AN EVALUATION OF TECHNIQUES FOR THE PRESENTATION OF HORTICULTURAL TOPICS THROUGH THE MEDIUM OF TELEVISION

Thesis for the Degree of M. S.

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This is to certify that the

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AN EVALUATION OF TECHNIQUES FOR THE PRESENTATION OF HORTICULTURAL TOPICS THROUGH THE MEDIUM OF TELEVISION

By

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INTRODUCTION

Picture transmission was first conceived in 1839, when Becquerel discovered the electro-chemical effect of light. Although this discovery did not lead to the television of today, it stimulated, according to Bolen (1950) such developments as the scanning discs (Nipkow, 1884); cathode ray tube (Braun and Wehnelt, 1859); radio, (Marconi, 1896); and DeForest's development of the amplifying tube. In 1931 the Don Lee System in Hollywood, California, began transmitting one hour each day, six days each week, employing a completely electronic system. The National Broadcasting Company's station "WNBT" became the first commercially licensed television transmitter in the United States on July 1, 1941.

Although television has reached a stage of perfection mechanically, in program production it is still in its infancy. In spite of the excellent opportunity to bring educational programs into the home, the bulk of the programs scheduled are supplying entertainment. There is, therefore, little evidence to demonstrate the most effective manner to present education to the television audience and it becomes necessary to establish more fundamental facts in relation to programming educational topics. The field of horticulture covering a wide range of specialized material, is in a position to furnish a wealth of educational information for the televiewer; a variety of subject matter of interest to everyone. Horticulture as a science and an art is tangible and can be demonstrated

effectively. It can be directed to: specialized groups such as gardeners, fruit growers, vegetable growers, flower growers, and food processors; to general groups such as home owners, and everyone interested in growing plants.

Purpose: When an established author, R. Hubbell in his book "Television Programming and Production" says "Any discussion of programming art is usually vague and superficial, ending with glowing predictions of wonderful things to come", it is apparent that much research is necessary in this area. For the most successful program, a study of presentation techniques for Horticulture and the communication of information holds the key to the success of television as an effective educational medium. In the study of presentation techniques it is necessary to know how well the facts are reaching and holding the interest of the audience. Since there is no proven method for the best presentation of Horticultural topics through the medium of television, the following three basic types of presentation were selected: lecture, discussion, and drama. They were placed on a comparative basis for evaluation of audience response and retention of subject matter.

PROCEDURE

Topics: It was necessary to select topics for study which would be typical in the field of Horticulture and at the same time typify the wide variety of topics which do exist. For this purpose "Forcing Buds for Winter Bloom", and "The Little Green Factory" were adopted. The first program was produced in early March when the interest in forcing dormant buds was high; the second program, not seasonal in nature, was the study of five physiological function of plant growth.

Presentation: Lecture, discussion, and dramatization methods of presentation were adopted. The lecture was given by one person, as a means of direct communication between the lecturer and the audience which assumed the proportion of a classroom or a small lecture group. In the discussion, the same facts were conveyed by the interplay of questions and answers between two persons. Direct relation to the audience was achieved by a professor speaking to the audience when the two players were not speaking to one another. The audience observed the action and dialogue of the drama in order to comprehend the same factual material that was contained in the other methods of presentation.

Production: For the lecture presentation of "Forcing Buds Into Winter Bloom", (Topic I) diagrams were prepared to illustrate the longitudinal section of a leaf bud; longitudinal section of a flower bud; and

a hypothetical shrub (2 and 3 Fig. 1). Living dormant branches were used to show the unopened buds. Kodachrome slides of flowering branches of: Forsythia ovata, Magnolia stellata, Prunus Maackii, Salix caprea, and Chaenomeles lagenaria grandiflora, were photographed to demonstrate how the "forced" branches might be arranged for the home.

The following diagrams were made on the blackboard in the laboratory for the discussion presentation: a longitudinal section of a leaf bud, and a longitudinal section of a flower bud. Living dormant branches were used to clarify the position of the buds. Flowering branches of Aesculus Hippocastanum, Forsythia ovata, Salix caprea, Malus floribunda, Prunus Maackii, Chaenomeles lagenaria grandiflora served for use in making flower arrangements in front of the camera.

For the dramatization the living materials listed above were also used.

During the lecture presentation of "The Little Green Factory", (Topic II) diagrams were prepared to illustrate: the factory analogy (5 and 6, Fig. I), transverse microscopic section of a leaf, and the enlargement of a root hair. A basket of fruit and vegetables and one foliage plant (Ficus elastica) were used as living materials in this production. The analogy of an industrial factory was used as a prop in the dialogue of all three presentations to further demonstrate the functions of the green plant.

The materials used in the discussion presentation were all living. One experiment was designed to demonstrate each of the five plant functions. For photosynthesis, plants of Coleus blumei were used: one

