and with the plants starting active growth, bleeding can be a problem.

VICE-PRESIDENT BRIGGS: For the second half of this afternoon session, Dr. Dale Kester of the University of California at Davis, will be our moderator. Dale:

MODERATOR KESTER: This afternoon we have some very interesting topics. The first talk will be given by a speaker that you heard this morning — Wes Hackett. His topic now is on bulblet formation under aseptic conditions. Wes:

ASEPTIC MULTIPLICATION OF LILY BULBLETS FROM BULB SCALES

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It has been known for many years that individual lily bulb scales when separated from the mother bulb will form adventitious bulblets at their base when placed in favorable environmental conditions. Three to five bulblets will usually develop from each scale depending on the species and cultivar. This propagation technique is called "scaling" and is useful for rapid build up of stocks of a new cultivar or to establish pathogen-free planting stocks.

The objectives of the experiments reported in this paper were to find methods of producing bulblets under aseptic conditions and to increase the efficiency of bulblet production from scales. Accomplishment of these objectives would increase the commercial feasibility of multiplying and maintaining pathogen-free stocks and also increase the rate at which planting stocks of new cultivars could be built up.

In performing these experiments, bulb scales of *Lilium longiflorum* 'Croft' about 1.5 cm wide and 3.0 cm long were used. 'Croft' is a cultivar used as a flowering potted plan tfor Easter. Early experiments showed that scales can be sterilized by washing them for 10 minutes in a 1:10 dilution of commercial bleach (Clorox or Purex) followed by thorough rinsing in sterile (autoclaved) water. After sterilization the scales were asceptically cut into a proximal and da distal section each 1.0 cm^2, as shown in Figure 1, and kept separate for experimental purposes. These scale sections were implanted aseptically in glass vials (See Fig. 2) on a culture medium consisting of inorganic salts, vitamins, sucrose and agar (3). The vials with implanted scale sections were placed at 70°F under fluorescent lights with an intensity of 400 ft. c. (Bulblet formation will occur just as well at 100 ft. c. light intensity and in the dark).

In one experiment, the plant growth regulators, indoleacetic acid (IAA) and kinetin were incorporated into the me-

