to bring them back with nitrogen, although I had two beds that never did come back. The chemical was applied right after they were planted.

MR. WELLER: I think it is a case of checking the tolerance of each type of plant material to learn when to apply the chemical.

DR. MAHLSTEDE: You had ten perennials you said cost too much to produce, among them, *Phlox subulata.* Who grows them, or how do you reduce growing costs?

MR. WELLER: In a case like this we have to check through our records to see where we made an error or where we have been doing something wrong. In the case of *Phlox subulata,* as you all know, it is propagated by taking divisions, and if this thing isn't done efficiently you can run into quite a number of man hours in just tearing the plants apart.

MR. RICHARD VAN HEININGEN (Deep River, Connecticut): What is the water pressure in your mist line?

MR WELLER: We are running at city pressure, which is 80 pounds. I mentioned that by the time it gets down to the end of the line it is probably down to around 65 pounds

MODERATOR NELSON: Thank you, Mr. Weller, for a very informative talk.

Now, to move right along, the next speaker needs no introduction, in the person of Mr Harvey Gray. I will now call on Harvey to speak on "Light Factors and Rooting Cuttings"

Mr. Harvey Gray, Farmingdale, New York, presented his prepared manuscript, on the effects of light on the rooting of cuttings. (Applause)

LIGHT FACTORS AND ROOTING CUTTINGS

HARVEY GRAY
State University of New York
Farmingdale, Long Island, New York

The original title suggested for this talk was "Rooting Cuttings with North Light.' I asked permission to change the title so that details allied to "north light" might be considered and developed. This is a generalization of a few concepts held in the area of rooting cuttings. Such a generalization, for me, is possible through a series of demonstrational tests set up and developed over several years by students as part of their application and appreciation of the subject of plant propagation The following remarks are offered for consideration and discussion, a learning process, if you please, rather than material of unquestionable fact

We are led to believe that when all other factors are favorable, total food manufacture is in direct proportion to light intensity and duration With this thought in mind it might be wise to attempt rooting all of our cuttings in long and strong sunlight What happens to temperature in this strong and long light? It is here where we must go to an adjustment, making use of light reduction, misting or both But

wait, is it the high temperature that creates the problem in rooting cuttings? We have rooted a wide variety of plants with temperatures in the area of 120° F. I must hasten to add that at these high temperatures the humiity was held close to 100% with the aid of a vapor proof case

I have rushed into the subject of rooting cuttings too quickly. Let's go back to the source of the cuttings. Research and practice points to the fact that it is the food content of the cuttings at the time of insertion in the medium that effects the percentage of rooting. Cuttings taken from plants in subdued light have considerable less chance to produce vigorous rooted cuttings. The carbohydrate/protein ratio, usually referred to as the C/N ratio, is a very important control factor in rooting cuttings Cuttings from plants growing in supressed light condition fail to possess sufficient amounts of carbohydrate, and possess an excessive amount of protein to encourage rooting. Cuttings taken from plants growing in full sunight possess a good quantity of carbohydrate properly balanced with protein to produce favorable rooting At this time I am prompted to throw in another thought in regard to the C/N ratio concept Cuttings taken from plants growing in the sun, well fertilized, and well watered, unless given the opportunity to become well matured, present a problem in rooting. Again it is a case of too little carbohydrate and too much protein. Let us say, the wood is too soft

To summarize this, it might be put this way. The well chosen cutting with the proper C/N ratio is equally important, if not more important, than the number of foot candles of light permitted to fall on a cutting in the process of rooting Paraphrasing a cigarette ad, catch line, "It's what's in the cutting that counts."

Now let us return to the subject of light and the rooting of cuttings. The major problem, in summer, of strong sunlight, temperature and "evapo-transpiration" becomes a minor problem as we get into the fall and winter period when cuttings are rooted under glass. It is the summer period, from May through August, wherein lies the challenge I think that most of us would agree that it is the strong light, and the accompaning high temperature that creates the problem In order to reduce the temperature and yet not to restrict too much light is where the "North Light" principle applies.

North light implies that light that falls upon a surface makes its entry from the north sky only. Shading, on the other hand, is the reduction of direct sunlight with the aid of a wide variety of screening devices In order to obtain the maximum north light there should be no obstructions to the north such as shrubs, trees or buildings. A number of devices may be taken advantage of in creating "North Light." The north side of a grove of trees, the base of a tall wall, as well as the light deflector device made use of by Guy Nearing in his Nearing Propagation Frame, all make available the cool efficient north light for rooting cuttings.

In our instruction program at Farmingdale, many tests and demonstrations are set up to study rooting of cuttings with various light intensities Light intensity under the north light system varies within its limited range just as the direct sunlight varies over its very wide range.