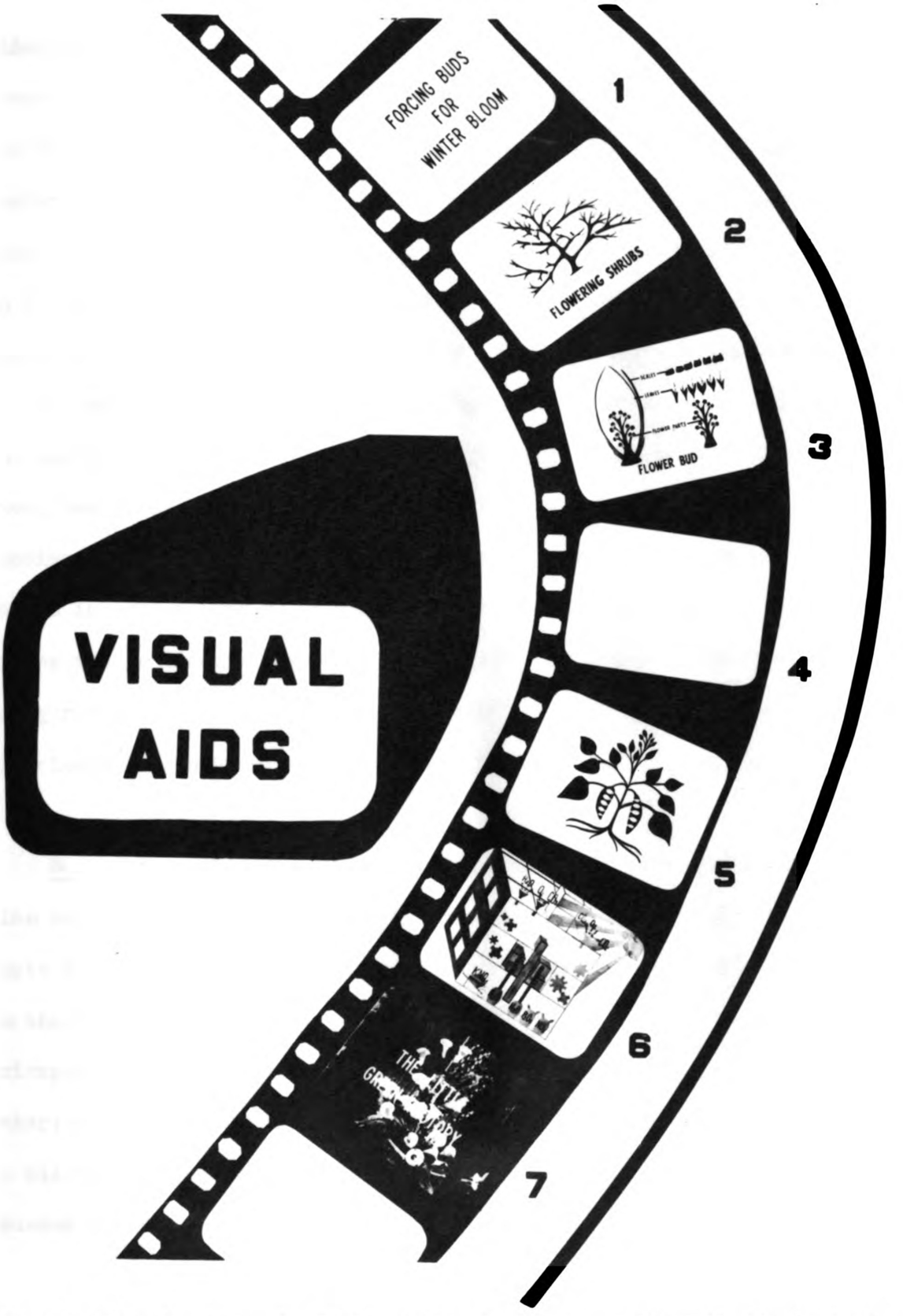

Fig. I. Visual Aids: 1. Title slide. 2. Diagram of hypothetical shrub. 3. Diagram of the internal arrangement of floral parts in a flower bud. 4. Blank. 5. Diagram of a green plant representing "The Little Green Factory". 6. Diagram of an industrial factory used separately and as a super-imposition with number 5. 7. Title slide for "The Little Green

etiolated from being under a black bell jar excluding the light; one under a clear bell jar with the carbon dioxide removed; one from which the water had been withheld; one plant to which had been supplied all factors necessary for growth. For the experiment illustrating transpiration, two plants of Lantana camara were selected: one wilted plant placed in front of an electric fan, the other unwilted because of not being subjected to moving air. Two plants of Hydrangea macrophylla were used to demonstrate nutrient absorption. To the soil of one pot additional nutrients had been added, to the other, nutrients withheld. For respiration, two plants of Pelargonium hortorum were found to be suitable specimens. One was shown to have been placed in a cool temperature, giving an intense flower color and the other was placed near the steam pipes giving a less intense flower color. The flower colors were faked by using red and white varieties. The plants for the nutrient absorption experiment also served to demonstrate translocation.

Scripts: Individual outlines of facts for each method of presentation were made before preparing the scripts. Talent familiar with the topic were then brought into conference so that scripts might be recorded in their own words on a dictaphone. Although this method provided extemporaneous dialogue which was good, it was found that the factual material could not be as easily controlled and was therefore not uniform in all three types of presentation. As a result of this experience and because it was necessary to control the facts for evaluation of the techniques of presentation, a master outline was prepared as a guide for

rewriting the scripts of the three presentations. Memorization was not required for the lecture or the discussion because a copy of the master outline was placed on the teleprompter as a guide for the talent in the studio. The dialogue for the drama was memorized by the talent.

The scripts for "Forcing Buds into Winter Bloom" (Topic I) were not rewritten since this topic was dropped from the testing program before the final recording was made.

Casting: Uniformity of the factual material was important for purposes of comparing methods of presentation. To attain this uniformity it was important that one person who knew the subject matter and the application of the materials be cast in all three productions. Experience in lecturing and dramatics was important to assure a polished performance. The supporting cast for the discussion and drama was selected for ease and ability in handling the subject matter, the script, and to suit the characters to be portrayed. This cast included a professor of Horticulture, a professor of Speech, and a student, all with a minimum of experience before a television camera.

Program Development: Scripts were given to the talent at the first pre-studio conference with the director three weeks in advance of recording the telecast. At this conference the objectives of the show as well as rehearsal schedules, props for the talent, the set, and timing were discussed. After the general discussion was completed the script was read by the talent to avoid problems and to take a rough timing. The next step

considered at this conference was the division of responsibility, the talent in relation to the script, and the details which were to be added at the studio. Three rehearsals using demonstrative props and further timing were conducted in the Department of Horticulture by the producer, before the presentation was taken to the studio. The following pre-studio technical details were supervised by the director at the television studio: construction of sets, collection of studio props, slides and scripts for co-ordination of opening and closing the program, and alerting of the studio crews.

On the scheduled day for recording the telecast, the director was in full charge. He conducted the first rehearsal without cameras for the purpose of planning the camera shots, the second rehearsal with cameras to work out control room problems while assisting the talent in relation to the cameras, and the dress rehearsal. "The Little Green Factory" was recorded by a kinescope on 16 mm. moving picture film for future presentation through the television system or through a sound moving picture projector during the testing program.

Testing: The testing program was accomplished by showing the kinescopic recordings to four categories of selected audiences: college classes, women's garden clubs, men's business club, and general mixed audiences. Within each group the recordings were shown to four separate audiences according to the scheme outlined in TABLE I. The questionnaires were of two types: one designed to test how much factual material was retained by the audience (TABLE II); the other, to test the appeal of the

three types of presentation to the audience (TABLE III). These questionnaires were used as outlined in TABLE I, audiences viewing individual programs being tested by the "factual" questionnaire, audiences viewing all three presentations being given "appeal" questionnaires. The questionnaires were distributed at the beginning of each showing and six minutes were allowed after each presentation for the completion of the answers.

TABLE I

SCHEDULE OF TESTING

Group I College Class	Group II Business Men	Group III Garden Club	Group IV Mixed
Lecture 1 Effective Living 151 Mich. State College	Lecture 5 Grand Ledge Rotary Grand Ledge, Mich.	Lecture 9 Dansville Garden Club Dansville, Mich.	Lecture 13 Manlius Community Manlius, Illinois
Discussion 2 Effective Living 151 Mich. State College	Discussion 6 Lansing Exch.Club Lansing, Mich.	Discussion 10 Tri-County Organic Gardening Club Lansing, Mich.	Discussion 14 Young Men's Christian Association Lansing, Michigan
Dramatization 3 Effective Living 152 Mich. State College	Dramatization 7 Nursery-Landscape Conference Mich. State College	Dramatization 11 Perry Garden Club Perry, Mich.	Dramatization 15 Horticultural Therapy Mich. State College
Lecture Discussion Dramatization 4 Effective Living 151 Mich. State College	Lecture Discussion Dramatization 8 Horticulture Sem. Mich. State College	Discussion Lecture Dramatization 12 Florists' Telegraph Delivery Service Mich. State College	Dramatization Lecture Discussion 16 Horticultural Therapy Mich. State College

TABLE II

THE LITTLE GREEN FACTORY QUESTIONNAIRE

Instructions: Do not sign name; indicate only facts that are clearly in your mind; do not guess at answers.

