returned to Connecticut he needed a 2½ ton truck to transport his research materials.

By this time you know of whom I speak. He has received honors for his work with orchids, carnations, and rhododendrons — the list of awards spans over 30 years.

His standards have always been of the highest and his work is highly regarded by all kowledgeable plantsmen, both at the commercial and the academic level.

Though he retired from the University of Connecticut in 1976, he is still active as a Professor Emeritus. He is still doing breeding work with rhododendrons in Connecticut and Rhode Island. Our recipient for the Award of Merit for 1983 is Dr. Gustav Mehlquist.

Friday Morning, December 9, 1983

The Friday morning session convened at 8:00 a.m. with Chris Graham serving as moderator.

TEN YEARS OF PLANT PROPAGATION PROGRESS

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From time to time it is good to reflect on past accomplishments to assess one's rate of progress. This presentation will deal with some of the changes in plant propagation that have occurred during the past 10 years. The first item of progress that I want to bring to your attention is the printing in 1983 of a 4th edition of the Hartmann and Kester plant propagation text. This new edition deals extensively with findings that have occurred since the 1975, 3rd edition.

Significant changes in plastics and their diverse uses have occurred in the past 10 years. The new greenhouse coverings, which include UV inhibitors, have greatly extended the life of greenhouse coverings. Milky opaque plastics have greatly simplified winter protection of container-grown stock and now show promise in providing an ideal environment for winter propagation. Plastics are now available that include reflective surfaces to control light intensity; others include mesh structure for increased strength; some are perforated with tiny pores to allow for water penetration; and some are black on one side to exclude light and white on the other side to reflect light. All of these variations allow us to choose plastic designed for almost any environmental condition desired. Further use of plastics that have come into use in the past 10 years include bags for growing plants, use of plastic pipe to build simple inexpensive houses, and new wrapping materials for grafting.

The oil crisis brought many changes to the propagator. The hardships caused by this crisis brought out the creative nature in the propagator and has resulted in many changes in operations. Summer propagation, sunken greenhouses, moveable thermal curtains, thermo blankets, and alternate heat sources became common topics of discussion among propagators. Many operations have made major design changes to become more energy efficient. A large Virginia greenhouse operation is currently relocating to take advantage of low-cost, hot-water heat provided by an electric power plant. Another greenhouse operation is studying the feasibility of linking with a poultry operation in order to utilize body heat from chickens to aid in heating the greenhouses. Several operations have converted from raised .propagation beds to ground beds to improve energy efficiency.

During the past 10 years space-age technology has affected everyone and the propagator is no exception. Solid state, low-voltage electronic timers have replaced the older style timer that worked off 115 volts and had contact points that easily corroded and malfunctioned. Of course, there is also the computer which is now common place in even small businesses. In addition to the traditional bookkeeping functions, computers can be programmed to provide total control of the complex greenhouse operations (i.e. automated misting, heating, ventilation, and lighting). A newly constructed, commercial operation in Virginia will use computer control to provide a day/night temperature cycle that gradually raises and lowers the temperature to approximate natural diurnal fluctuations. Linking the computer system to the telephone has provided various types of alarms to alert for mechanical failures during unattended hours. An important function for computers that should not be overlooked is their value in planning or decision-making. Programs are now being perfected that will cover almost any type of analysis desired.

Improved electronic environmental control has prompted dramatic increases in softwood propagation of cultivars that previously had to be grafted or budded. Propagators have not only learned to handle the soft tissue during the preparation and rooting cycle, but also have learned how to handle the cutting in order to survive the first winter. Debate continues as to the hardiness of a cultivar propagated on its own roots as opposed to being placed on a rootstock. Production of cultivars on their own roots has certainly benefited the production of those plants that commonly sucker from below or above the graft union. It would be good if all nursery catalogs provided information as to whether a plant was propagated on its own roots or by grafting.

High humidity propagation has been reinvented in the last 10 years. When I grew up, high humidity propagation was a quart fruit jar placed over an unrooted cutting on the north side of a building. Plastics and shading have now allowed this simple technique to be performed on a large scale. As expected, some plants give better results using high humidity than if misted. One must be cautious about making such comparisons as results are compared to a single misting cycle which may or may not be the optimal mist cycle for the plant in question.

