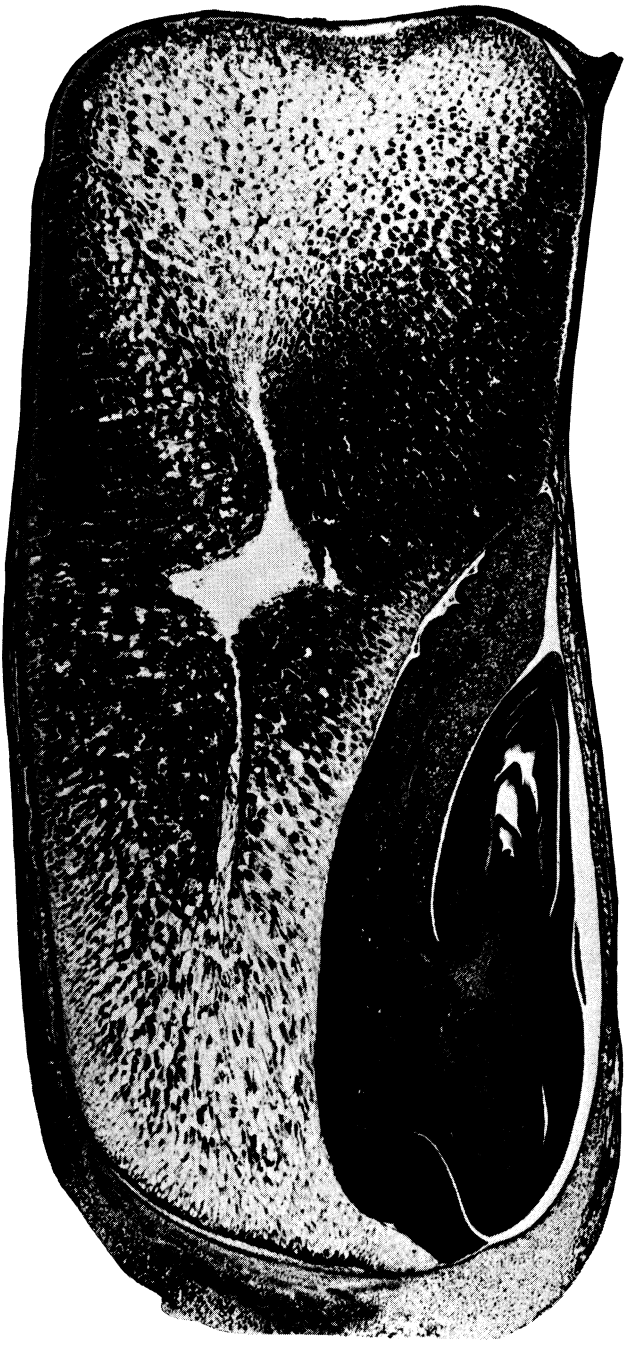
Botanical Microtechnique



Longitudinal section of kernel of yellow dent maize, 25 days after pollination. Craf III; dioxan-tertiary butyl alcohol; photographed at 8X with B & L 48 mm. Micro Tessar objective; reproduced at 16X.

Botanical Microtechnique

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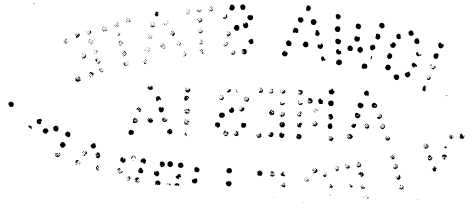

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A man who works with his hands is a laborer; a man who works with his hands and his brain is a craftsman; but a man who works with his hands and his brain and his heart is an artist.

—LOUIS NIZER, *Between You and Me* (Beechhurst)

Preface

Permanent slides for microscopic study are indispensable in the teaching of a basic course in botany and also in specialized advanced courses. In some advanced courses, the students prepare many of the slides used in the course, but in elementary courses the slides are furnished. In the latter case, the slides either are purchased from commercial sources or made in the departmental laboratory. Biological supply houses make excellent slides of the subjects commonly used in elementary teaching, but the quality is likely to be variable. Jobbing houses that purchase slides from constantly changing sources also may furnish disappointing slides at times.