Age _____ Sex _____

Education: Grade School _____ years, High School _____ years, College _____ years.

Occupation: _____

1. The following factors are necessary for the manufacture of sugar by photosynthesis: a_____; b_____; c_____; d_____.

2. Sugar is manufactured in _____(part) of the plant.

3. The process by which a plant loses water by evaporation from the leaves is called_____.

4. The evaporation from the leaves will be more rapid when the air surrounding the leaves is_____.

5. You were shown that nutrients enter the root of the plant through the _____.

6. Which is the most important process in growing a healthy plant?_____.

7. Through the process of respiration, the plant converts_____into more available forms that can be utilized for plant growth.

8. In this presentation, how was the rate of respiration increased? _____.

9. The movement of sugars and soil nutrients in the water stream throughout the green plant is called_____.

10. Name two places where the sugars and nutrients are used in large quantities. a._____; b. _____.

11. What made this program interesting to you?_____
_____
_____

TABLE III

THE LITTLE GREEN FACTORY QUESTIONNAIRE

Instructions: Do not sign name; indicate only facts that are clearly in your mind; do not guess at answers.

Age _____ Sex _____

Education: Grade School _____ years; High School _____ years; College _____ years.

Occupation: _____

Do you have access to a television set? _____
Do you observe it 3 hours a week? _____

1. Did you find the program interesting? _____
2. Would you include similar programs on your weekly viewing schedule? ___
3. Was this subject matter useful to you?_____
4. Which of the three programs did you find most instructive: _____.
5. List in order of your preference the programs as you would most enjoy viewing. _____
6. Did you feel that the facts contained in the program were forced upon you? _____
7. Did you feel that the presentation was too elementary? _____
8. Did the program stimulate you sufficiently to want to learn more about the Little Green Factory _____.
9. Was the lecture presentation too formal? _____
10. Did the illustrations of each plant process help? _____.

COMMENTS:

Suggested improvements:_____

Do you like education programs?_____

Would you enroll in a Michigan State College Course presented on Television?___

Other comments?_____

_____

EVALUATION OF RESULTS

Program Scripts: The following is a program outline and the scripts used in the three television programs.

THE LITTLE GREEN FACTORY

Program Outline

I Introduction

- Good afternoon
- Depend on green plant
- Lunch
- Analogy

II Photosynthesis

- Products of
- Leaf structure
- Sugar
- Factory simile-----assembly line

III Transpiration

- Define
- Path of water (plant)
- Leaf section
- Control
- Factory simile

IV Nutrient Absorption

- Fertilizer
- Define

Diagram of root

Selective absorption

Factory simile---storage warehouse and conveyor

V Respiration

Foods stored

Addition of oxygen and enzyme activity

Cool temperature, brighter color

Factory simile

VI Translocation

Define

Intricate plumbing system

Nutrient ascent

Sugars throughout plant

VII Summary

Photosynthesis---sugars

Transpiration----excess water

Nutrient absorption

Respiration-----energy for growth

Translocation---movement

Our existence depends on the Little Green

Factory

Script

The Lecture

THE LITTLE GREEN FACTORY

Good afternoon. Have you ever considered just how essential the green plant is to our existence? We depend upon it for our food, our clothing and our fuel. Let us consider the lunch we had today: a sandwich, the bread is a direct product of the seed of a wheat plant; the meat in the sandwich from an animal that fed upon the green plant; butter, a salad, ice cream, coffee, all direct or indirect plant products. Almost all of our clothing is derived from a green plant - cotton directly from a cotton plant, wool from a sheep. Our homes are frequently built of wood from the trunk of a large green plant and heated with wood or coal or oil from prehistoric plant remains.

Yes, we are dependent upon the green plant for a good portion of our livelihood. That is why a little knowledge of how the green plants makes these products for us will give us a better appreciation of plant life.

To demonstrate the processes by which the plants are able to grow and serve us, let us compare the green plant to an industrial factory.

The process of photosynthesis provides the food or energy by which a plant is able to grow. Photosynthesis might be defined simply as the process by which sugars are manufactured from carbon dioxide and water through the agency of chlorophyll in the presence of sunlight.

What are some of the products which are manufactured? There are the sugars which we find in oranges, the starch in potatoes, fats and oil from nuts, and fiber which we find in paper.

Let us now examine the plant more closely and discover just how photosynthesis is accomplished. Suppose we take this leaf and cut a slice through the center. Then if we could expand each cell so that we could see it as under a microscope, at once it would look similar to this diagram. First let us consider it with the sun shining down on the upper surface of the leaf. The sunlight provides the energy for the manufacture of the food. The movement of the water from the roots up to the leaves serves as a conveyor. The excess water in the plant might be considered a by-product of the factory. The sunlight penetrates this surface layer and spreads throughout the leaf. Throughout the cells of the leaf we find chloroplasts, globules which contain the chlorophyll, a green pigment. This lower spongy area contains water vapor. Carbon dioxide enters this small opening on the lower side of the leaf. Now we have located all the basic materials for the sugar manufacture, which you remember we called photosynthesis. We have the sunlight entering the leaf, the carbon dioxide and water, and the chlorophyll which is the agency responsible for the manufactured product. You may not see immediately just how the process of photosynthesis is similar to an industrial factory? It is characteristic of our modern factory to have everything on an assembly line basis. In the leaf we have a section devoted to assembling the finished product. The chlorophyll is similar to machine tools which grind and finish products of industry. Water acts as a conveyor and is a part of the finished product. The small openings in the leaf might be compared to gas jets. The sunshine provides the energy as would electricity.

Water plays many roles in the plant: Let us give it a little more consideration. If so much water is used by the plant how does the water leave the plant? This is called the process of transpiration. It is the evaporation of water from the leaf. Suppose we pour some water in this pot. The water goes down into the soil, and is absorbed by the roots. It is then carried up the plant by a system of tubes, to the leaves. Let us look at the leaf section again. This spongy area is saturated with water vapor. Through this small opening at the bottom of the leaf it is possible for the vapor to escape. The rate at which the water vapor will leave the plant through the process of transpiration depends upon the humidity of the air which surrounds the leaf. The less water vapor in the air, the greater the difference between the relative humidity inside and outside the leaf and the faster it evaporates from the leaf.

So often we hear that we must fertilize the plants in our homes and in our gardens. What we are doing is simply adding to the soil nutrients which are necessary for the plant to grow. The entrance of these plant nutrients into the plant is called nutrient absorption. The mineral elements are building blocks of the finished product. Let us look at this diagram of highly enlarged small part of a root. These are root hairs. These are soil particles. Water is usually clinging to most soil particles. Nutrients are dissolved in the water. The soil water serves as a carrier for the nutrients. The water is in contact with these root hairs which have the ability of selectively absorbing the nutrients. After the water and nutrients have entered the root hairs it travels from cell to cell

until it reaches a conducting tube. The nutrients are then carried up the stem to those places where they are used.

