fall with an assortment of cuttings that had varying requirements and by subjecting them to average conditions, a fairly good stand could be realized by spring. Those items that are rooted and actually deteriorating by growing in the rooting medium should be potted or flatted and removed to another greenhouse. By using all the aids available to propagators, it is now possible to root many hitherto difficult items in a matter of a few weeks. While this is very desirable, the problem of caring for the increased production of plants once they are rooted becomes acute To solve this problem, we have been looking, for several years, for a growing-on facility that could be used all times of the year that was better than a cold frame but more economical to build than a conventional type greenhouse.

Last year Dr. Wendell H. Camp devoted a portion of his address to plastic-covered propagation units. His enthusiasum over the new material Polyflex 230 encouraged us to build a 15 x 65 foot house last winter. We used a low concrete block foundation, bolted a wooden plate onto it and used 2 x 4's, 20 inches on centers to make proper use of the 42 inch Polyflex. Ten mil. Polyflex was used on the outside and 5 mil. was used on the inside of the 2 x 4's Shortly after erection we had an 18 inch snow with no damage to the plastic There are no ventilators but an exhaust fan has been installed in one end and humidity could be introduced at the other end Since construction was late last year, we are just now putting this house to real use.

I have the following reservations about the material Polyflex 230: (1) the house must be built in a wind-free location, if the material does not suffer from fatigue, the workers will, from the cracking noises caused by the wind, (2) after one year, the Polyflex has shattered in two or three places from bitternuts dropping from an overhanging tree and therefore I believe the material has deteriorated a little in the one year that it has been up. Nevertheless, I am confident that a suitable material will be available shortly. When this happens, it will be possible to enclose larger areas at low cost.

There are instances both here and abroad of moving greenhouses in order to rehabilitate the soil. Other favorable results from moving a greenhouse that occur to me are: (1) increased control over the growth and dormancy of plants, (2) expensive handling of plants could be eliminated in many cases by simply moving the house, and (3) planting operations could be carried on continuously regardless of weather. The development of plastic films for use on rigid or semi-rigid structures, stationary or movable, will continue to have interesting applications to our profession

MODERATOR REISCH: Thank you, Mr. Warner, for your comments on the use of plastic for propagation structures. The structure we will be talking about now is the Nearing Propagating Frame. Mr. David Leach is quite a rhododendron fancier and a book written by him was published in 1955. Mr. Leach.

MR DAVID LEACH (Brooksville, Pennsylvania): The Nearing Propagating Frame was developed by Guy Nearing of New Jersey, after some years of work, and was perfected in 1928. It was patented in 1932. Mr. Nearing tells me the reason he patented the frame is that it appeared someone would come in and copy the design and prevent him from using it himself. In any case, the patents have now run out and the frame can be built by anyone.

The largest commercial installation I know anything about is in New Jersey, and consists of 60 of these structures. There is one in New York composed of 40 structures. There is another one in Pennsylvania which has about 12 units. I have sent blueprints to New Zealand, The Netherlands, England, Germany and to almost every part of the United States and Canada.

The advantages of the frame are many. It consistently produces the successful rooting of cuttings which are notorious for their difficult propagation. It eliminates expensive greenhouse space and greenhouse maintenance. It produces plants of superior vigor. I have kept records of plants propagated in this frame and the propagation percentage is better than 99 per cent. Post-rooting losses of rhododendrons are less than one per cent compared with a regular mortality of 15 per cent. There is a great reduction of labor cost and disease problems are minimized as well I experimented for about eight years in devising a hormone treatment which was specifically adapted to this method of propagation. I contributed nothing whatever to the design of the frame and it all came about because Warren Bostwick, from New York State came up to my place and offered to build a frame if I would make a series of experiments on hormone treatments, which I did.

The device isn't quite as simple as it looks. The overhang is calculated according to the angle of declination of the sun. The amount of space at this point is calculated for a specific cubic foot flow of air as a ventilating medium. A wide variety of plants have been successfully propagated in the structure and includes the Japanese maples, boxwood, falsecypress, dogwood, cotoneaster, euonymus, English and American holly, magnolia, the tree peonies, pieris, yews, and hemlock. They have all been propagated on a commercial scale.