Under the aluminum "deflector-reflector" as used in the Nearing Frame, the light intensity does not go much higher than 1000 foot candles, while direct sunlight may go ten to twenty times higher.

Foot candle requirement for photosynthesis varies between species of plants There is a limited amount of information on the most effective wave length of light for maximum food manufacture. It has been indicated that for most plants the rate of photosynthesis drops rapidly under a light intensity of 500 fc. With this thought in mind, we can readily see the importance of using strong cuttings with a high rooting potential when we choose to use "North Light."

With very few exceptions we successfully root more sorts of plants with "North Light," under vapor proof case conditions, than we do with full sun light under various misting systems During the 1958 summer season varieties of the following plants were rooted, making use of a vapor proof case and the principles of "North Light." *Acer palmatum, Azalea* "Knap Hill," *Cotoneaster horizontalis, Ilex opaca, Magnolia soulangeana, Prunus subhirtella, Prunus* "Kwanzan," *Pyracantha coccinea, Rhododendron* "Catawba Hybrids," and *Taxus cuspidata.*

The vapor proof case is made by putting down plastic across the bottom, up the sides and over the top of the unit, which is held in position with a turkey wire supporting device. We have found that there is no need in this chamber to use any special rooting mixtures. We just take the so-called Dutch peat as it comes out of the bale, and moisten it to the degree that when it is squeezed in the hand only a few drops of water will fall. The cuttings are then sunk into this medium with a sufficient amount of firming so as to prevent twisting after they have been positioned. All of the cutting types considered difficult to root are treated as far as wounding and rooting powders are concerned.

* * * * *

(*Editor's Note*: Mr. Gray concluded his talk with a series of seven slides which summarized the points he brought out in his paper).

MODERATOR NELSON: Thank you, Mr. Gray. Are there questions?

MR. HOOGENDOORN: Under 100 per cent humidity, do you have any finishing problems?

MR. GRAY: To date we have not had any problems and I am at a loss to explain why.

MR HOOGENDOORN: What is the temperature inside your vapor proof case in the greenhouse during the winter?

MR. GRAY: As to the temperature of the bench in the winter, I might say that we attempt to regulate our heat by twisting a valve on the heating line, which is under the bench. We think we have a bottom heat temperature somewhere in the area of 68 to 72 degrees F. What the temperature in the air space above the cuttings may be, I do not have any idea.

DR. CHARLES HESS (Lafayette, Indiana). Harvey, have you made a direct comparison between the mist system and your vapor proof case system using the deflector reflector?

MR. GRAY: Indeed, I have, Charlie. I would not stand up here if I had not.

DR. HESS· Then have you made a cost analysis of the two? With the increased cost of the deflector reflector I wonder if you do not have a higher cost per cutting than you would have using a mist system alone?

MR. GRAY: No doubt you would. In this case I would not re recommend the deflector reflector, but would suggest as I did in my formal presentation, that you go to the north side of the woods and set the cases up there. Here you would need no aluminum, and you would have plenty of light reaching the cuttings. I get 1000 fc on the north side in the summer period, ample and sufficient to do a good job in rooting, bearing in mind that our cuttings are strong with a high rooting potential.

MR. WALTER GRAMPP (Red Bank, New Jersey). Using that north light setup, how long does it take to root *Acer palmatum?*

MR. GRAY. We get very nice roots showing in six weeks time, and the root system comparable to the plants on exhibit in twelve weeks.

MR. GERALD VERKADE (New London, Conn): Is there any definite distance between the top of your plastic and the tops of your cuttings?

MR. GRAY: I don't think it makes a great deal of difference. We are checking this at the present time.

The important thing in case construction is that you do not build a circus tent and call it a vapor proof case. You have to keep the roof of your case flat You fellows who have been in this business of propagating plants for a long time know what a grafting case looks like. A vapor proof case is exactly the same thing, except you vapor proof it with plastic.

MODERATOR NELSON. Thank you very much, Harvey.

The next person on our programm is John Hill, better known to all of us as Jack He is speaking on "A Practical Approach to Greenhouse and Liner Bed Sanitation" Mr. Jack Hill.

Mr. Hill discussed the subject of sanitation as it is related to the successful propagation of plants (Applause)

A PRACTICAL APPROACH TO GREENHOUSE AND LINER BED SANITATION

J. B. HILL
D. Hill Nursery Company
Dundee, Illinois

Perhaps I should first define what I mean by greenhouse sanitation. Actually it is not a thing, but rather, condition. It is a condition which results from the application of cultural practices that are designed to initiate and maintain cleanliness throughout an entire plant producing facility. We feel that sanitation is a very important factor in this process of attempting to standardize. It is one of those factors which can be