The cuttings should be rooted by April 1, so the heat can be turned off. The procedure just described is used for juniper cuttings taken in October, and arborvitae cuttings taken in November.

Chloromone rather than Auxan or Stimroot treatment has given us a better rooting percentage. Watering is watched and regulated carefully according to the weather.

Some results selected at random from our 1957 propagation records are listed in the following table.

Table 1.—Electric cable frame propagation results

Plant Type	Number of cuttings			Number of grafts		
	Made	Rooted	%	Made	Take	%
Thuja occidentalis (Little Champion)	6975	6275	90%			
Juniperus c pfitzeriana nana	1400	1200	86%	224	223	99 5%
Taxus cuspidata nana	2310	2310	100%			
Juniperus virginiana hilli				500	500	100 %
Juniperus chinensis (Mountbatten)				700	600	86 %

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MODERATOR COLE: Thank you, Mr Blyth. We will now ask Mr. Jack Hill, D. Hill Nursery Company, Dundee, Illinois, to explain "Propagating Plants Directly in Containers."

Mr. Hill presented his paper, entitled, "Propagating Plants Directly in Containers." (Applause)

PROPAGATING PLANTS DIRECTLY IN CONTAINERS

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Discussing the propagation of plants directly in containers should be prefaced by indicating that the propagation that we have done directly in one-gallon containers has been on an experimental rather than on a production basis. This was done two years ago and was not followed up this past year. I think we have sufficient information about it, and therefore I will describe the procedures we have used and the results obtained.

The reason we did not follow it up this past year was because we thought we could get a saleable plant in one season from going into the container early in the spring with an established, potted or banded liner. Having now had one year's production experience with that program, I am not sure we can do it across the board with the line of deciduous flowering shrubs that we wish to market in one-gallon containers.

The purpose of attempting to propagate directly in the container is two-fold, namely, to save cost and time. To an extent these two purposes are interrelated.

When I refer to cost, I am talking about the actual cost of handling the plant after it is propagated. The firm of C. W Stuart coined a term that I think is very good. It is called down-time. I think if all of us will look at our procedures and look at the amount of down-time, from the time a cutting is removed from the parent and put down into container and another is taken, and all those down-time plants are picked up and taken to a central working area, where they are again put down in large containers and later put down on a bench, and someone picks one up and makes a cutting and puts it down, and someone takes them and puts them down in containers and finally puts them in the bench.

Examination of procedures of this kind indicate without too much difficulty the genuine economy that could be achieved if it were possible to simply grab that cutting while on the parent plant, cut it, stick it and leave it alone until it is ready to market. Of course, there are practical problems which preclude any of us doing that in our operation, but the more we can eliminate that down-time, the more economical will be the production of our plants Therefore, one of the principal reasons in considering the propagation of plants directly in a container is to eliminate the down-time If you can get a plant to root from a cutting or a seed of the desired variety to germinate directly in the container, you will save cost through this reduction of down-time.

The saving of production time, in addition to the cost of down-time, is another consideration. I wish to differentiate between the time which I have already mentioned and the time that is lost in the production of the plant through disturbing it after it has been propagated in a particular location. For reference, I go back to the series of experiments that were run in England with the tomato seedlings. In these studies they actually germinated the seedlings in pots and utilized several methods for checking against the established procedure of shifting or boosting. They discovered that if they could germinate seed in the size of pot they wanted, they were able to get a plant much more quickly. They had a much more vigorous-growing plant, which invariably produced more pounds of fruit in the first season, than those that had been disturbed. The same factors apply to our plants even though we are principally concerned with vegetative growth rather than flowering and fruit production. If we can grow the plant, like Harvey Templeton does with his Phytotektor, then we can approach the phenomenal growth he gets on plants the first season simply because they are left alone Because the plant is rooted and left right in place, is the reason both Mr Templeton and Mr Hancock are so successful.

Now there are three places where we have attempted to follow this practice of continued, undisturbed growing. The first was in the use of unrooted grafting understock This was done simply by taking an unrooted Hetzi cutting, making the typical graft incision on it, attaching the scion, and inserting them both into a two-inch rose pot filled with the standard sand-peat mixture, which we are now using throughout

our operation. We did this with only a small experimental lot. The rooting of the Hetzi understock was good, as was the healing at the union. One of the problems, of course, came in the removal of the rubber band, after the union had healed. It became necessary to completely disturb that plant by lifting it, shaking the pot soil off and then going in and removing the rubber band I would not regard this as an entirely practical operation, although, I believe the principle can be adapted.