The relative merits of making slides and of purchasing them must be decided on the basis of local conditions. Uncertainties in the commercial supply and the need for specialized or unlisted items necessitates the preparation of slides in the biological departments of schools. This service work often is performed by a skilled professional technician with more or less supervision by the departmental staff. In other departments a member of the teaching staff, usually a morphologist, assumes this responsibility, with the aid of student assistants.

Some research organizations maintain a technician for the preparation of research slides. There are many types of investigation in which it is possible for the technician to prepare and place the finished slides before the investigator, who then carries out the study and interpretation of the material. However, in many investigations, some or all steps in the preparation require an intimate knowledge of the history, structure, and orientation of the material and the aims of the study. The use of a technician who allegedly merely "turns the crank" is then less valid, and the so-called technician may in fact be a research collaborator. The investigator in any field of plant science is urged to utilize microtechnique as a tool, but to do so critically and intelligently and in proper fairness to the workers who contribute their skill, patience, and understanding to the furtherance of the research. It cannot be too strongly emphasized that in order to

have a proper appreciation of the possibilities and limitations of present-day techniques, and to utilize the services of commercial or institutional technicians to best advantage, every teacher and investigator in the biological sciences should be familiar with at least the elements of microtechnique. We can do no better than to quote the late Dr. Charles J. Chamberlain, the dean of American microscopists: "The student who has not had sufficient experience to make a first-class preparation for microscopic study cannot safely interpret slides made by others. He is in the same class with the one who claims he sees it but can't draw it; while the real trouble is not in his hand, but in his head."

The term *histology* is very commonly misused to imply histological methods or technique. Histology means the study of the structure and development of tissues, and does not refer to the preparation of slides. A good textbook of histology need not contain a word about sectioning and staining of tissues. A person who takes an afternoon off and learns to whittle some fair freehand sections is neither a histologist nor a technician.

Botanical microtechnique may be defined in terms of its functions, which fall into the following overlapping categories:

1. the preparation of plant tissues for microscopic study.
2. the skillful use of the microscope and related equipment for the critical study and interpretation of the material.
3. the recording and illustrating of the results by means of the graphic arts.

In some schools microtechnique is taught as part of the work in some branch of morphology, such as anatomy or cytology. That system has marked advantages. The student who has collected and processed his own plant materials, and made his slides, can visualize the orientation of the sections in the plant and interpret the relationship of parts to the whole plant. A disadvantage of the system is that specialized courses in morphology are likely to utilize a limited number of methods – for instance, the smear method in cytogenetics. The student may acquire remarkable skill in making preparations of one type and have no experience with other useful methods. He may develop great skill in making smear preparations of pollen mother cells, but one cannot smear a kernel of corn or a pine stem. He may even acquire disdain for methods which versatile and experienced workers regard as indispendsable.

The maintenance of a separate course in microtechnique makes possible the presentation of the fundamentals of useful standard

methods, which experience has shown to be the backbone of research and which have long served the routine needs in teaching. A course should be organized to give a systematic, graded series of exercises, each exercise pointing to some definite objective and yielding superior preparations of a given type. Student interest can be maintained by working with plants that are of interest to the student or the institution, and with plants that are characteristic of the region. It is not desirable to permit the student to interject his research problem into the course. The integrity of the teaching functions of the course could be compromised by using it as a device to do the research of the student, the teacher, or a colleague.

This manual has evolved over a period of years in connection with the teaching of a college course in botanical microtechnique. The author is not a technician, he is a teacher and researcher in plant science. It is not his function to train technicians, but to contribute to the training of future teachers and researchers in plant science.

Since this is primarily a training manual rather than a reference work, use is made of a graded series of assignments, beginning with subjects in which orientation is easily visualized, few sectioning difficulties are encountered, and a simple stain is used. Subsequent assignments require greater skill in the processing, sectioning, and differential staining of cell and tissue components. A few carefully selected processing and staining methods are presented in detail. Emphasis is placed on gaining an understanding of the aim of the undertaking and the function of every operation, rather than on memorizing and mechanically following a written outline or numbered jars. After mastering the fundamentals, the worker can readily delve into the literature of specialized fields by consulting the brief bibliography. The advanced worker will use the excellent texts by Johansen (1950) and Gray (1954), and in particular the comprehensive bibliography in the latter.

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