The storage of nutrients in the soil is very much like the storage of raw materials in a factory. They are placed in a store room and are brought out on to the assembly line when they are needed.

The next process that we shall discuss is that of respiration. In respiration a plant converts stored food into forms which can be used by the plant for growth. These foods are stored in the roots, in stems, in leaves or in the seeds of plants. By the addition of oxygen to the stored food and enzyme activity, food is broken down to forms which can be carried throughout the plant.

Respiration plays a very important part in plant growth. Flowers or fruits grown where the nights are cool are a much brighter color because there was more sugar allowed to accumulate. The respiration rate is not as high in these low temperatures as it would have been in a warmer one. The higher temperatures increased respiration and that in turn used up the sugar.

The process of respiration might easily be compared to the marketing of industrial products. The finished products are stored until there is a market demand. In the plant the food is stored and is later used for new growth. There is another process which is most important for growth--the process by which all these foods and nutrients are moved about the plant. This is known as translocation. It is accomplished by an intricate plumbing system. Not only is it important for the nutrients to be taken up from the soil to the green areas where photosynthesis is going on, but

also it is important that products of photosynthesis be transported to storage and growth areas.

You have seen those functions in the plant which are necessary for growth. Photosynthesis for the manufacture of sugars; transpiration for the disposition of the excess water vapor; nutrient absorption to provide nutrients from the soil; respiration to make food available for growth; and translocation for distribution of water, nutrients, and manufactured food throughout the plant. You can see how these processes operate, dependent and yet independent of one another. You have seen how similar the organization of the little green plant is to our industrial factory. In better knowing and understanding the "Little Green Factory" we come to appreciate the importance of this sugar mill which provides our food, our fodder, our finery, and our fuel.

The Discussion

THE LITTLE GREEN FACTORY

Scene--an experimental green house where experiments have been set up for Horticultural research. As the scene opens Dr. Watson is speaking. (See Figs. II, III, IV and V.)

Prof.--To so many of you the function necessary for the growth and development of a green plant may be a mystery. It is my intention to make a simple comparison between the operation of a green plant and the operation of the industrial factory. Gregg Stecker has been working on a group of experiments which will help illustrate the comparison. Now I would like you to meet Gregg.

Fig. II. "The Little Green Factory", discussion presentation: production scene. From left to right are, C. Gustav Hard, the producer, Dr. Donald P. Watson, the guest lecturer, and Gregg Stecker, a student assisting Dr. Watson.

Fig. III. "The Little Green Factory", discussion presentation: experiments demonstrating five plant functions. Left to right, nutrient absorption, transpiration, photosynthesis, and others not clearly visible.

Fig. IV. "The Little Green Factory", discussion presentation: greenhouse set constructed in the studio of a painted brick wall; wood lattice representing windows; paper tubing to simulate steam pipes; and stage flats to give the appearance of the greenhouse walls.

Fig. V. "The Little Green Factory", discussion presentation: experiment demonstrating transpiration.

Gregg--How do you do Dr. Watson.

Prof.--Now Gregg the first process I want to explain is photosynthesis. Concerning this experiment on photosynthesis can you explain it to our audience?

Gregg--I'm sorry I can't, you see there are a few points which are not clear.

Prof.--Well tell me what you have done. Perhaps I can help you.

Gregg--You see I have four plants, three of them under bell jars. This first jar is all black so that no light can enter.

Prof.--Let's have a look under that one Gregg. This plant is all white. It has lost all of it's chlorophyll. That would certainly indicate that sunlight is influencing the manufacture of chlorophyll.

Gregg--Just what is the function of chlorophyll in the plant Dr. Watson.

Prof.--Well Gregg, chlorophyll is the green pigment which is responsible for the combining of the water and the carbon dioxide to form a simple sugar.

Gregg--Then it would be impossible to get sugar manufactured without chlorophyll. Then that is why when I gave it the iodine test by bleaching the leaf and pouring iodine on it nothing happened?

Prof.--Yes. The iodine test is a simple test to show the starches that are present. Now you can see the value of sunlight in photosynthesis. Now what about this second jar marked no carbon dioxide?

Gregg--In this jar I have been introducing air with the carbon dioxide removed. This plant is still green but when I tested for stored food by pouring iodine on a bleached leaf there was no sign that any had been manufactured.

Prof.--Then you are convinced that carbon dioxide is necessary for photosynthesis.

Gregg--Yes that seems obvious from the test. But now this plant has been in the sunlight and carbon dioxide has been available, but water has been withheld and look there is still no stored food.

Prof.--Right and now what about this last jar?

Gregg--It has everything, carbon dioxide, water, and sunlight, and look at the leaf from it. Just packed with food.

Prof.--Then you will agree that there are four factors necessary in the manufacture of sugars in the green plant. Sunshine, chlorophyll, water, and carbon dioxide.

Gregg--Yes, that demonstrates it clearly.

Prof.--Well now that you have discovered the factors in photosynthesis let us see how it compares to the industrial factory. First of all we have the sun shining on the leaf to provide the energy. This would be comparable to the electricity which provides the energy for the industrial factory. Then we have our machinery, the chlorophyll which combines the water and carbon dioxide to form the sugar.

Gregg--And the water and carbon dioxide are the raw materials.

Prof.--That is correct. Let us look for a moment at your experiment on transpiration. Now you have <u>these</u> two plants growing under similar conditions, but you have the <u>one</u> placed in front of the fan.

Gregg--You notice this one in front of the fan is wilted from the movement of the air.

Prof.--Well let us consider the leaf for a moment. Inside the leaf, you see, we have a structure very much like a sponge. It is porous and these pores are saturated with water vapor. Most of the water vapor leaves the leaf through thousands of little openings called stomates.

Gregg--I see--then the fan blows the air across these openings and exposes the water vapor to more air. That is why the plant wilted.

Prof.--That is true, however the fact that the plant did not absorb water fast enough through the roots should not be overlooked.

Gregg--You mean then the water actually makes a cycle? You water the plant in the pot. The water is absorbed by the roots and is taken up the stem and into the leaves. Then the water leaves the plant as water vapor.

Prof.--That's right--and there you have the process of transpiration. You should remember also that air inside the leaf is saturated with water vapor and the rate of evaporation is controlled by the difference between the amount of water vapor in the air and in the leaf. The higher the humidity in the air the slower will be the rate of transpiration.

Gregg--Then in homes where the air is dry you will have to water the plants more often.

Prof.--Yes that is true or else add some water into the air. The water serves as an excellent conveying system to carry the nutrients from the soils.

Gregg--This fertilizer experiment should demonstrate nutrient absorption. I have two plants growing in a very starved soil. To the one plant I have added a balanced fertilizer, and notice how much greener it is?