Fortunately, progress has also been made in the area of fungicides for the propagator. Softwood cutting and high humidity propagation techniques provide an environment especially suited to pathogen development and a good fungicide program may mean the difference between success and failure.

New developments have also occurred in the area of budding and grafting. The chip bud has provided success with many cultivars that did not respond well to other methods of budding or grafting. New methods of securing the bud to the stock and protecting it from drying have also been developed. New types of budding rubbers and an assortment of plastic ties are now available for a variety of uses. In addition to the conventional wax or water base asphalt coatings, a new latex base material called "Gold Seal" is now available. Another material new to the propagator is Parafilm, a wax-impregnated plastic that has been widely used in laboratories for many years. Recently, Parafilm has been found to be quite suitable for covering chip buds of roses. The material stretches and sticks without tying and a bud will grow through it. No doubt the technique developed with roses will be applicable to other plants as well.

Hot callusing is a simple new technique that allows for localized heating of a graft union without heating the remainder of the scion or stock. This allows for rapid healing of the graft union without promoting premature bud break of the scion. The same general principle exists when an unrooted cutting is bottom heated to promote root growth without causing bud break.

Techniques for accelerated growth of many plants have been perfected in the past few years. By controlling temperatures and light it has been possible to greatly reduce the time required to produce plant liners. With some plants this has been primarily through control of day length, but with various conifers, cold cycles have been used to produce more than one growth cycle per year.

Micropropagation has, no doubt, become the superstar of the last 10 years. During this period, it has moved from the realm of laboratory fantasy to commercial production. No longer is it confined to relatively easy-to-culture herbaceous plants but includes some of the very difficult-to-propagate woody plants such as *Kalmia latifolia*. Tissue culture has also served a very useful purpose in virus elimination from various fruit clones. The future of tissue culture is even more exciting in that it will open many new possibilities in the area of plant breeding. It has the potential for rapid development of pure (homozygous) breeding lines that would otherwise take many generations of inbreeding to develop. It also has the potential for changing chromosome numbers of cultured cells. Plants produced from the cells with new chromosome numbers would be capable of crossing with a new group of related plants bearing the same chromosome number.

Various advances have been made in the area of mechanization during the last 10 years. These involve all phases of the nursery business from materials handling, to potting and harvesting. Many plants are now produced in containers designed for mechanical planting. The Weyerhaeuser-owned facility, Oakdell at Apopca, Florida, represents the ultimate in mechanization with rolling bench tops and computer controlled assembly of various plants needed to fill a given order. Small operations have also made advances in the area of mechanization. It may be a better way to fertilize, to bend a pipe, or direct rooting to reduce handling, but certainly significant within that particular operation.

Many items developed within the past few years are still in the research stage but will prove to be practical in future years. There are new growth regulators and new media ranging from bark to composted sludge. Microwave generators, small and large, have been shown to be effective for media pasteurization. Hydroponics in a variety of forms continues to be researched and placed into production. A refinement of the hydroponic technique has led to "air rooting" where roots are suspended in air and moistened at frequent intervals with a nutrient mist. Research continues with CO_2 enrichment of the greenhouse environment. The CO_2 can be supplied as a gas or through the mist system.

In summary, it appears that the last 10 years have indeed been productive in terms of advances in plant propagation. Current research indicates that the next 10 years will also supply us with many more changes.

WITCHES'-BROOM COLLECTION OF CONIFERS AND THEIR PROPAGATION

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Witches'-brooms are dense shrub-like growths that occur as a result of the mutation of buds (Figure 1). They are found mainly on conifers and generally retain their dwarf and dense character when propagated vegetatively (1, 2). The grafting of witches'-broom tissue has been done since 1874 and is the origin of such dwarf evergreens as *Pinus sylvestris* 'Beauvronensis' and *Pinus nigra* 'Hornibrookiana'.

Figure 1. A witches'-broom found on an eastern white pine.

The number of different forms of such dwarf plants is limited by the number of witches'-brooms found. A much larger number of different plant forms can be obtained, however, from the seed of the broom.

Over 20,000 seedlings of *Pinus strobus*, *P. sylvestris*, *P. resinosa*, *P. banksiana*, *P. rigida*, *P. densiflora*, *Picea abies*,