The most convenient construction makes use of corrugated aluminum sheets for the back, Celotex for the two ends and cypress or redwood for the wooden parts. The two frames which are oriented back to back make use of ordinary 3′ x 6′ sash covers As far as the site is concerned, it should have good drainage. The land immediately underneath the frame must be absolutely level to avoid later complications in watering and the site must be open to the north in order to insure maximum light. The most critical thing about the frame is its orientation to due north If you get it more than 5 or 6 degrees off due north the usefulness is seriously impaired. In order to get it exactly due north it should be oriented by someone who knows the deviations of the compass or if you are doing it yourself you can set up three sticks in line with Polaris, and the next day orient your frame, without a compass, exactly parallel to the three sticks.

The inside of the frame should be painted white for best results, since the whole purpose of it is to provide maximum light without any direct sun, in order to encourage photosynthesis which is necessary for the production of carbohydates. Furthermore, when the cuttings are watered the glass should be flushed clean to allow a maximum amount of light to reach the cutting.

Each of the two frames has a bottom in it. The purpose of the bottom is to retard the exit of the water when cuttings are watered but not to inhibit water run-off completely. If the floor is constructed correctly, water will run out between the cracks in the boards. The propagation medium in these frames is in three layers. The bottom one consists of four bushels of peat which acts as a sponge for water conduction I have tried various kinds of peat and feel nothing is equal to Premier brand peat. This bottom peat layer has to be level. If you don't level the different layers you will have an uneven distribution of water to the cuttings. The middle layer consists of either two bushels of coarse sand and one bushel of peat or one part coarse sand, one part of Premier peat, and one part Styrofoam. I am going to use the latter in the future rather than the sand and peat combination alone. The top layer consists of a quarter inch of pure sand The only purpose of this is to keep the peat moss from floating up and covering the leaves of the cutting. The sand must be coarse and non-alkaline In those cases where people have failed with the frame it has been because the people have used fine or alkaline sand. In order to pin that down, 100 per cent of the sand should pass through a 50-mesh screen. This whole frame is then watered until the three layers are saturated. It takes about ten minutes and is the most time-consuming operation of all. At no time is the rooting medium compressed.

The great time and labor saver is this home-made template which consists of nails arranged in two rows, each nail one and one-quarter inches apart in the row and rows one and one-quarter inches apart, each row with the same number of nails. These are just 12-penny nails with a handle screwed on top. You can go along the rooting medium and put the cuttings in very quickly. If you are propagating azaleas, use every hole, if you are propagating rhododendrons, use every second hole. I believe you could use close spacing in commercial practice Some put in about 750 rhododendrons or about 1400 azaleas per frame, in commercial practice All of my experimenting has been done with azaleas and rhododendrons and I have found that as far as my own experience is concerned, the cuttings should be rather short, that is not more than two and a quarter inches. By making the cutting this size and placing it in the medium it puts the rooting zone in the top of the medium where there is a better supply of oxygen. Another reason is that I suspect there is a greater concentration of the natural auxin in the short cutting. In any case, I have found after experimenting with cuttings of all rhododendrons that the optimum length is two and a quarter inches. There is a one-inch wound made along the side before the cutting is ready for insertion. The reasons for this are first, there is a mobilization of hormones and carbohydrates which accumulate in the region of the injury and secondly, in my experiments I have found a wounded cutting absorbs about three times more water than an unwounded one. The leaves are reduced to three. I think perhaps you might leave more on if you could The thing to keep in mind is that the idea is to leave as much leaf surface on as possible without causing excessive wilting. The larger the leaf area the greater the production of carbohydrates. The greater the amount of carbohydrates in relation to nitrogen the more vigorous the rooting