Prof.--It certainly shows the effect of the additional nutrients. You see Gregg, in order for a plant to grow there are nutrients that plants must get from the soil.

Gregg--Now when I fertilized this plant I put the fertilizer on top of the soil and then watered the plant.

Prof.--I see, and the fertilizer was carried down into the soil. Part of these nutrients are soon in solution in the soil water.

Gregg--Then when the plant takes in water it also takes in the nutrients?

Prof.--That is almost correct. However, the root hairs are really plastic membranes. There is a membrane surrounding the roots which has the ability to select the nutrients as they are needed.

Gregg--I can see where this is an important function of the plant.

Prof.--Yes and there is much more to be learned about this phenomenna of nutrient absorption. It is particularly important in Horticulture where we try to maintain desirable levels of nutrients. Again you can see how similar the green factory is to our industrial factory. The water serves as a conveyor for these nutrients and takes them where they are used.

Gregg--And the soil then acts as a warehouse for storage of the nutrients.

Prof.--Correct--and now you have an experiment to demonstrate respiration, don't you?

Gregg--Yes, I do. This plant has been flowering on this shelf. I have another plant which has been flowering here on the floor by these steam pipes. Now as I put these plants side by side you can see that the plant flowering in the warmer temperature has much paler flowers.

Prof.--Yes that is true. Now how do you account for this lighter color?

Gregg--It is evident that temperature is a factor.

Prof.--Temperature is a factor but what about this process we call respiration?

Gregg--Well respiration is the process by which a plant converts stored food into forms that can be used by the plant.

Prof.--Then it would seem that there is less stored sugars in this pale plant than in this one with the vivid colored flowers. You see the sugar is responsible for the color pigments in the flowers.

Gregg--I see, the higher temperature influenced the respiration rate so that less storage was possible.

Prof.--Yes that is true. Oxygen is also a factor. In the process of respiration oxygen and enzyme activity are most important. Actually respiration is the addition of oxygen to the stored foods. So without oxygen, respiration could not take place. The higher temperature accelerates the process so that the sugars are used almost as fast as they are manufactured.

Gregg--Then without the manufactured sugars the respiration could not take place.

Prof.--True--the plant must have these foods for growth. Just like in the industrial factory the finished products are stored until there is a market demand for them. In the plant they are stored until they are needed for growth and then through the process of respiration they become available for the plant to use. Now Gregg, there is one more process we should discuss, the process of translocation.

Gregg--Well translocation is the movement of the materials from one place to another, like the delivery service for the plant.

Prof.--And we have all these processes going on in the different parts of the plant. For example we have photosynthesis taking place in the leaves. The manufactured sugars have to get to the storage organs and to the growth areas.

Gregg--Storage organs like the tuber of the potato and seeds.

Prof.--Yes and areas where new growth is taking place, the tips of branches and in the tops of plants.

Gregg--Then there is the absorption of the nutrients by the roots and they are being carried up the plant to the leaves and to the growth areas.

Prof.--You see we have movement of materials up and down and all through the plant. This is accomplished by an intricate plumbing system. It is important that the movement of these materials goes on uninterrupted.

Gregg--Water certainly plays an important role in the transfer of all these products doesn't it? It's just like in a factory. It acts to keep the manufacturing unit supplied with all the parts as they are needed for assembly, and the water also takes the finished product to the storage area.

Prof.--Thank you Gregg for showing us these experiments.

Gregg--It makes them more clear to me. Thank you.

Prof.--You have seen the processes necessary for plant growth. Photosynthesis for the manufacture of sugar; transpiration to remove the excess water vapor from the plant; nutrient absorption for the intake of nutrients from the soil; respiration for the conversion of stored food; and translocation

for the movement of the nutrients and finished products throughout the plant. It is important to remember that all these processes are going on dependent and interdependent upon one another just as in the individual units of industry. So often it is thought that all that is necessary for a plant to grow is to give it some fertilizer. You have now seen that the plant is a very complex factory. And it is upon these processes of the plant growth that civilization depends for its existence. For this existence the plant furnishes our food, clothing, our shelter, and fuel.

The Drama

THE LITTLE GREEN FACTORY

Opening Scene--The Watsons are at home on a Saturday morning. They are having a late breakfast. Dr. Watson, a professor in Horticulture, seems to be more interested in his morning paper than the breakfast his wife has prepared. Mrs. Watson, being very energetic, has been to the garden and cut some flowers that are badly wilted. As the scene opens Mrs. Watson is trying to get her husband's attention.

Mrs.--pst----darling, your breakfast. You don't like cold coffee.

Mr.---That's what I like to see in a newspaper, good constructive articles. Now here's something everyone should read. Why it's sensational! It makes everything clear! I like that "The Little Green Factory."

Mrs.--Something certainly has bit you this morning. I haven't seen you so awake at breakfast in years. What's this all about?

Mr.---This article is called the "Little Green Factory". See! It explains just how a plant is able to maintain itself and then just to make everything

clear, it compares the green plant to an industrial factory.

Mrs.--That doesn't sound exciting to me.

Mr.---You see this toast? The cereal? Milk? This sugar? The strawberries, yes the table cloth and even the table. They are all products of the green plant. Why your whole life depends upon the green factory and probably you don't even realize it.

Mrs.--Are you telling me that milk comes from a plant? What plant? Milk weed?

Mr.---No, but animals are certainly dependent on the green grass, and the grains which are products of plant life.

Mrs.--Now just how does a plant do all these high and mighty things?

Mr.---Well, to begin with there are five processes which are necessary for a plant to grow and develop. The first process is photosynthesis.

Mrs.--Photo----------what?

Mr.---Photosynthesis, the process by which a plant manufactures sugars.

Mrs.--Sugars? You mean like this? (dipping spoon in sugar bowl)

Mr.---Not quite. If you shake carbon dioxide and water you get soda water. But if a plant combines carbon dioxide and water in its leaf it makes sugar.

Mrs.--Just how does it make sugar?

Mr.---In the leaf of a green plant we have a spongy area which is saturated with water vapor, carbon dioxide comes in from the air. The cells of the leaves contain the green pigment called chlorophyll. Then with sun shining down on the green leaves, the leaf forms the sugar from the carbon dioxide and water.

Mrs.--Isn't that amazing. (she says thoughtfully) Carbon dioxide, water, chlorophyll, and sunshine--------and we have our whole breakfast. But what has this to do with an industrial factory?

Mr.---Well the article says the carbon dioxide and water are the raw materials in the factory you see. The sunlight is like the electrical energy of the factory. The chlorophyll is the machinery which assemble the finished product. And the water in the plant is like an assembly line. Altogether simple for a professor, but it is clear.

Mrs.--(Picking up her wilted flowers) Looks to me as if the assembly line has broken down in these.

Mr.---It certainly does. You know I think you should read this article, then I could eat my breakfast instead of answering questions.

Mrs.--But you answer my questions so beautifully.

