SATURDAY MORNING SESSION
November 23, 1957

The session convened at 9:25 o'clock, President Vanderbrook presiding. President Vanderbrook called the meeting to order At this time, we will have a discussion of "New Concepts in Propagating Structures." The man who will moderate the panel is Dr. Kenneth W. Reisch, Department of Horticulture, Ohio State University. Dr. Reisch.

MODERATOR REISCH: This panel will be concerned with factors and structures associated with the propagation of plants by vegetative means. A brief review of the use and development of these structures will introduce the discussion.

Dr. Reisch presented his paper entitled, "Plant Propagating Structures." (Applause)

PLANT PROPAGATING STRUCTURES

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Structures for growing plants under controlled conditions are known to have been in existence since 42 B.C. The doctor of Roman Emperor Tiberius Claudius Nero prescribed cucumbers for an ailment, so a translucent structure of slabs of talc or thin sheets of mica was constructed for their culture. The modern greenhouse probably had its inception with the use of forcing houses in northern Europe to grow such fruits as oranges and grapes. The growers then decided to heat the air inside the structure and used dung, stone stoves, or fireplaces. Oranges were grown in structures with an open framework in the summer and covered with wooden shutters and heated in the winter. One of these, built in Germany during the 17th Century, was 32 feet wide and 400 feet long. It wasn't until the early 18th Century that glass roofs were used and the first greenhouses in this country came into existence in the late 18th Century. They were narrow with a solid wall on the north and a glass roof sloping to the south. There is little evidence of the use of these structures for propagating plants. However, we know that practices in plant propagation date back to ancient times and can assume that much of it was carried out in various structures.

A propagating structure may be as complex as our modern greenhouses with light, temperature, and moisture controlled by electronic devices or as simple as an overturned mason jar. In either one of these structures the same physiological principles would apply to the propagating material regardless of the techniques used. In either situation, when a plant part is separated from the parent plant, conditions must be provided to maintain that part in a viable, active condition until it is self supporting by means of roots or a graft union The three environmental factors of light, temperature, and moisture, which can be controlled, are fundamentally important in the maintenance of propagating materials, and the means of controlling them are primarily dependent on the structure and its equipment.

It is common knowledge that light is necessary for food manufacture in a plant, and is essential to rooting and healing in propagation. It makes little difference whether the light passes through Nero's mica, through glass, through plastic, through fiberglass, or is furnished by some artifical source, providing it is of the desirable quality or intensity This indicates that the physiological importance of light has not been changed by the design or construction of new types of propagating structures. Of course, we have learned new concepts in the use and control of light and have adapted our structures to these by such techniques as variation in location, and use of shade.

We all know that temperature is very critical in plant propagation because of its effects on the metabolic factors associated with all phases of plant growth. Excessive temperatures without high levels of the other environmental factors, are usually undesirable because a depletion in food reserves may result due to acceleration of the process of respiration or by the promotion of lush top growth before rooting or union take place. Low temperature, on the other hand, may slow plant processes to a virtual standstill and result in little or no vegetative reproduction. We've learned the value of accurate temperature control and have utilized many valuable electronic devices to accomplish this end. The propagators of earlier years also knew the value of temperature, but had none of the devices or technical know-how of today. An article of 1824 discusses the techniques for heating glasshouses with fireplaces, and another illustrates the use of a piping system to prevent excessive heat build-up in a hot bed heated with dung. In the same year two authors discussed devices for opening glasshouse ventilators, automatically, for improved temperature control. These consisted of a black copper cylinder with water in the base. When the air in the cylinder became heated due to sunlight or increased outside air temperature, it forced the water down, which, by means of a float connected to a weight, caused a wheel to turn and open the ventilators. Today, 133 years later, we also have automatic ventilator controls in greenhouses which can be activated by timeclocks, changes in light intensity, changes in temperature, or rain. This is a great advance in temperature control, but again, the plant part has not changed because of its use. The same principles apply.

The somewhat spectacular results of successfully propagating some previously hard or impossible to root plants by use of high humidity or constant mist has indicated the value of moisture in propagating plants Over 50% of the fresh weight of a plant is water and water is absolutely essential to all life processes. In the case of a plant part which has been severed from the parent plant, water is of critical importance. We know that in order to maintain the plant part in an optimum condition it is necessary to maintain a humid condition around the surfaces of the plant. A worker of 1824 also realized this and discussed the use of double glass on hot beds to decrease the effect of cold surfaces which result in condensation and reduction in relative humidity. In relation to this he also commented on the possible value of heating air and passing it through a wet surface before it reached the greenhouse. The value of syringing greenhouse walks to raise humidity was also noted.

