rooting was obtained. Fifty percent rooting was obtained in all other medias where Chloromone was used except in straight peat, rooting was reduced considerably even when Chloromone was used as a rooting aid. Where coarse calcined clay was used, rooting was increased when treated with Hormodin No. 3, but not significantly greater than where Chloromone was used. In addition to percent rooted, cuttings in calcined clay and peat had a heavier root system, being much thicker and coarser than in other medias. The cuttings retained their foliage longer and were much greener in this media. The leaves of the cuttings in the other medias had a tendency to turn chlorotic and drop off. The possible factors to attribute the superiority of the calcined clay and peat mixture is that this mixture had better drainage and aeration than the other medias used in these experiments. As indicated by Kamp and Wilkins, rooting percentages were decreased significantly on cuttings taken at later dates after the wood matured.

MODERATOR MCDANIEL: Thank you very much, Mr. Carbonneau. Next, we have a very interesting paper by Mr. Al Fordham, Arnold Arboretum, Jamaica Plain, Massachusetts.

AN UNUSUAL WITCHES'-BROOM ON PINUS STROBUS

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This series of slides depicts a witches' - broom development on *Pinus strobus*, located in the Berkshire Hills of western Massachusetts. It is of unusual interest for although witches'-brooms seldom produce flowers or fruits, this one bears cones containing viable seeds which have given rise to numerous dwarf plants. What appears to be two trees is actually one that divides into two parts four feet above ground and the broom comprises the entire crown of one leader. It is about ten feet tall by ten feet wide and is borne on a tree approximately eighty feet high.

A second view shows the site and gives some idea of its immediate surroundings. In the foreground, with the broom-bearing tree situated at its edge, is a fifty yard wide clearance cut through the woods to accommodate high-tension electric lines. As a result of this unnatural opening in the woods, seeds shed from the broom had a better chance of developing into plants than would be the case in natural woodland where any abnormal or slow-growing subject would be at a serious competitive disadvantage.

Herbarium specimens collected bore only female conelets and this appears to be the sex of the entire formation. Its growth is clean and apparently free from the usual witches'-broom

causitive agents thereby making it reasonable to suppose it originated as a bud sport.

Twig and cone specimens from the broom, compared with those of normal white pine, show its small cone and growth characteristics.

Cones from the broom compared with normal white pine cones show the diversity of subnormal sizes that have occurred. The upper row taken from a normal tree measured from four and three-quarters to five and one-half inches in length, while those produced on the witches'-broom varied from one and three-quarters to three and five-eighths inches with most being less than two and one-half inches long. Normal white pine cones have five clearly defined sets of spirally arranged cone-scales fixed to a central axis. Though not as clearly defined in some cases, this same cone-scale arrangement persisted in the witches'-broom cones. However, the number of scales present varied enormously. Scales on twenty-five witches'-broom cones were counted and the number ranged from a low of twenty to a high of fifty while scales of the normal cones ran between sixty-eight and eighty. There was no relationship between cone length and scale number as the shortest cone, one and three-quarter inches, had twenty-five scales, whereas the longest cone, three and five-eighths inches, had only twenty-one scales. However, seed size varied with the small cones having proportionately small seeds.

Through the years over two-hundred and fifty dwarf pines such as this one have arisen in the vicinity of the broom-bearing pine, some as far distant as one-quarter of a mile.

This professional plant collector, who wishes to remain anonymous, discovered the witches'-broom and the abnormal seedlings in October of 1962. He holds its location in great secrecy and showed it to me only after exacting a promise that I would never reveal its whereabouts to anyone. Last autumn he collected about one-hundred dwarf seedlings from the area and carried them to a nearby farm where he started a small nursery.

Two closer views show the assortment of dwarf forms which are present. Some bear leaves about normal in size while others have leaves less than one inch long. A number have started to assume shapes similar to that of *Pinus strobus umbraculifera.*

The method of maintaining the line clearance in past years was to have a crew pass through and cut out unwanted growth. Fortunately, the pine seedlings were left undisturbed because of their small size. This year, however, the power company decided to treat the clearance with an application of brush-killer.

In early September the discoverer, on realizing that any remaining plants were in jeopardy, searched the area carefully and gathered about one hundred and fifty more dwarf seedlings. They were carried to a location near a brook where

water could be provided during the drought which prevailed at that time. Again the wide range of variation can be seen in these plants which are distinctly abnormal.

This series of slides has illustrated one method by which dwarf conifers originate spontaneously.

MODERATOR MCDANIEL: Thank you very much, Al. We will now take time to have questions on the papers you have just heard.

MR. VINCENT BAILEY: I would like to ask Mr. Bosley if he has used any other ties in addition to rubber strips in his budding operation?

MR. BOSLEY: The answer is no.

MR. CASE HOOGENDOORN: You say you must remove the wood from the bud. How do you bud cherries, and mountain ash? When you take the wood out you also take the heart out of the eye.

MR. BOSLEY: I said nine out of ten budders should take the wood out. It takes a good budder to use a wood bud. We have budded cherries and we have taken the wood out and have had no trouble.

MR. HOOGENDOORN: Yes, but when you take the wood out you also take the heart out. What is going to sustain it?

MR. BOSLEY: Are you referring to that little point that goes into the eye?

MR. HOOGENDOORN: Yes.

MR. BOSLEY: Removing it does not seem to have caused any problems in our area. Our biggest problem is to get good enough budders who can cut thin enough buds so the ratio of healing tissue is great enough to cause healing to take place.

VOICE: I might say that in Michigan all cherries are budded with the wood in. When we tried to bud with the wood out we have had failure. We usually can not bud until about August 25th when the buds are mature.

MODERATOR MCDANIEL: We have had somewhat similar experience with cherry and pear at the University of Illinois. We use the buds with the wood.

MR. BOSLEY: I want to mention that our experience with cherry had been with the flowering cherry and not that which is grown for fruit.

MODERATOR MCDANIEL: We will now return to the presentation of papers.