time you get the reverse effect. It takes 86 calories per gram of water to melt the ice. So you have a cold storage.

PETE VERMEULEN: Do you have any problem with the breakdown of the white plastic?

DICK VANDERBILT: We are the asbolute experts in the whole world on white polyethylene. The stuff is horrible. It doesn't break down, Pete, but when they put in the pigment nobody can predict what it will do. Last year the quality control was horrible. This year the quality is good.

MODERATOR TINGA: Next we have outdoor overwintering structures by Mr. Paul Bosley, which will be presented by his son, Richard.

THE LESS ELABORATE POLYETHYLENE STRUCTURE FOR WINTER PROTECTION

PAUL BOSLEY, SR.
Bosley Nurseries
Mentor, Ohio

Container grown material constitutes a major portion of our nursery growing; and as a result, our methods of protecting plant material was originally built around our need to protect these particular plants.

We have been using polyethylene almost since the beginning of polyethylene, and many of our methods are a continuing evolution or refinement of what we have done previously. However, the basic principle of polyethylene has not changed. It is a flexible covering that will allow the passing of gases but will not allow the passing of moisture through itself. It took us a number of years to realize some of the basic advantages of this method. For example, we know that many of the Evergreen Azaleas and Rhododendrons will lose their bloom buds when the temperature drops to around to 10 below zero; and yet when temperatures dropped to 25 degrees below zero, Azaleas underneath polyethylene protection, did not have their bloom buds damaged in the slightest. We know that there is a relationship between the damaging effects of low temperatures with and without wind, and we have come to the conclusion that the loss of the plant's cell moisture is a more damaging condition than mere low temperatures as such. We again come to the principle that polyethylene does not allow moisture to pass through its walls.

We have used many devices to attain results. The original and probably the simplest protective method is illustrated by this picture. You will see where concrete blocks are set on end and 2x4's are placed on top of them and the whole arrangement made so that a standard 4 foot roll of snow fencing will span either a bed or a group of containers. The snow fencing serves a double purpose. It immediately gives 50 per cent shade during the winter time when there are periods of

bright sun. It also affords mechanical support of the polyethylene which covers it. An arrangement of this sort requires a 10-foot wide piece of polyethylene to lay 10 inches on the ground and to come up over and lay 10 inches in the ground on the other side. We cover the portion that lays on the ground with either soil or gravel. Here is an additional suggestion gained from experience; namely, to throw a shovel of gravel on top of the polyethylene about every six or seven feet. This will entirely stop the ballooning effect that would otherwise occur during high winds and the tendancy to come loose at the sides. The ends are completely folded in and covered with gravel so that the entire area is sealed, and the bed or containers will emerge in the spring with the same moisture they went into the winter with.

This year, for the first time, we are using altogether the new white, and I mean white, not clear, polyethylene. This is sometimes known as highway film, and we have the road building people to thank because their wide use of this new material has made it possible for the nursery industry to have it. Whatever light comes through the white plastic is soft and diffused. We open the sides of these protective beds early in the spring; and as soon as possible, entirely remove the polyethylene but leave the snow fencing on for somewhat longer period.

It is a known fact that the intense ultra-violet light of the June, July, and August sun completely destroys the usefulness of polyethylene, but by removing it early, it is possible to get as many as four years use out of the same material. As a safety factor, we double the old polyethylene the second, third, and fourth years. At this point, we do not know how many years use, if any, additional can be gotten out of the new, white polyethylene.

Based on a 5-year use of snow fencing, 2x4's and cement blocks together with a single years use of polyethylene, we have figured the material cost of covering by this method to be 4 8/10 cents per square foot. I might also mention that once we have closed these units, they are not opened for any reason until spring.

Some growers have chosen to bend highway reinforcing mesh into a quonset shape and cover with polyethylene, but the results are disasterous if one should fail to ventilate on a day in January or February that becomes suddenly bright. We have had a 100 per cent loss on an experimental plot that was so constructed.

