Thimet can drive you out of the greenhouse because of its odor and the fumes are toxic.

ANDY KNAUER: You protect yourself during application but what happens concerning the men who work around these plants and soil on successive days.

CHARLIE SCHEER: The rule we followed is to keep the men out of the greenhouse for 4-6 weeks, this was based on the recommendations of the various manufacturers. We saw no need to handle the soil, perhaps Lloyd might have a further comment.

LLOYD RASWEILER: There was no need to handle the soil and I put up signs in the greenhouses to warn anyone against handling the plants and soil.

The plants were planted before treatment and there was no need to disturb them until it was time to put them out in the field. I like to run the Rhododendrons on the dry side but occasionally we did have to go into the houses to water. I also like to reach down into the bench and pull up some of the medium to check for water and when we did this we used rubber gloves.

TOM CANNON: I thought these organic phosphates built up in the body even though you only get small amounts at a time.

CHARLIE SCHEER: From the literature I've reviewed the organic phosphates go out of the body. Di-Syston will be absorbed by the body and if you get enough to be in the killing dose range you will get nerve damage. Temik, however, does not give nerve damage, but all these products should be handled with care.

MODERATOR HANCOCK: The consensus of opinion seems to be that its still more important to protect our own skin than our Rhododendrons. The next speaker is Hubert Rhodes who is to speak to us on the subject of juvenility in plants.

JUVENILITY IN RELATION TO ADVENTITIOUS BUD AND ROOT INITIATION IN WOODY PLANTS

HUBERT L. J. RHODES
Algonquin Nurseries
Merrickville, Ontario

There are some well known facts about juvenility that have a particular bearing on the propagation of woody plants from cuttings and by other asexual methods: (1) that juvenile shoots generally root very readily as cuttings, even in those species and cultivars in which the adult phase can be rooted only with great difficulty; (2) that adventitious shoots formed on roots normally resemble the juvenile shoots of young seedlings; (3) that a juvenile capacity persists in the basal region of the stem of a plant grown from seed or from cuttings of roots or juvenile shoots, making possible the establishment

of a permanent source of juvenile propagating material through stooling; and (4) that the juvenile base may become lost through the use of adult shoots for propagating material, at least in some plants under some conditions. In persistent juvenile forms on the other hand, the juvenile zone is enlarged, so that development is arrested in a juvenile or semi-juvenile state for a longer part of the plant's lifetime than is usual. Some horticultural juvenile forms appear to be arrested indefinitely in the juvenile phase, but most of them eventually develop adult foliage apically when grown to sufficient stature in a suitable environment.

During recent years there have been many investigations of juvenility in higher plants, and most of these are mentioned in a recent review by Allsopp. It would seem that no general interpretation that would account for the various phenomena associated with juvenility has been yet put forward. In experiments concerning relative ease of rooting, Hess was able to isolate and characterize rooting cofactors from the cut stems of juvenile English ivy, and later was able to demonstrate the presence of similar substances in easily rooted cultivars of other ornamentals with juvenility not being involved. It seems reasonable to expect that non-auxinic substances similar to those discovered by Hess are fundamental to the initiation of the root pattern of organization, whether this occurs in an embryo, in an existing root giving rise to lateral roots, or in a shoot giving rise to adventitious roots. In regard to the other aspect of this discussion of juvenility, the juvenile nature of adventitious shoots formed on roots, there is no corresponding body of evidence to explain this reverse effect.

A few months ago it occurred to me that juvenility might be more easily understood in terms of the relation between juvenile shoots and what might be called the developmental shunt system between shoots and roots, rather than in terms of differences between juvenile and adult shoot phases. The schemes by which different species of trees and shrubs grow up to maturity appear to be many and varied, whereas the differentiation of a plant into aerial structure and root system is a general and basic process. It is important to remember that roots are more than just another kind of organ, being rather a different, semi-independent system whose organization is mediated in the root tips, while the organization of the aerial structure is mediated in the shoot apices. Whenever a bud is initiated on a root, or a root on a stem, a basic reorganization has to occur in the tissue of a 'foreign' system.

I would suggest that juvenile stem cuttings root easily because the kinds and proportions of substances mediating the juvenile configuration in shoots are not very different from those mediating the root type of organization. By this interpretation the juvenile form of shoot originates through the *first and least difference* in substances between those determining root initiation and those determining bud initiation.