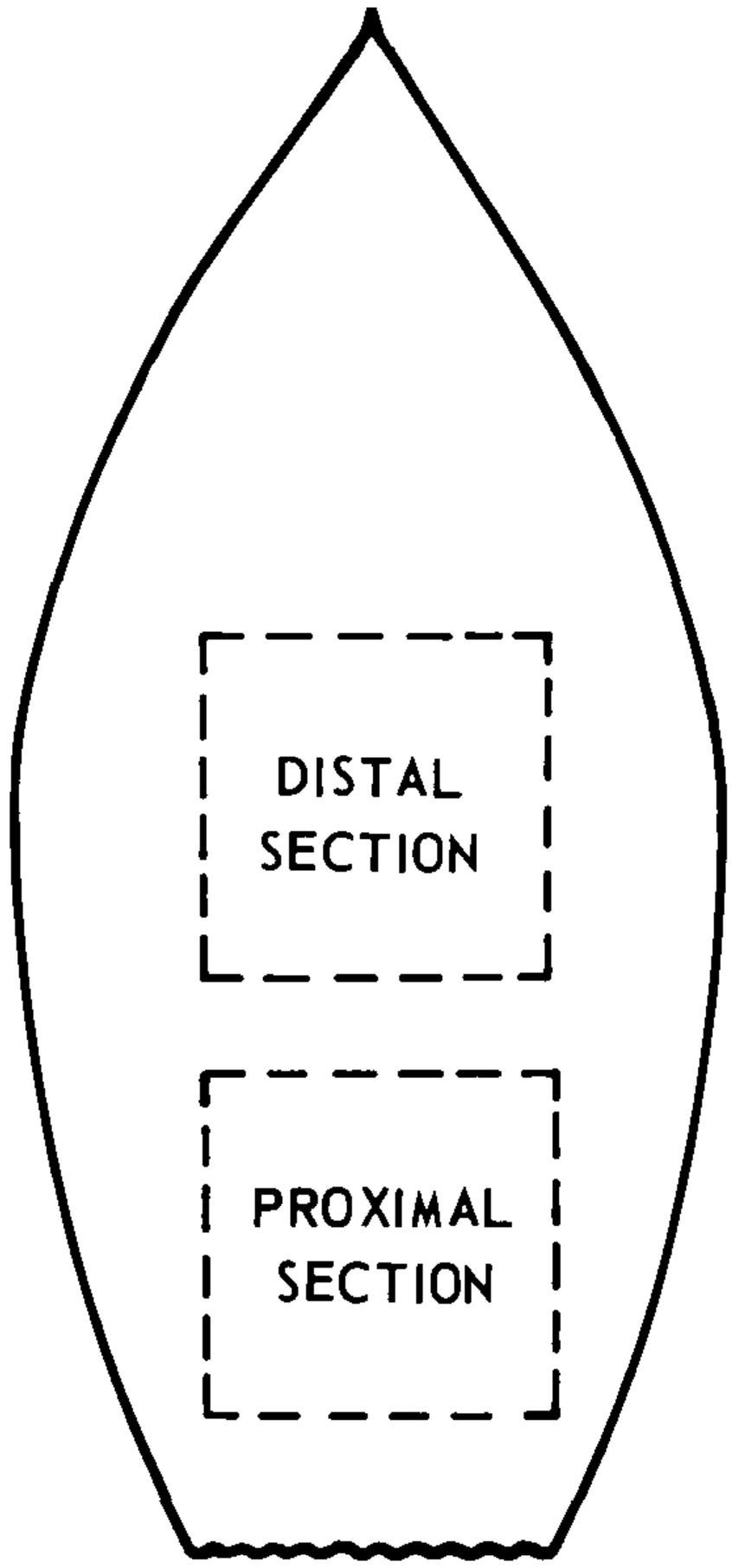

Fig. 1. Diagram of lily bulb scale showing the proximal and distal sections used in the experiments.

dium at various concentrations to test their influence on bulblet formation. The scales were implanted with their abaxial side (convex surface) in contact with the medium because bulblets naturally form at the base of the adaxial side (concave surface) of intact scales (2). This experiment showed that the proximal sections form more bulblets than do the distal sections. With regard to plant growth regulators, IAA has a much greater influence on bulblet formation than does kinetin. When no kinetin is added, IAA at 10 mg/1 gives a 100% increase in bulblet formation and the response has not reached its maximum with this concentration. When no IAA is added, there is little or no response to kinetin. However, there is an interaction between IAA and kinetin and maximum bulblet formation occurred when IAA was incorporated into the medium at 10 mg/1, along with kinetin at 0.1 mg/1. Figure 2 illustrates bulblet formation on proximal and distal sections. Notice that there are not only more bulblets on the proximal sections but the bulblets formed are larger.

Orientation of the scale section on the medium is very important. When distal sections are placed with their abaxial surface on the medium, an average of 4.1 bulblets form on the adaxial surface. In contrast, when similar sections are placed with their adaxial surface on the medium, only an average of 0.4 bulblet forms on the abaxial surface and knobs form on the adaxial surface in contact with the medium. This difference in potential of the two surfaces to form bulblets is not nearly as great in proximal sections. This means that when proximal sections are bisected parallel to their two surfaces and the two pieces placed with their cut surface on the medium both pieces will form bulblets. When both proximal and distal sections are bisected parallel to their two surfaces and the pieces implanted with the cut surface on the medium, a total of 12.5 bulblets are formed per scale. This production occurs when using a suboptimal combination of IAA (1.0 mg/1) and kinetin (0.1 mg/1) and is a great increase over the 3-5 bulblets produced with whole scales. If the IAA concentration were increased to 10 mg/1 the production would be even greater.

These procedures have also been successfully used with *Lilium longiflorum* 'Ace' and several aurelian and oriental hybrids which do not form bulblets profusely on whole scales.

From the standpoint of producing pathogen-free plants these results have considerable implication. Kohl and Nelson (1) showed that pathogen-free bulbs can be obtained by use of heat treatment and meristem techniques. Using aseptic propa-

Fig. 2. Aseptic cultures of lily scale sections showing bulblet formation and growth. Proximal sections above and distal sections below.

gation of bulblets from scales, these plants could be rapidly multiplied and maintained pathogen-free.

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MODERATOR KESTER: Our next speaker is Dr. Hudson Hartmann of the University of California at Davis and Editor of the Western Region of the IPPS. He will discuss some of the factors involved in rooting hardwood cuttings. Hudson:

SOME PHYSIOLOGICAL FACTORS INVOLVED IN PROPAGATION BY HARDWOOD CUTTINGS

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Some of our most ancient cultivated plants, as the fig, olive and grape, are ones that are readily propagated by hardwood cuttings. With these plants early man was able, when he turned to agricultural pursuits, to easily establish clones of superior types merely by inserting into the ground sticks broken from desirable seedlings, thereby producing great numbers of equally desirable plants.

Propagation by hardwood cuttings is, no doubt, the simplest and least expensive method of vegetative propagation. It would be most desirable to be able to extend this type of propagation to a much greater range of plants. It would be particularly desirable to be able to utilize hardwood cuttings in place of the more laborious layering methods now widely used in propagating clonal fruit tree rootstocks and other difficult to propagate plants. Furthermore, hardwood cutting propagation procedures lend themselves readily to mechanization practices which are more and more being utilized by the nursery industry. However, as is well known, striking differences are encountered among the various species and clones in adventitious root initiation. Some plants, as the willow, poplar and citron, have preformed root initials in the shoots of the intact plants. Cuttings made from such material quickly develop roots when placed under the proper environment. Hardwood cuttings of many other plants too, as the grape, rose or privet, will rapidly form adventitious root initials after the cuttings are prepared, with new roots forming soon after planting so that the developing buds and subsequent leaves are supplied