of a small tree for extremely dry areas is the one leaf ash *Fraxineus anomala.*

Fallugia paradoxa or Apache Plum has been reported doing quite well at Manitoba and is quite ornamental. Many of the Mountain Mahogany species, *Cercocarpus,* are of excellent ornamental qualities. *Pursha tridentala* is of extreme interest to us an ornamental and as a possible ground cover plant for highway slopes. Clones were observed with a diameter of 20 feet. The plant is found native from Wyoming down through Utah and Arizona. Clones of *Cornus stotonifera* were collected north of Zion National Park with a very low habit of growth and a diameter of 20 feet across the clump. The height was about 3 feet. *Peraphyllum* or squaw apple is another plant with excellent aesthetic qualities. It has a spreading growth habit and reaches a height of five to six feet.

MODERATOR BORK: Thank you very much, Dr. Pellett. Continuing right along with the program, the next paper will be given by Mr. Wolfgang Matzke, from the Burwell Nurseries, Columbus, Ohio.

THE RUTHNER TOWER GREENHOUSE

WOLFGANG MATZKE
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Within the short 15 minutes allowed for my paper, I can only present a brief outline of a very interesting new concept of plant growing. This concept was not originated by a nurseryman, but by an industrial engineer who derived the idea of continuous plant production from his experience with the operation of machines and control instruments in the steel and metal industry.

All industrial production of any importance uses automatically controlled conveyor systems. The raw materials are continously fed in on one side and the finished product emerges by the time all the programed stages have been completed. Furthermore in industrial production every phase must be clearly comprehensive and the progress within a given time must be planned and controlled.

Mr. Ruthner, the Austrian engineer and inventor of the Tower Greenhouse (TGH), developed the idea of setting the plants on a space-filling conveyor system and pass through a number of chambers each providing for a different — but constant — set of environmental factors, according to the growth stage of the plants. In such a way, he envisions the possibility of a *continuous crop production* which will eventually lead to a completely controlled environment and make the grower independent of his geographical location and the change of seasons.

Such an industrial plant for crop production could then turn out, let us say 10,000 heads of lettuce every day once the whole

set up would have gone into operation by setting a specified number of seeds or young plants on the conveyor every day. A big industrial concern in Western Germany is now pushing this project and several European food chains have been very interested in the establishment of such a continuously operating plant production.

So far, only the first units of such industrial installations have been constructed. These units are todays Tower Greenhouses, six of which have already been erected in Austria and Germany and several more will be installed within the next couple of months.