After the cuttings are prepared in this manner they are soaked for 18 hours in a 75 p p m. indolebutyric acid solution. This concentration is the result of my experiments extending over a period of eight years. The first thinig I determined, as far as rhododendrons are concerned, was that the aqueous soak is not just a little more effective than the powder, it is infinitely more effective. I suppose the magnitude would be in the neighborhood of 300 to 400 times more effective. Since 1950 this technique has yielded approximately 92 per cent rooting of 3,600 rhododendron cuttings, representing 84 different hybrids This also includes a great many which, just a few years ago, were considered completely impossible to root. Even yet, most of the plants on the market are grafted but each year the technique has improved until in 1956 I had an unprecedented 99.4 per cent successful rooting of 600 cuttings representing 58 different hybrids. I don't expect to ever repeat such near perfect results, but this happens to be a mathematical answer. My feeling is that any propagator should be able to average better than 92 per cent with rhododendrons in a Nearing Propagating Frame

Indolebutyric acid is purchased by the gram, from Eastman Organic Chemicals Wherever you purchase it, the easiest way is to take it to a druggist and have him put it up in capsules of 296 milligrams each.

You dissolve one capsule in a tablespoonful of ethyl alcohol, add it to one gallon of water, and your average concentration will be approximately 75 parts per million You can vary the concentration advantageously. I have used up to 600 parts per million. The more difficult cuttings may require a more powerful concentration. There isn't too much incentive to experiment with different concentrations when you are getting in excess of 92 per cent. I don't think it is worth while to vary the concentration of hormones.

Japanese maples and magnolias are inserted in early June, tree peonies in mid-June, dogwood in early July and rhododendrons in mid-September English and American hollies are rooted in mid-July and yews early in September. Incidentally, with dogwood, one of the important things is to leave them in the frame over winter. Hollies should be removed from the case after they are rooted. Yews are one plant which should have less water than the others. The rhododendron cuttings which are inserted in September do not root until in the following August. The only labor required throughout this long period is watering which should be done about once a week. By the end of October when the weather cools, the water is reduced to every two weeks until the medium freezes. After it thaws in the spring they are watered again every two weeks until early May and then weekly watering is resumed. This is not a case of using your judgment about watering, since they should be watered whether you think they need it or not At least, that has been my experience. With someone else it may be different.

After the rhododendron cuttings are taken out, in mid-August, they are put in flats; not into pots. Rhododendrons will grow better in the field if the root systems are not first confined in containers. The flats are put under glass in cold frames to protect them over winter, and are not ventilated until they are taken out the following August.

All propagation resolves itself pretty well to maintaining the right balance between aeration and moisture. I first heard about Styrofoam when I read some articles by Mr. Coggeshall of the Arnold Arboretum The rhododendrons, particularly, require oxygen, which apparently is a higher requirement than many other plants. Stryofoam seems to increase the aeration in the rooting medium and has a beneficial effect on the root masses.

Leaf bud cuttings root very well in the Nearing Propagating Frame. If you have a hybrid with a limited amount of propagating wood, just take the leaf with the leaf stem and dormant bud at the base of the petiole and it will root very well. There has been a lot of talk, I know, among rhododendron propagators that it doesn't produce a good plant. I have had excellent success with this type of cutting. Initially it is not as large, sturdy or as vigorous as the stem cutting but if you are working with rare material the results are still perfectly satisfactory, and my experience is that after the end of three years there is very little difference in the size between them.

Deciduous azaleas root very well in the Nearing Propagating Frame. There are two critical points in the propagation of the deciduous azaleas. One is, take them when they are very soft, around the latter part

of May. The next important thing is to pinch out the terminal bud. If you pinch out the terminal bud at the time of inserting, they start to grow right away without any trouble at all.

In summarizing, then, while the fall-inserted cuttings are slow, after the first year you get a regular annual crop with this method. It is a much cheaper method of producing plants from cuttings and gives a much higher survival rate. It is consistently successful with many plants that are inconsistent in the greenhouse. I might say the Nearing Propagating Frame can be improved, but the experience of others has shown that changes are likely to be expensive. Those of you who are interested in trying the frame are urged to discard your prejudices and follow the directions explicitly. As soon as you begin to vary from the experience of others you are likely to run into trouble Mr. Nearing resolved the frame as a result of 10 or 15 years of work and Mr. Bostwick devised the rooting medium over a period of many years The hormone applications have been fairly accurately worked out. I believe that the procedure is adaptable to large commercial operations and is worthy of consideration by anyone who is thinking about the propagation of these woody ornamentals.