The Wardian case, sealed grafting cases, closed hot beds or cold frames, bell jars, the simple overturned mason jar or the overturned Dixie cup described by Jack Hill, all create the same effect of maintaining an area of high humidity around the propagating material. Through our technical advances and an increased understanding of the moisture factor, techniques for providing optimum moisture conditions have been developed. These include the high humidity system controlled by an humidistat, and intermittent or constant mist controlled by the same device, time clocks, electronic leaf, or other similar devices. Through the use of these systems we have reduced the all important limiting factors such as light and temperature which have resulted in improved propagating results. This advance has actualy reduced the need for enclosed structures by enabling the propagator to carry out his work in the open air under full sunlight. With this factor, as with those of light and temperature, we have not changed the physiology but have simply provided new and better means of control. The environmental factor of oxygen has not been mentioned because in most cases the structure does not affect its availability. There is evidence that oxygen may become limiting in the media in a closed propagating case if ventilation is not provided Oxygen would definitely be limiting when a poorly drained propagating medium resulted from faulty bench construction.

The members of our panel will tell you about new concepts in propagating structures and the control of environmental factors in these structures Again, you will note that the knowledge of past experience and the advancements in technical fields have enabled us to bring about new methods of control over the same three fundamental factors of light, temperature, and moisture. The future holds promise of new discoveries and innovations in plant propagating structures. We will probably see new discoveries in the effect of light quality, intensity, and quantity on plant propagation. New advancements in temperature control will undoubtedly occur, and techniques for using moisture more effectively are sure to be developed However, unless some radical change occurs naturally in the materials we are propagating, or unless we find a means of bringing about a change in plants, we will continue to be concerned with the problems of the same physiological fundamentals that the propagators of past centuries recognized and attempted to solve. Even the most *ideal* structures in existence wont give 100% rooting. We know that the only way to do that is to have an expert propagator tell about his results. This indicates *that* regardless of the changes or improvements in propagating structures, the most important factor affecting successful plant propagation will continue to be you, the plant propagator.

MODERATOR REISCH: Those were my introductory remarks Our first speaker is a florist. Since Mr Miller was unable to be with us, he sent an able replacement, Mr. Paul Daum, who is a general troubleshooter and problem corrector with Yoder Brothers, which has one of the largest plant propagation departments in the world. He is stationed at their Barberton Section. They have done a lot of work in plastic structures and washed-air cooling and certainly, the same problems apply whether we are considering herbaceous or woody plants.

At this time, I would like to introduce Mr Daum.

MR. DAUM (Yoder Bros., Barberton, Ohio): Good morning, ladies and gentlemen. Mr. Miller was not able to come, although, before I left we had a discussion on what we thought might be pertinent and interesting to this group. He was of the opinion that it might be a good idea to briefly outline what we, as an organization, operate.

As a business, we operate about 50 acres of glass in the State of Ohio, a portion of it in Ashtabula, Ohio, some in Cleveland and a portion in Barberton. About ten per cent of this glass or about 11½ acres in Barberton is devoted to propagation. During the summer period of the year the whole area is used for propagation. During the winter months the demand for rooted chrysanthemum and carnation cuttings is not high, and we can devote some of the area to finished stock.

The organization as such is divided into various groups or departments. We have a propagation staff, a stock production staff, and a pathology staff This results in an exchange of ideas among the men in the organization, yet making particular departments with trained personnel responsible for their specific field

At the present time we have only experimented with greenhouse construction using Polyflex 230. We, like most other people, are interested in getting started in plastics as a supplement to our acreage, since it is necessary for us to lease some of our area. The plastic would be advantageous to us from the standpoint of cost and in regard to the possibility of decentralizing at some later date, once we had established that the operation could perform satisfactorily in a structure as low in cost of erection and maintenance as has been advertised. By the use of plastics we could also isolate the carnation and chrysanthemum programs, which operate under different temperatures. We have at present a little over a half acre of plastic. Some of this is in Ashtabula and some is in Barberton, Ohio In both cases they are devoted to propagation. At present, we are not growing stock in either one, except on an experimental basis. I might add that the stock we have growing on an experimental basis had been satisfactory.

We have the conventional greenhouse type of construction, with side and top ventilators which are operated by hand. We have also had structures with no ventilators, no wet pad air cooling, no heating underneath the bench, but heated simply by pulling air through huge radiators One advantage that we have found is that high humidity can be maintained, even in the plastic house, without washed air cooling. Another is the advantage of being able to heat a plastic house with less total energy. We have also used washed air cooling in our conventional greenhouse. I will make a comparison, between the washed air cooling in the plastic house. We have found that the washed air cooling in the plastic house is much more successful.

