

GENERAL DISCUSSION

MR. ROY M. ALLEN.¹—A common theme can be recognized in most of these papers. Mr. Mason identified this theme very completely except for one point that he probably would have made, had he had time. Mr. Zieler mentioned it most emphatically, but from a slightly different standpoint. In all of these discussions the question of how to use the basic fundamental knowledge of the microscope and the optics of it, as the first requisite for doing good microscopical work arises.

The average microscopist has an idea that a microscope is merely an instrument and that to provide a light suitable to shoot through it with the necessary lenses to achieve the proper magnification is all that is necessary.

The question of proper aperture, the question of critical illumination, the question of how to change from a considerable depth of focus to optical sectioning, all of those things seem to be missing in the life of the average microscopist. At least that has been my reaction to the great majority of so-called microscopists I have known in my consulting work for the past 35 years.

The time will come when some of our colleges and universities will give a course on the microscope and train students how to use it, as they should be trained.

Because, as these papers have suggested today there are so many specialists in the microscopical science—the biologist uses one type of microscope, the petrologist another, the mineralogist a third, etc.—it is a real necessity to train students to use any kind of microscope for any kind of job. Only then would there

be fully qualified operators. Mr. Mason has indicated how this can be done.

MRS. MARY S. JAFFE.²—Mr. Allen's remarks should be extended with a plea not to allow too great a cleavage to grow between light and electron microscopy. In too many places the departments are totally separated. Whenever possible, it is advisable to have the more experienced operators equally well trained in both techniques, so that they can use the instrument which happens to give an answer in the most unequivocal terms.

MR. C. W. MASON.³—The supply of microscopists is a continual problem. They are always scarce, partly because, even in the small number of schools where the subject is taught, relatively few students take the necessary courses, and only a fraction of them will look forward to careers as microscopists. Microscopy is acquired in the five-year curriculum in Chemical and Metallurgical Engineering at Cornell. Most of the students are pointing toward jobs where microscopy will not be of major importance; it will be a valuable tool for their technical work and the knowledge gained from the course will be a permanent part of their background, but this does not help the supply of microscopists.

Undergraduates do not have much time for extras such as microscopy. A good "solid" course means more work than the popular electives, and more than one course in microscopy is needed. The development of specialists with more than a beginner's training cannot be accomplished by making courses easy or

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required. Some selling of the field by advisers is valuable as the initial contact, but most of us went on in microscopy because we were drawn to it by its variety and its challenge to an insatiable curiosity.

The final answer is not just in academic training; we have all gone far beyond our courses. Self-education is essential, even to keep up with the advances. There are good microscopists who have had no formal instruction in the field; they have read, experimented, asked questions, and have developed proficiency and experience from very small beginnings. The solution of the problem will take time and support from the management groups in industrial companies. With such aid, the dividends begin to come early, since the microscopist in real contact with technical problems becomes an important contributor to their solution—not just a manipulator of apparatus.

MRS. KATHERINE MATHER.⁴—Mr. Mason's remarks could be supplemented by the observation that a geologist who has received training in petrography and optical mineralogy is not an adequately trained microscopist unless he has gone to the literature and, on his own initiative, greatly supplemented his formal training. While geological training that includes petrography and optical mineralogy is very valuable to a potential microscopist, it is usually very inadequate in its coverage of the optics concerned with microscopes.

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MR. BRYANT MATHER.⁵—It may be relevant to the plea for training in microscopy, made by Mr. McCrone in his paper, to point out that we have found people who can be developed into concrete research microscopists not among those who have been trained as chemists but rather among those trained in petrography by departments of geology. Most individuals who have done graduate work in geology and many who have done only undergraduate work in colleges and universities with good geology departments, located in those parts of the United States underlain by crystalline rocks, will be found to have training in the use of the polarizing microscope. Perhaps other engineering and chemical research organizations might, because of the present state of affairs, look more to the supply of geologically trained personnel to find potential microscopists than they may have in the past.

MR. T. G. ROCHOW.⁶—This discussor agrees with Mr. Mather. In our group of a dozen microscopists at Stanford, two are geologists. These geologists have made valuable contributions to the solutions of some of the problems which arise in the chemical industrial research work.

Societies in which microscopists gather in general do not entertain the geologist. They do not recognize him. They do not think of him. They do not invite him. They should reconsider this attitude.

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