When the transplants have reached the desired stage of growth, they are moved from the greenhouses to beds outside, where they are grown to the finished stage for marketing. We have covered most of the beds in the nursery with coarse gravel, upon which we set the flats of transplants. This seems to be adequate in most cases in preventing the transmission of disease from the soil, and allows good drainage through the flats. Naturally, after the plants have been moved from the greenhouse, the opportunities of becoming infected are greater. However, by this time, the plants have reached a stage of growth in which they are better able to ward off the effects of disease organisms. Should disease be prevalent, we have found that the application of Panogen as a soil drench is quite effective.

Now I do not want to give the impression that everything we do is absolutely aseptic. This simply is not practical in any volume production. However, just plain good housekeeping practices should be followed. You wouldn't eat from a dirty table with dirty utensils. The same degree of cleanliness your wife uses in the conduct of your household will usually be adequate for the conduct of your bedding plant nursery, in so far as the cleanliness of the plants you produce are concerned.

MODERATOR MAIRE: Thank you, Carl. Next we will hear from Henry and Fumio Satow, who will describe their methods of producing carnation plants by these clean culture practices.

CLEAN CULTURE OF CARNATIONS

HENRY AND FUMIO SATOW
Satow's Floral
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The events that led us up to the system of clean cultural practices are as follows:

(a) In 1955, cuttings were taken in the usual manner from *flowering areas* where no sanitary procedures were practiced. These cuttings were misted in steam sterilized sand; rooted cuttings were planted in steam-sterilized *ground beds.* Analysis at the end of 18 months of the blooming period showed that out of an original 125,000 plants planted, only 50% of the plants survived. The other 50% was lost to Fusarium stem rot, Fusarium wilt, and bacterial wilt of carnation. *Reason* for loss of plants:uncultured cuttings were planted into steam sterilized soil. A mass inoculation of harmful carnation pathogens into a soil which has lost its bacterial balance due to sterilization. *Solution*: Use of cuttings entirely from cultured mother-block plants. This resulted in the construction of a double-range, fan-padded glass house, with completely asphalted floor and raised benches housing 6,000 cultured mother-block plants.

(b) In 1957, rooted cuttings from cultured mother-block plants were planted in sterilized ground beds. (Same area as in 1955.) Analysis at the end of 18 months blooming cycle again showed that

30 to 50% of the original plants were lost to the same pathogens.

Reason: Recontamination of sterilized areas in the soil from contaminated areas that steam could not reach.

Solution: Use of raised beds in place of ground beds, where steam can completely sterilize all the soil in the bed. This resulted in construction of 8 miles of raised beds.

(c) In 1959 with the use of cultured cuttings from mother-block plants, planted in raised steam-sterilized beds, analysis at the end of 18 months blooming cycle showed that a very minute percent was lost to pathogens.

Today, the following procedure is followed to maintain clean cultural practice in raising carnations:

(1) All original cuttings procured from outside sources are cultured, even if they are from a cultured mother-block source. Mother-block plants are re-cultured. Culturing procedure described by James Tammen, R. R. Baker, and W. D. Holley, "Control of Carnation Disease Through the Cultured-Cutting Technique," 1956 Plant Disease Reporter Supplement #238: 72-76, is followed to obtain cultured cuttings for our mother-block plants.

(2) Mother-block plants are planted in August and discarded in July of the following year. Cuttings for our entire field plantings are taken from these mother-plants. Therefore, mother-block plants are handled separately and with the greatest precaution, not overlooking any detail which will re-contaminate the mother plants.

A very strict enforcement of the U. C. System of growing as described in University of California Manual 23 is used.

Once the plants are planted in the raised beds a good common sense sanitation is practiced to maintain the growing carnation plants for two years.

Never get over-confident and become sloppy once you have good clean culture practice. The minute you do, disease will spring up here and there to let you know. We know, because this has happened to us, more than once.

MODERATOR MAIRE: Thank you. Our final presentation in this section will be by Mr. Henry Ishida, who will discuss clean culture of foliage plants. Mr. Ishida.

PRODUCTION OF CLEAN CULTURED FOLIAGE PLANTS

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Perhaps the advantage of using clean culture, or better yet the U. C. System, in the production of foliage plants can be better shown by a relative newcomer in the foliage business such as myself, since I feel that we breezed into it without too many headaches or difficulties. I say the U. C. system, since it not only includes clean culture, that is, clean plant material and sterilization, but it also includes soil mixes, nutrition, mechanization and efficient practices.