The transformation of the shoot apex toward the more adult and eventually reproductive phases involves further differences in mediating substances, and some of these differences may interfere with the initiation of the root pattern. Once this idea is accepted, it is not difficult to account for the juvenile nature of buds initiated on roots, and perhaps partly explain the persistence of juvenility in the base of the original stem of a woody plant. The above is a brief outline only of a subject explored more fully in a manuscript in preparation.

By another somewhat related approach, bud initiation on roots might be interpreted as being a process physiologically similar to the original differentiation of a plant into shoot and root across the hypocotyl of the embryo, or in other words, as being an approximate reconstitution of a late stage of the embryo. If something similar to adventive embryony is involved here, some of what has been learned through induction of plant embryos from callus tissue in culture might be adapted to obtain practical methods of inducing buds on root cuttings in species in which this does not occur spontaneously. The method of root cuttings could be more widely used than at present, especially in the re-establishment of juvenile propagation stools when the original juvenile base has been lost though the use of adult material for propagation. Root cuttings cannot be used with chimeras or tissue mixtures of course, and could produce undesired habit patterns or unsuitable growth phases in particular instances. But the method is probably more adaptable to nursery conditions than tissue culture, and can accomplish similar ends. So little has been done experimentally with root cuttings of woody plants that it is difficult to predict what might result if a small fraction of the time and energy presently devoted to experiments with stem cuttings were diverted to studies on induced bud formation in roots. In the present day, with the problems of increasing shortage of skilled labour and high labour costs, any means of reducing the necessity for budding or grafting and of widening the variety or ornamentals that can be raised from cuttings on their own roots will be welcome.

REFERENCES

Ali, N, and M. N Westwood, 1966 Nucleic acids as related to juvenility in several *Pyrus* species Am Soc Hort. Sci. Proc 89 123-131.

Allsopp, A, 1967 Heteroblastic development in vascular plants In Advances in Morphogenesis 6: 127-171

Flemer, W, 1961 Propagating woody plants by root cuttings Int Plant Prop. Soc Proc 11: 42-45

Girouard, R. 1967. Initiation and development of adventitious roots in stem cuttings of *Hedera helix*. Can J. Bot. 45: 1877-81, 1883-86.

Halperin, W, 1966. Alternative morphogenetic events in cell suspensions. Am J. Bot. 53: 443-453.

Hess, C. 1965 Rooting cofactors— identification and functions Int. Plant Prop. Soc Proc 15: 181-186. Also earlier papers

Maini, J, and K Horton, 1966. Vegetative propagation of *Populus* spp.; influence of temperature on formation and initial growth of aspen suckers. Can J Bot 44: 1183-89.

MODERATE HANCOCK: Thank you Hubert for that thought provoking talk. I'm always intrigued by such wonderful phenomena of nature. Are there any questions?

RON HUROV: Researchers have shown that basal parts of the tree are associated with juvenility and this is also associated with the roots but as you get further out along the root the juvenility disappears. But in some plants juvenility can be induced in the upper portion of the tree. Have you had any experience in rooting different parts of the plant and is etiolation a factor in the induction of juvenility in your root cuttings?

HUBERT RHODES: In respect to etiolation, I don't think that light is too much of a direct factor in induction of roots on root cuttings. Unfortunately there is little information on the induction of roots on root cuttings on many species but from the information I've read there is a variation in time and season. Concerning the tops of plants, high humidity and high temperature have been found to cause a varying amount of rejuvenation, particularly in the case of *Hedera helix*. In the case of tropical and sub-tropical trees this would be expected to occur more generally on the plant than in just the basal region and many of the tropical plants have a juvenile stage that persists for many years or much more extensively than occurs in our plants of the more temperate climates.

GUS MEHLQUIST: You indicate that we can propagate plants easier by going to the juvenile stage and if we are going to produce plants by tissue culture we will have to go to some sort of juvenile tissue to start with. You mentioned dwarf evergreens and this got me to thinking that many of these are periclinal chimeras and when you can propagate some of these by root cuttings you don't get the desirable type but rather the old "mother" form and this of course would not be good.

HUBERT RHODES: The point about chimeras is in my manuscript but I was not specifying dwarf evergreens but was talking about juvenile evergreens some of which are fairly low growing since as you mention many of these are chimeras derived from witches brooms.

MODERATOR HANCOCK: The next gentlemen really needs no introduction since by his enthusiasm coupled with his love of plants he has become a great propagator and is known to all of us. Mr. Joe Cesarini.

DWARF CONIFERS

JOE CESARINI
Johnson Avenue Rare Plants Nursery
Sayville, New York

In the last few decades, smaller homes and properties have become very popular; likewise the interest in low growing and dwarf plants has increased due to a desire to create a