The second place we have attempted undisturbed growing is in the propagation of multiple cuttings of the more or less easy-to-root, easy-to-propagate plants that are in our sales program. Among these are the ground covers, *Pachysandra terminalis, Euonymus fortunei vegetus* and *Euonymus fortunei coloratus* We find by sticking three small cuttings directly in a plant band, which are assembled in multiples of 25 in a veneer tray, we get very good results. For this operation, which is done in July we fill the bands with a steamed, sand-peat mixture, and insert three small unrooted cutings. These are then removed to an outdoor frame with board sides, but without heat of any kind. Glass sash is then placed over the top of these frames. They are shaded for a period of three or four weeks. After the three cuttings have rooted the sash is simply lifted off and the plants grown in the frame until ready for market the next year The procedure as we have designed it actually consists of two adjacent frames. One of these is filled one year in July as I have outlined The next year as these plants flush, perhaps during the latter part of June, the top of each is pinched off and inserted in a band in the adjacent frame. These cuttings are rooted and again become the sales plants for the next season Actually, you have a turn-about method of using a single facility that gives you a continuous year-after-year flow of plants. Again, it is difficult to quote rooting percentages, but it has been sufficiently high that when we lift a tray of these bands in preparation for shipment it is seldom that it becomes necessary to replace one

The third place where we have experimented with this growing sequence has been directly in one gallon containers. In early summer of 1956 we stuck single cuttings of three or four varieties These plants included the Dwarf Arctic willow, Redleaf plum, Golden mockorange, and the variegated dogwood. The varieties were not important. since they were all recognized as more or less easy-to-root items. Early in the season we placed single cuttings directly in gallon cans outdoors, without shade or heat Over the top of each cutting, and extending down into the mix to a depth of perhaps three-quarters of an inch we pressed a large-sized Dixie Cup. These plants were interspaced in a growing block of junipers at the time. They were irrigated with up to five-eighths of an inch water, three times a week. They rooted unusually quick. When this was done, in late May and early June, I would guess the soil temperature was running on the warm days in excess of 80 degrees, which favored good rooting results. During the rooting process we kept checking two or three of them to see how they were coming. The minute there was evidence of rooting we opened a corner of the Dixie cup with a sharp knife. It was interesting to see how, when you

admitted more light, the plant headed right for that opening. After perhaps a week of what you would call hardening, we pressed in the remaining bottom portion of the malted milk cup which left what was in effect a tube inserted around these plants. Any time after that we lifted the rest of the tube off the plant and once again we had the plant established in a can.

The growth rate this first season I would estimate as nearly double that which you would expect when the same individual is propagated in an outdoor bed, lifted, bedded, and handled in the usual manner. Therefore, once again, one of the advantages of this technique is the increased growth rate one obtains by not disturbing the plant.

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MODERATOR COLE: If there are no questions, we will continue our discussion of container propagation by calling on Dr. Ken Reisch, of the Department of Horticulture, Ohio State University.

Dr. Reisch presented his talk on "Hardwood Cutting Propagation in Containers." (Applause)

HARDWOOD CUTTING PROPAGATION IN CONTAINERS

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I believe Mr. Hill explained the purpose for doing this type of propagation very thoroughly. Here again we are interested in producing plants with the minimum amount of handling by propagating directly in the container in which they will be finally marketed. Our tests on which I will report were conducted during the Spring of 1956 and 1957

Cutting wood was collected in the usual manner in January and February Eight inch cuttings were then made, stored at 70 degrees for roughly two weeks, and then held at 40 degrees until they were stuck directly in the containers in March and April. Multiples of one through four cuttings were used in these experiments. The containers were then put right out in the nursery without any protection. The cuttings rooted and produced saleable 15 to 18 inch plants that same year.

The first year we propagated *Weigela, Forsythia,* and *Philadelphus* by this technique. Although I do not have the percentages I would say we had 75 or 80 per cent stands by this type of propagation. In '57 we did the same thing, with the same plants, plus European privet, and had similar results We found about three cuttings to a container was enough to insure a stand. When we had three, in practically every case at least one cutting survived.

We conducted one other test this past year in which we used rooted hardwood cuttings. These were propagated in the usual manner in the greenhouse. After they had rooted, we planted them directly