We originally went into air cooling for the reasons most people do. For example, Ashtabula is approximately 100 miles from our propagating operation, which necessitates storing cuttings until enough are gathered to transport These cuttings are stored at 31°F., or above. In order to overcome moisture loss and to increase rooting we installed a washed air cooling system with the idea of providing very high humidity for the cuttings after they are stuck. Previously heavy shading, cheesecloth, and the Skinner system were tried, but any light reduction seems to be detrimental to the production of good rooted cuttings. With washed air conditioning, high humidity and light conditions can be maintained at the same time. In other words, optimum conditions can be constantly maintained. Briefly, here are some of the reasons we tried washed air cooling: (1) a constant level of humidity can be maintained with no reduction of light, (2) shading greenhouses for a large operation is extremely costly, (it entails broken glass, labor, cost of material and, I might add, it cost us $400 a year for the hydrochloric acid to remove the shading compound), (3) it is possible, with washed air cooling, to increase quality immensely, (4) the cuttings are cool when they are packed for shipment and, we have found, ship better The reasons being that there is less respiration during shipment and fewer disease problems. I might add here, that some shading is still necessary although less shading is required.

Further, we found that the air movement of the fans, even without the moisture pad, greatly increased quality and decreased disease incidence. After 5 or 6 days we often reduce the moisture and just operate the fans, alternating wet and dry air.

One plastic house was built with no top ventilators and the money saved was used to purchase air conditioning equipment. This has been very successful since it has increased both quality and rooting over the other houses. The labor required for propagating a unit of material has decreased, diseases were decreased and the operation as a whole has been more consistent. Growers all over the country have found growth under plastic is definitely superior to growth under glass. This may possibly be because glass sifts out the ultra-violet radiation and plastic doesn't.

Polyflex 230 does pose some problems. Most growers, including Yoder Brothers, have noted deterioration of Polyflex that has been in use less than one full year. It consistently blows out under winds of 60 miles per hour or more and constant flexing of Polyflex greatly weakens it. This may be overcome by stretching the plastic as tight as possible when it is installed and placing a bowed stick under the center of each panel so that it pushes the plastic out which tightens the panel so that flexing is impossible.

CHAIRMAN REISCH: Thank you Mr. Daum The next man on our program is Mr. Tom Kyle, Jr, from the Spring Hill Nurseries of Tipp City, Ohio They are wholesalers, retailers, and mail order nurserymen. Mr. Kyle will discuss the subject of greenhouse cooling as it is related to woody plant propagation.

MR. TOM KYLE, JR. (Spring Hill Nurseries, Tipp City, Ohio): Thank you, Ken. Ladies, gentlemen and guests of the Plant Propagators Society.

We have used washed air cooling for about two years. It has been a wonderful thing for the florist, since it allows them to grow a crop in the summer, which they were not able to do before, because of the terrific heat which was generated.

Our system is really a forced air cooling system, because we have coupled this with an intermittent mist system similar to the systems which have been described here at the meetings.

Mr. Kyle discussed the subject of greenhouse cooling as it influences propagation of woody plants. (Applause)

THE USE OF WASHED-AIR COOLING IN WOODY PLANT PROPAGATING HOUSES

TOM KYLE, JR.
Spring Hill Nurseries
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The system of washed air cooling is accomplished by equipping the greenhouses with large volume exhaust fans mounted on one side, or end, and wet fiberous pads on the opposite side of the house Air drawn through the pads by the fans is cooled by evaporation and drawn through the house. We try to build ours up to the point where a complete removal of our air is accomplished every minute, throughout the house The propagation house which we equipped was 16 feet by 100 feet. On the end of the greenhouse where we have our work rooms we put in a 42 inch bladed fan operated by a three-quarter horsepower motor. This fan is rated to exhaust 14,000 cubic feet of air per minute. At the opposite end of the greenhouse we were forced to construct our pads on a rafter. They were five feet high, 16 feet wide, or a total of 80 square feet of pad which is required to provide the right amount of cooling. Above the rafter we placed an ordinary galvanized gutter, similar to the type you use to drain water off your roof at home. This drip conductor, as we call it, had 1/16″ holes drilled at six inch intervals along the gutter. The drip conductor must be kept covered to exclude dust and debris from the pads Water flows through this conductor, through the holes, down through the aspen wood pads and is caught below by another gutter. There is a circulating pump placed in a sump at the base which in turn brings the water back to the top and lets it flow through the pads again. The water is re-used and according to the information we have there is only about two per cent of the water used by evaporation through the pads. The fan in our propagating house is started when the inside temperature reaches 80 degrees This year the fan was manipulated by hand. We are contemplating hooking a thermostat to turn on the fan.

We have intermittent mist installed in the house and it is a similar system to what has been described at these meetings. We use a Florida type nozzle with a time switch clock. In our system the mist is on for two seconds out of every minute. We have no problems as a result of