The next structure that we experimented with and have found most useful is a so-called A-frame house, which is illustrated here. This structure is built in rather small sections which are bolted together at the ridge and then bolted together in units to make any length house desired. I have had the plans and bill of material for this house written up and printed so that each of you may have one to take home. The wood

members, especially the parts at the base are all treated with copper napthenate (cuprinol) and as you all know, copper napthenate extends the life of any wood at least five times. This house can be easily disassembled and re-erected at any other location. We use this particular structure to over-winter balled and burlapped material for our spring orders. The plants are double and sometimes triple decked; and we have found everything in the line of broad leafed evergreens kept in perfect condition with the exception of *Pieris Japonica*. We may yet find out what we did wrong with this plant. The south half of this house can either be covered with white polyethylene or perhaps black polyethylene or clear polyethylene that has been sprayed with paint.

The advantages of this structure are many. Any hammer and saw mechanic can build one. The end doors are constructed to a dimension that will allow a tractor to go into it. It can easily be heated, and adapts itself to double lining. Furthermore, it can be used for the overflow of spring annuals and for a sales building as well.

Mentor, Ohio, lays in a snow belt along the south shore of Lake Erie, and much of our thinking has to take this into consideration. A rounded or quonset type structure will shed its snow load. We have designed a simplified quonset structure which is now very economical. As a matter of fact, the cost of this new quonset structure is identical with the cement block and snow fence structure we started with originally. We bend ¾ inch thin wall conduit over a home-made form. You will note from the picture, that the form is a series of wood blocks bolted onto a board in an arc, which if continued would make a perfect circle. I should mention that the arc is less than a perfect circle; but when the conduit springs back, it assumes the shape of a perfect circle. These two pictures will give you an idea of how we do this part of the job. We cut one inch iron pipe into 15-inch lengths, and drive them into the ground within 2-inches of the surface. Two lengths of conduit are fastened together with a screw type of steel conduit connector, as shown by the illustration. Three-quarter inch conduits will slip inside of a one inch pipe, and we soon have a structure that looks like this picture. You will notice that we use a one by three strip of wood down the ridge to tie the whole structure together. In addition, we wire the four end units in an x fashion to attain almost absolute rigidity. The accompanying illustration tries to illustrate this, and you will notice the handkerchief that is placed where the two wires cross. This structure will take a 24 foot width of white polyethylene, and will allow approximately two feet to lay on the ground to be covered with sand, dirt, or gravel.

Inasmuch as we are using the white polyethylene, we do not fall into the pitfall of previous structures and get a big build up of heat. Various methods may be used to close the ends and one method can be as simple as allowing enough

polyethylene on the end to gather it all together and tie it in a bunch as if it had an old-fashioned puckering string.

Still a fourth method which in itself is very simple, is shown by the next illustration where tall container grown material is laid on its side and then stacked up two or three high like a double or triple stacked row of barrels and then covered with polyethylene.

A variation of this arrangement is to lay two rows of material down with the tops heading toward each other and overlapping. Down through the center we put a 2x4, supported occasionally by up ended concrete blocks. This forms a ridge pole and polyethylene is draped over both rows of containers as shown by the picture which I feel illustrated them very clearly.

The last word has never been said on these methods, and I am sure that many of you will copy what we have done and vastly improve upon our methods. Frankly, we know right now some changes that we ourselves will make next year. I would appreciate knowing some of your ideas. Thank you all.

CASE HOOGENDOORN: Do you water that balled and burlapped material?

DICK BOSLEY: In the "A" frame structure we do ventilate and whenever you ventilate you have to water. On the *Ilex oppaca* in the large containers that were laid over, no, we don't water. We make sure they are thoroughly watered before they are covered.

MODERATOR TINGA: Our next speaker is Andrew Adams, Jr.

"OVERWINTERING AZALEAS IN TEMPERATURE-CONTROLLED PLASTIC GREENHOUSES"

ANDREW N. ADAMS, JR.
Ten Oaks Nursery & Gardens, Inc.,
Clarksville, Maryland

It became apparent to us back in 1955, if we were to continue in the Azalea business we would have to find some means of protecting our plants better in order to have saleable plants in the early spring with good foliage and buds.

Polyethylene plastic was just coming into the picture around this period so we constructed a small house (12'x96') by bending some old electrical conduit into a half circle and covering with some concrete mesh wire 6"x6", thus making a quonset type of house. We installed a small exhaust fan in one end and several louvers in the opposite end, plus a couple of propane gas heaters used for curing tobacco in the Southland. The idea was to keep the plants just above freezing, with plenty of air to prevent leaf drop. The following spring the results were so gratifying, plus the fact the Azaleas were gone in no time, that we decided to expand this idea.

We constructed 12 gutter-connected houses with a truss