(Editor's Note. Mr. Leach supplemented his discussion with a series of well selected, colored slides.)

MODERATOR REISCH: Thank you, Mr. Leach, for your interesting comments on the Nearing Propagating Frame. We have about ten minutes for questions.

MR. ALBERT LOWENFELS: Mr Kyle, what is the benefit of this greenhouse cooling system? I don't go to Florida and leave my cuttings alone, but I am in another line of business and I go down to New York every day. I use the electronic leaf and Polyflex covering in a new greenhouse, and from lilac cuttings taken in May to holly cuttings taken right now I get at least 70 to 80 per cent rooting. What is the benefit of all this washed air?

MR. TOM KYLE: I don't know. If you come to one of these propagators meetings, you will find there are a multitude of new things being tried I think that the main reason is that the florists have had phenomenal success with this type of cooling. I think it can be adapted, much like they have at Yoder Bros, by using the mist in combination with the ventilation, and maybe eliminating this wet pad. I think moving the air in the mist has some advantage.

MR. LOWENFELS: My experience has been the hotter the greenhouse the better, in fact, my greenhouse got up to 120°F. I don't see the benefit of having it air cooled. You can get it as hot as possible, as long as you have enough mist.

DR. CHARLES E. HESS: I think we had the same experience in Ithaca. Our experience was that we had better success in the greenhouse during the summer than in the outdoor frame. I think it was because of our cold season. The average night temperature was around 55 degrees that year, and we felt the additional heat speeded up rooting and we also felt that in climates like Ithaca, it could be possible that the use of bottom heat would be more beneficial than an outdoor mist frame.

The thing I was going to ask Mr. Kyle was that on the basis of the comparison, would he feel that the investment in air washing is worth while? In other words, does he get enough increase in his percentage rooting using the air wash to make the investment worth while.

MR. KYLE: To tell you the truth, I was in Korea while most of this was going on. From what I understand from our propagator, we do not feel that there is a real advantage over the outside mist However, this was our first year in outdoor misting and we did have better results compared to outdoors frames. In our locality, controlling the temperature is quite advantageous. For conditions in New York or somewhere else, it might not be needed. During the middle of the summer we get extreme changes in temperature and this way, we don't have to worry about working our ventilators.

MODERATOR REISCH: Remember, forced air cooling is in its infancy in the nursery business while we have had mist a little bit longer.

MR. HANS HESS: You mentioned propagating clematis under the combination of double glass and mist. Would you elaborate on that just a little bit?

MR. KYLE: Well, to tell you the truth, that is sort of a fallacy. You can't very well put mist under a double glass. We did have clematis in the open bench mist, and later we cut the mist off because it was getting too wet. However, we had the cool, moist air. I will let Mr. Englemann answer your question.

MR. HERMAN ENGELMANN: I think clematis propagation is easy if you can keep the leaves healthy. Clematis leaves are very tender and rot easily. It is a little easier to keep the leaves in good condition under the double glass. You must keep the leaves good for about 40 days to get a good root system. I think with plenty of sunlight and under the double glass we possibly got 80% to 95%.

PRESIDENT VANDERBROOK: Thank you very much, gentlemen, for the excellent presentations. We will now have a talk which I know many of you have been looking forward to on dwarfing and hybridization techniques for the plant propagator. It gives me great pleasure to introduce Dr. Karl Sax.

Dr. Sax presented his paper entitled "Dwarf Ornamental and Fruit Trees." (Applause)

DWARF ORNAMENTAL AND FRUIT TREES

DR. KARL SAX
Arnold Arboretum and Bussey Institution
Harvard University
Jamaica Plain, Massachusetts

The ranch type house and limited grounds demand smaller types of ornamental trees and shrubs for landscaping. The migration to the shrubs has also revived an interest in fruit trees. For such orchards, dwarf trees are essential to provide a variety of fruits in a limited space