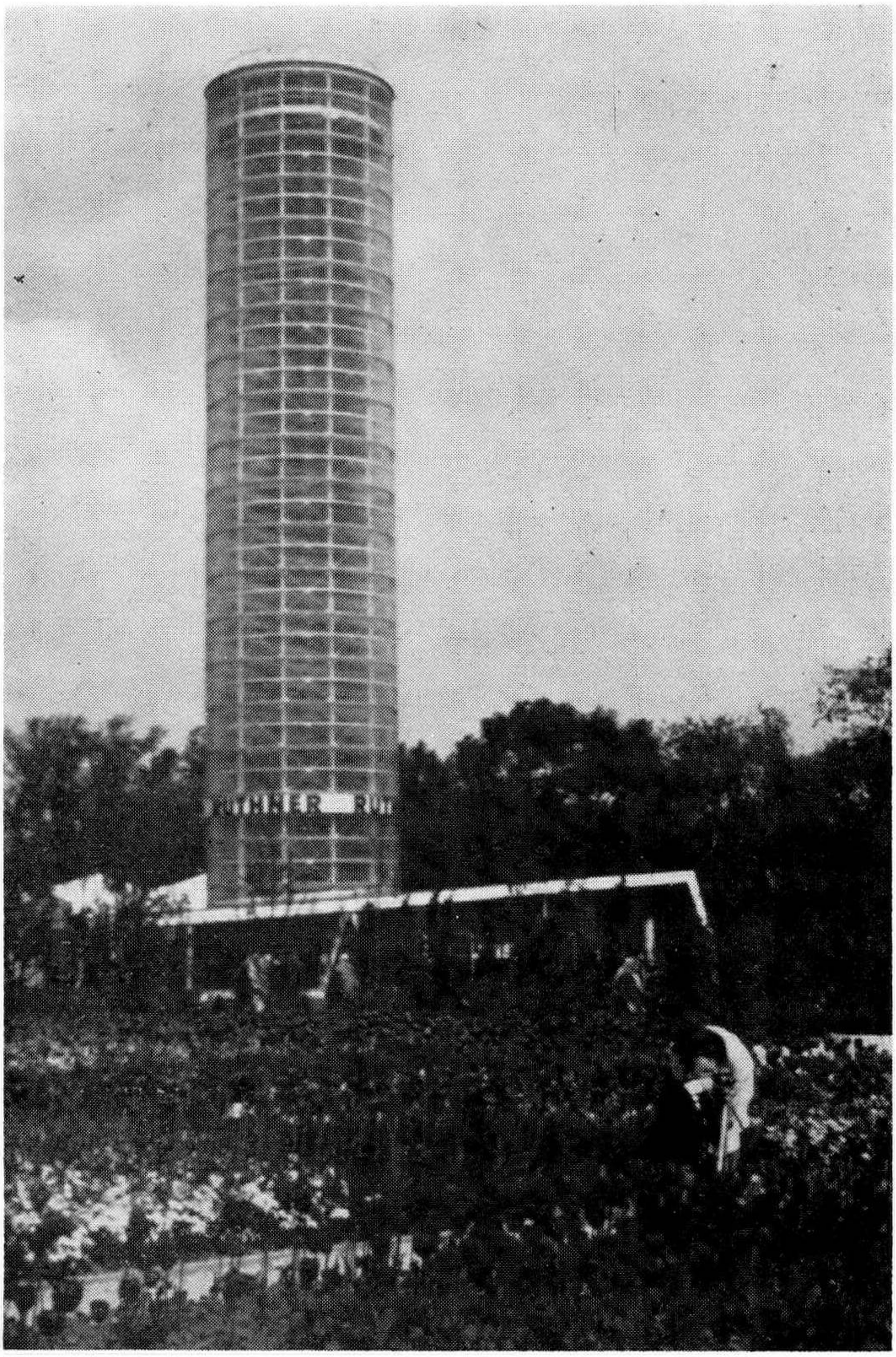

Figure 1. Ruther Tower Greenhouse, Vienna, Austria.