Mr.---Yes dear----------. These flowers have been subjected to excessive transpiration.

Mrs.--Don't you mean perspiration?

Mr.---No. Transpiration is the evaporation of water from the plant. You remember I told you that the inside of the leaf was saturated with water vapor?

Mrs.--Yes.

Mr.---The lower surface of the leaf has thousands of little pin holes in it. The water vapor leaves through these holes.

Mrs.--But I only cut these an hour ago.

Mr.---Yes but in cutting them you cut off the water supply from the soil and the plant went right on transpiring.

Mrs.--Are you telling me that I should have placed them in water right away, or would you suggest I cut all the leaves off?

Mr.---Either would help, but putting them in water would have solved the problem. Take that plant you have growing in that bowl. You don't have to water it do you?

Mrs.--No, and why don't I?

Mr.---Well, there you have a continuous system. The water is evaporated from the leaves, condenses on the glass, runs down into the soil, then it is taken up by the plant again and evaporates again and so on.

Mrs.--How is that different from these flowers?

Mr.---In the first place the air around these leaves is much drier. The rate at which transpiration takes place is influenced by the amount of moisture in the air. If the air is dry evaporation is more rapid and also by the amount of water available from soil.

Mrs.--So this is why I have to keep adding water to my plants?

Mr.---That's right, this continuous flow of water is like the continuous assembly line in the factory. It flows through the plant, evaporates, and then goes into the air just as an assembly line, it goes back and repeats the process.

Mrs.--You know, since you are in such a good mood for answering questions this morning, I have a $64 question for you now.

Mr.---The one morning in the week for a leisurely time to read my paper and what do you do, ask questions, questions, and questions.

Mrs.--(Rising) Come along. You've got to see this.

Mr.---But my breakfast.

Mrs.--(The scene shifts to living room where on the book case there is a pale looking plant obviously needing fertilizer. On the coffee table in the front of the divan is a bowl of fruit. The banana is black). Look at this poor plant!

Mr.---Looks to me as if it's as hungry as I am. Starved.

Mrs.--Starved?

Mr.---Now that's something else you could learn from this article. Although carbon dioxide and water are very necessary for a plant to make sugar and grow, you have to add some nutritions to the soil.

Mrs.--How on earth am I going to feed a plant?

Mr.---A plant has a very nice way of absorbing nutrients if you provide them. Now suppose you had a plant fertilizer and you sprinkled some on top of the soil.

Mrs.--Don't be silly, the plant can't reach out and grab them there.

Mr.---No, but when you water the plant the nutrients will dissolve in the water and will be carried down to the roots.

Mrs.--That sounds plausible.

Mr.---The nutrients are then in contact with the roots. On the roots there are little fingers sticking out called root hairs. These are especially designed for the nutrient intake.

Mrs.--Oh, then when the plant takes up water, the fertilizer sort of sneaks in.

Mr.---That's about right, but these root hairs are constructed with a membrane and the nutrients are selected as the plant uses them.

Mrs.--I see, sort of like a cafeteria?

Mr.---Now you know how a plant gets its soil nutrients. The water is like a conveyor in a factory. It carries the nutrients to where they are used in the plant. You might even say that the soil serves as a warehouse for these raw materials.

Mrs.--You know that article might have something. Is it on the society page?

Mr.---No it's not on the society page, but you will find it in the feature section. (Looking down at the fruit bowl, sees the banana.) This banana certainly is getting ripe isn't it.

Mrs.--Yes and I just put them there last night. They were such a golden yellow, and the oranges are a bright color. I thought we'd just enjoy their beauty for a few days.

Mr.---Actually what you did was increased the respiration rate.

Mrs.--But they say never put bananas in the refrigerator.

Mr.---I know, but if you would put them where it is a little cooler they wouldn't respire as rapidly.

Mrs.--There you go springing a fancy word again. What do you mean, respire?

Mr.---In the plant, respiration is the process by which stored food is converted into a form that can be used by the plant. Actually it involves the addition of oxygen in the stored food and a high temperature accelerates this process. The banana is alive even though it has been removed from the plant.

Mrs.--I see, then in the banana we have stored food and the warm temperature causes the banana to respire faster and that's why it is black.

Mr.---That's right. Then too, here in this room there is a good supply of oxygen so the conditions are almost ideal.

Mrs.--If I had placed them in the refrigerator respiration would have slowed down because of the cool temperature?

Mr.---Yes, respiration provides this energy, energy that came from the sunlight originally.

Mrs.--It must be similar to digestion. We eat our food and we digest it to get energy.

Mr.---Yes, it is comparable. As I was reading from this article the plant stores up food in seeds, in the stem, and also in the roots. Then, when there is a demand for the energy, respiration begins, and it is provided. In the factory quite often the finished products are stored until there is a market demand, then the goods are placed on the market.

Mrs.--It certainly is marvelous how the plant is organized so that when all its needs are provided it actually works for us.

Mr.---I think it is about time that my needs be provided for. How about some breakfast?

Mrs.--Maybe you'd like a nice ripe banana, it must be bursting with energy by now. (She says this as Mr. walks out of the shot and back to the breakfast nook--------next shot opens on Mr. at the table again.)

Mr.---You certainly are getting educated this morning aren't you?

Mrs.--(walking into the shot) I must confess you have answered a lot of questions. Now let me see, have I everything on the table? Cereal, coffee, cream, toast, maple syrup-----this maple syrup must be manufactured by the plant. It says maple right on it.

Mr.---It is, and that is another example the writer of the factory article could have used for translocation.

Mrs.--Is a maple tree a plant?

Mr.---Of course.

Mrs.--Then this is just sugar water?

Mr.---Yes and it is flowing in the stem of the tree. It serves to move the sugar out of storage and carry it throughout the plant.

Mrs.--You mean like sugars and the soil nutrients.

Mr.---That's right. Now take this maple syrup for example. It was manufactured in the leaves by the process of photosynthesis. It wasn't all used and much of it was stored during winter.

Mrs.--I see.

Mr.---Then this spring when growth began it was translocated, transported to the buds and the tips of branches where most of the new growth is found.

Mrs.--Well wouldn't the soil nutrients be in on this translocation business?

Mr.---Yes they are being translocated to the growth areas too. It takes an intricate plumbing system to accomplish all this movement in the plant.

Mrs.--Well I can see where the whole plant is a pretty intricate little factory.

Mr.---It certainly is! All these processes are going on dependently and interdependently at one time. Now how about my breakfast?

Mrs.--All right, but just one more question.

Mr.---No more questions. Here, you read about the "Little Green Factory" and I'll make my own hot cakes. You will find that we have to depend upon the functions of the "Little Green Factory" for our very existence, but I'm going to have to depend on my own cooking or I'll never survive.

Three reels of sound motion picture films, 550 feet long for each program recording accompany this thesis and are filed in the Department of Horticulture, Michigan State College, East Lansing, Michigan.