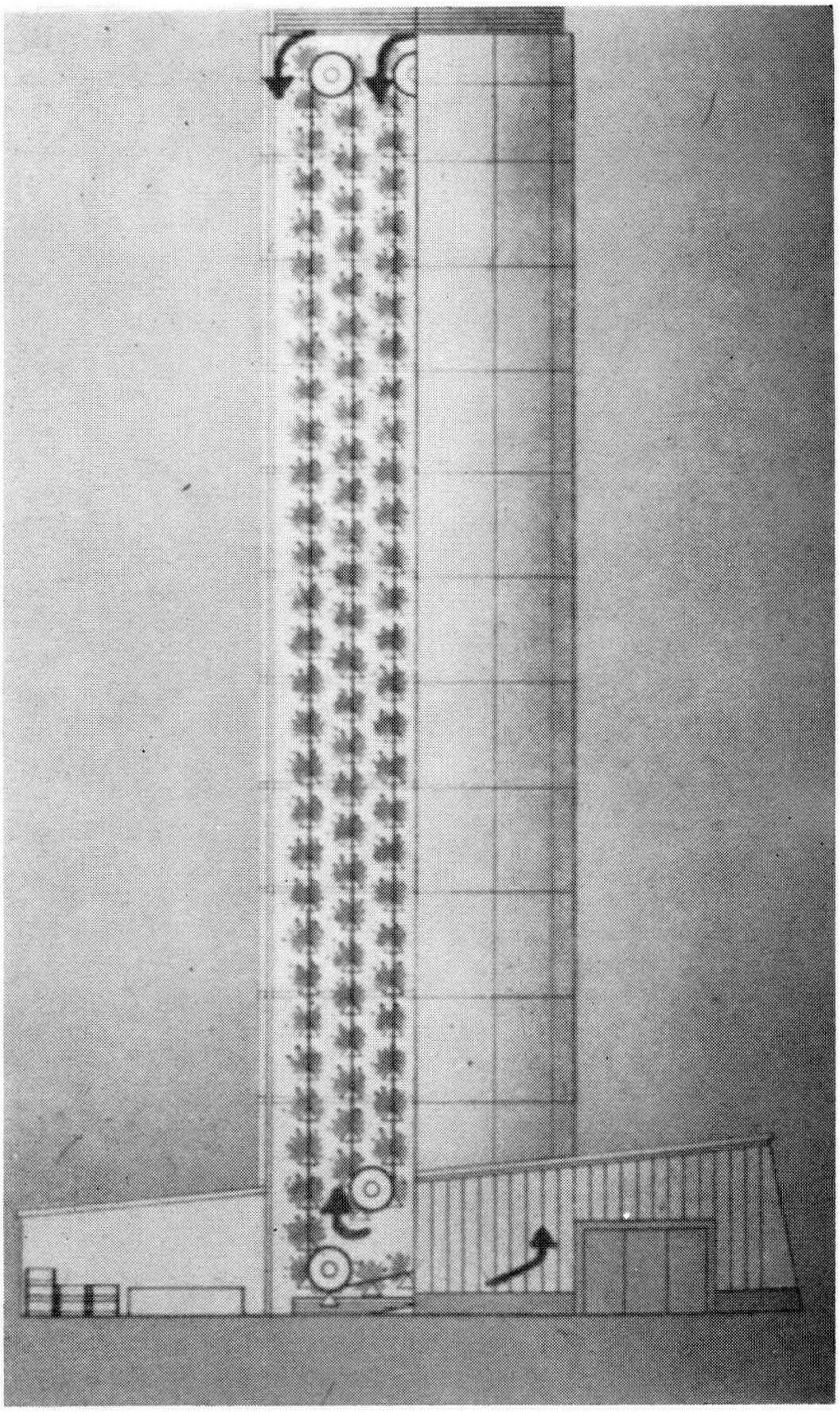

Figure 2. Diagram of a Ruther Tower Greenhouse.

I shall now explain some of the technical details by means of a few color slides and a short 8 mm movie:

Slide #1. This TGH was one of the main attractions at the 1964 International Horticultural Exhibition in Vienna, Austria. It is a 130 ft. high galvanized steel construction covered with corrugated polyester (plastic) material. Though it covers an area of only 250 sq. ft. it provides for an actual cultivating area

equal to 15,000 sq. ft. of bench space (or the equivalent of a greenhouse of approximately 50 ft. x 400 ft.).

Slide #2. The individual plants in either posts or flats are placed on shelves that are attached — one above another — to a conveyor belt system. By means of a small electric motor the plants are kept in a slow continuous vertical up and down motion as indicated by the arrows. This motion provides for three important things: (1) a very high space utilization, (2) a favorable environment for plant growth, since no single plant will remain under unfavorable light or temperature conditions for any length of time, and (3) on ideal set-up for a full automation of crop management as illustrated. *e.p.* by the water tank at the bottom of the TGH. The pots can be immersed and thus watered or fertilized by simply lowering or raising the water table.

Slide #3. The first TGH — shown in the foreground of this slde — was put into operation in May 1963. It is a 33 ft. high vertical greenhouse, covering an area of about 700 sq. ft. (*e.p.* comparable to a 20 by 40 ft. greenhouse). One can recognize the plants in their flats on the plant carrier (shelves). By opening the *vents* on top of the TGH a very efficient ventilation is achieved, because of the chimney effect due to the height of the tower.

Slide #4. With a misting line installed in a TGH, one mist nozzle can take care of many more plants than over a flat surface, because the flats pass by under the nozzle at regular intervals.

Slide #5. The results obtained in the first TGH were so encouraging that a second larger one was erected six months

Figure 3. Automatic watering in Ruther Tower Greenhouse.

later at the same location of a small vocational horticultural school in Langenlois, near Vienna, Austria. TGH II has a height of 60 ft. and is covered with corrugated polyester material. It covers approximately 160 sq. ft. and provides for a growing area of up to 3,500 sq. ft. (equals a 40 by 100 ft. regular greenhouse). Let's have a look inside:

Slide #6: Here is a crop of geraniums in plastic pots sitting in special racks on the plant carriers. As the plants move downwards to he bottom of the TGH they can be automatically watered by simply immersing the pots momentarily in a water tank.

Slide #7. Shows pots above water tank in more detail.

Movie:

Section 1. Shows the first TGH, erected 1963 in Langenlois, Austria, further a variety of vegetable and ornamental crops rotating in TGH II.

Section 2. Propagation of a batch of 50,000 carnation cuttings and of woody ornamentals in the TGH of a commercial nursery in Vienna, Austria.

Section 3. Ruthner — TGH at the International Horticulture Exposition in Vienna, Austria.

Summary

The idea of setting plants on a conveyor belt system and rotating them through space opens a completely new outlook towards plant production. Eventually, such a set-up may be operated above ground or underground under a completely controlled set of environmental factors. It offers possibilities for a mass production of food crops to supply both our modern super markets and the starving nations in underdeveloped areas of this world. Undoubtedly, the invention of the TGH will show the way to new discoveries in plant growing.

So far, the TGH has proven its suitability mainly for plant propagation, for growing bedding and groundcover plants and for the production of certain vegetable crops. Though the vertical greenhouse, at the present time, is not yet a foolproof device for plant growing it can definitely help the experienced grower to perform his work more efficiently and it has been stimulating to the imagination of many florists, nurserymen, and garden store operators.

MODERATOR BORK: Next we will have Dr. Harold Tukey, Jr. and Mr. G. L. Good talk to us about leaching of cuttings under mist. Dr. Tukey will talk first.