Factual Questionnaire: It was shown by the compilation of averages from the factual questionnaire that the results were not sufficiently different to indicate any one type of presentation as being the best technique for conveying factual material. After testing four separate representative audiences with each type of presentation, (a total of 12 audiences, 315 people), it was shown (TABLE IV) that the average grade for factual material was 50.7 for the lecture, 50.7 for the discussion, and 50.8 for the dramatic type of presentation. This did not suggest that any one type of presentation was more successful than any other in its ability to deliver the facts to the audience.

Appeal Questionnaire: A total of 139 people in four representative audiences indicated the preference of the dramatization type of presentation (TABLE V). It is most appealing to the most people with a total of 284 points. The lecture scored 204 points and the discussion 213 points which gave these two methods a much lower rating than the drama. On a percentage basis (Fig. VI) the three types of presentations rated:

TABLE IV

RESULTS OF FACTUAL QUESTIONNAIRE

Lecture			Discussion			Drama		
Group	Number People	Grade	Group	Number People	Grade	Group	Number People	Grade
Effective Living 151 Mich. State College	16	59.2	Effective Living 151 Mich. State College	19	52.9	Effective Living 152 Mich. State College	15	52.7
Grand Ledge Rotary Grand Ledge, Mich.	27	47.4	Lansing Exchange Club Lansing, Mich.	42	41.6	Nursery-Landscape Conference Mich. State College	48	53.3
Dansville Garden Club Dansville, Mich.	14	61.1	Tri-County Organic Gardening Club Lansing, Mich.	11	67.7	Perry Garden Club Perry, Mich.	23	34.1
Manlius Community Manlius, Illinois	52	35.1	Young Men's Christian Association Lansing, Mich.	15	40.5	Horticultural Therapy Mich. State College	33	63.3
Totals	109	202.8		87	202.7		119	203.4
Average %		50.7			50.7			50.8

TABLE V

RESULTS OF APPEAL QUESTIONNAIRE

Group	No. of People	Most Interesting	Order Of Preference	Most Instructive	Average Age	Sex M	Sex F
Florists' Tele. Delivery	26	Discussion	1 Discussion 2 Drama 3 Lecture	Discussion	36.3	0	26
Horticultural Therapy	34	Discussion	1 Discussion 2 Lecture 3 Drama	Discussion	44.6	8	26
Horticulture Seminar	58	Drama	1 Drama 2 Discussion 3 Lecture	Lecture	32.8	53	5
Effective Living	21	Lecture-Drama	1 Lecture 2 Drama 3 Discussion	Lecture	25.0	18	3
Totals	139					79	60

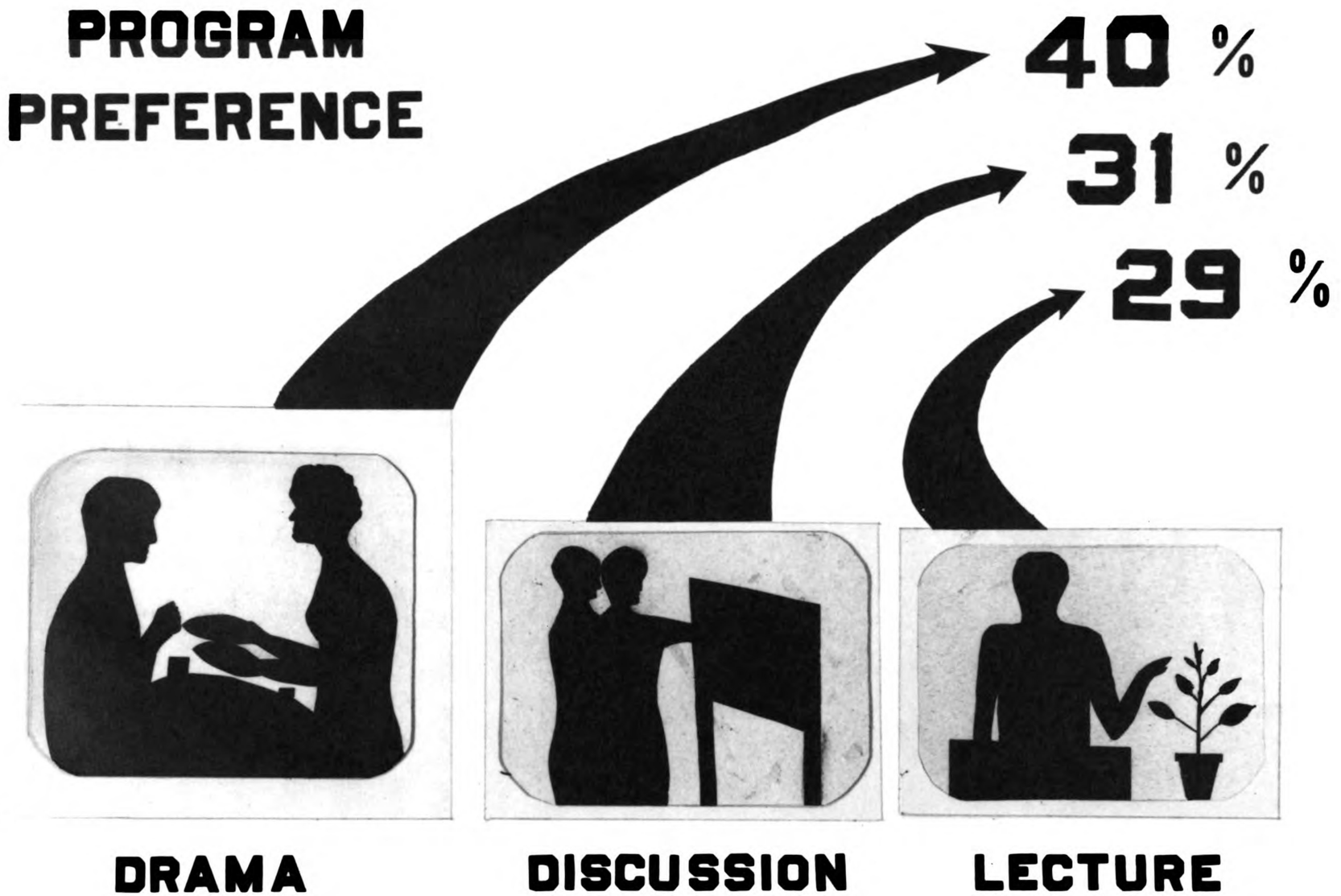

Fig. VI. Program Preference: In a program preference comparison the drama ranked 40%, the discussion 31%, and the lecture 29% as indicated from results of "appeal" questionnaire. See TABLE II.

drama 40, discussion 31, lecture 29. From the "appeal questionnaire" it was indicated that the lecture and discussion presentations were nearly of equal value for instructiveness, whereas the drama was rated 17 and 19 points respectively below the former two presentations (TABLE VI). This was merely an opinion question and was not given the validity of the "factual questionnaire" which showed little difference in the value of the methods for presenting facts. The three types of presentation therefore, are considered of equal value for conveying horticultural information. The dramatic type of presentation having more audience appeal holds the audience interest longer because of this appeal value.

Suggestions for Program Production: From the experience gained in planning and producing the six presentations for this testing program it was evident that a few basic considerations at the beginning would save much time in planning and producing a television program. The topic should be selected for timeliness, interest, and the needs of the audience. It is advisable to make a complete outline to be sure of including all essential information. Complete analysis of the program on the basis of: what is to be accomplished; how can the material best be illustrated; what talent is available; and what materials are available to make the program clear, is imperative. In choosing a method of presentation it is important to consider: retention of audience interest; availability of time for preparation; ability of the talent; and possibility of audience participation.

TABLE VI

COMPILATION OF INFORMATION FROM QUESTIONNAIRES SHOWING THE ORDER OF PREFERENCE FOR THE THREE PRESENTATIONS AND THE PROGRAM DESIGNATED MOST INSTRUCTIVE

Group	Order of Preference			Most Instructive		
	Lecture	Discussion	Drama	Lecture	Discussion	Drama
Florists' Telegraph Delivery Service	29	58	51	5	11	6
Horticultural Therapy	52	61	52	12	15	2
Horticulture Seminar	103	110	141	20	16	19
Effective Living 151	40	34	40	10	7	3
Totals	204	213	284	47	49	30

To make the audience your first consideration is a good technique. Special terms should be defined and terminology, not understood by the audience, should be avoided. For the lecture presentation, the talent must be familiarized with the complete outline. For a discussion, the talent may work from an outline of the topic and the visual aids used in the production. The scripts for a dramatic type of presentation need to be completed three weeks prior to the program to allow time for memorization of the scripts. Diagrams and other props should be prepared well in advance so that the talent can become familiar with them.

It is important that the show be rehearsed before it is produced in the studio to give the talent opportunity to become more familiar with the topic which will result in a more relaxed performance. The talent should have no other responsibility in the studio except the program itself. It has been found that it is important for the director to meet with the talent well in advance of the program in order to work out problems, thus alleviating confusion and tension during the pre-program rehearsals in the studio. It is difficult for the talent if they are not oriented in the studio and control room. They need to understand the procedure and the duties of the personnel with whom they are working.

Experience with the present programs has indicated that if consideration is given to the methods mentioned above much time can be saved in preparation of the program and the result will produce a more effective television performance.

Production Problems: From the experience of producing the programs for this investigation the solution of the problems is important for future programming of Horticultural television. The advent of television has brought to the public an audio-visual medium providing a "classroom" approach for education in the home. Many of the topics which would not lend themselves to a purely audible medium may now be demonstrated with much greater clarity. Television provides the means by which the audience can participate by being taken to the scene of action. It is intimate. The audience interest must be stimulated or the audience is lost.

The selection of the topic may control the success of a program. Choosing a topic of seasonal interest will aid in holding an audience. There is a danger however in scheduling a seasonal program because materials may not be available for the program. For example, in producing the program "Forcing Buds for Winter Bloom", the branches for forcing were collected six weeks prior to the program. It was difficult to regulate the blooming date of the branches to coincide with the program date. Several groups of branches were collected in order that the flowering wood might be available for the program. The time spent for the preparation of the program therefore, could have been utilized more effectively by building a program of equal interest. Some topics are not as easily adapted to television because the subject matter requires scientific terms which are difficult to avoid and yet not commonly known to the television audience. In adapting the script for "The Little Green Factory" to suitable terminology, it was necessary to carefully define the names of the functions and to substitute expressions in many places. For example,

"pin holes" in the leaf was used for stomatal apertures and "intricate plumbing system" for the vascular system.

The talent available from the educational personnel originated in the department preparing the program. Television experience was often limited. The control of the factual material was essential and could be handled most effectively by talent familiar with this subject matter. Although this is important, the personality of the talent must be pleasant so the viewer will listen and not be distracted. Timing a television program is imperative because of the rigidity of schedule maintained by a studio. Limiting the facts to the essentials and timing each rehearsal to the specified program length is essential.

Since television is visual, in contrast to radio, it is important that props, diagrams, photographs, and transparencies be vivid. Props should be large enough for comfortable handling, yet not so large that they are unwieldy. For instance the branches used in "Forcing Buds for Winter Bloom" were cut for home arrangement but in the studio they were unmanageable and interfered with the movement of the talent. Illustrations should not be cluttered on the set. They tend to confuse the audience and make it difficult for the movement of the performers. Faking props is helpful and frequently practised in television. This is a new approach for any scientific person. In the production of "The Little Green Factory" two flowers were used to give the contrast that was desired for illustrating respiration. One dark flower was red; the other was white. In reality they merely represented a different intensity of the same flower color. To demonstrate an etiolated plant the leaves were covered

with talc. In handling the props during a program it was found necessary to hold them close to the body and not tilted toward the camera to give a background for the picture and prevent excess light from falling on the prop. The design of diagrams should be in a three by four proportion (3 units vertical and 4 units horizontal) to assume the dimension of the television picture. In displaying a prop before the camera it may be oriented by the use of a monitor, which should be placed so that the talent can see it easily and also see the camera.

Theatrical cosmetics are not required by all people but when they improve the appearance of the talent, they should be used to give them this advantage. In producing the dramatic presentation complete memorization was necessary for control of the factual content and for planning the program in the studio. This presented a particular problem for the talent since the field of dramatics was not the classroom approach that was natural to them. This dramatic method of presentation was most time consuming, requiring many hours of rehearsal and timing the action.

The dress of the talent should be simple, lacking frills and embellishments. Clothing with a sheen, as well as jewelery, should not be used. White has a tendency to "flare" on the television screen.

To develop a successful television program, close harmony is necessary to maintain cooperation. It is very easy for tension to develop because of the many demands of the medium. To offset this problem a spirit of good will and an acceptance of criticism are necessary on the part of the talent and studio staff.

SUMMARY

Three methods of presenting Horticultural topics through the medium of television were tested. A testing program was designed to find out the method with the most audience appeal and the method that was most effective to convey facts to an audience. "Forcing Buds into Winter Bloom", a demonstration of how dormant buds of woody trees and shrubs are brought into leaf and flower, and "The Little Green Factory", a demonstration of five functions of plant growth, were selected as experimental topics. Each of these was presented as a lecture, a discussion, and a dramatization making sure that the factual content was uniform in each presentation. "The Little Green Factory" was produced using college talent and was recorded on a kinescope. For the testing program 16 representative audiences were polled. The summary of results from a factual and an appeal questionnaire submitted to a total of 454 people indicated that the three types of presentation are of equal value for conveying Horticultural information. It was shown that the dramatic type of presentation has more audience appeal and holds the audience interest longer. This paper includes suggestions for production as well as solution to production problems encountered in the development of Horticultural programs for television. The text includes the complete scripts for the three methods of presenting "The Little Green Factory" and it is supplemented by three kinescopic recordings.

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