Meetings

Microbiologists: Training for Industry

During the past decade, many industrial or applied microbiologists have indicated varying degrees of discontent with the training of students by "mother university." Criticism has ranged from one extreme ("the B.S. graduate cannot make a simple bacterial titration") to another ("John Doe University's B.S. graduates have wonderful basic training in microbiology but it's only good for medical bacteriology"). Criticism is not limited to undergraduate training either. If he is a Ph.D. from Eastern University, the training is poor and it will take a year before he is ready to do some real research, but if he's a postdoctorate from Midwest University, he'll do an excellent job, especially in the "submolecular nucleic acid field of making modified double-stranded DNA." These are generalizations, of course, but they exemplify kinds of expressed dissatisfaction that have drawn the attention of increasing numbers of both workers and teachers.

In an attempt to clarify the apparent discontent for a single level of college training, the education of B.S. microbiologists for industry, a symposium was held at the University of Western Ontario on 22 August 1967 in conjunction with the annual meeting of the Society for Industrial Microbiology.

The symposium was chaired by Brinton M. Miller and included the following as invited participants: A. C. Blackwood (McGill University), L. E. Casida, Jr. (Pennsylvania State University), Paul May (New York City Department of Health), R. G. E. Murray (University of Western Ontario), Harriet Vera (B-D Laboratories), and R. H. Weaver (University of Kentucky). The audience contained members of academic, governmental, and industrial institutions.

There were several areas of strong agreement among panelists and audience. Chief among these was that graduating students need some sort of laboratory experience before they can be expected to perform adequately without very close, direct supervision ("standing over him constantly to make sure that he pipettes 0.5 and not 0.55 milliliter"). Unfortunately this laboratory experience or training is not usually gained in formal courses. The laboratory exercises associated with courses only serve to introduce the methodology. Blackwood asked if an on-the-job training program was not an answer to the problem of graduates lacking practical laboratory experience. He remarked that in Canada some schools of engineering, where an engineering program takes 5 years, have their students spend 25 to 30 percent of their time on-the-job with cooperating commercial companies or governmental institutions.

A. Kaplan (Quartermaster Corps, Natick, Massachusetts) described a similar cooperative program for microbiologists between several Boston area laboratories and universities. Some schools, Cornell for example, give credit for summer work programs and make such "practice" a requirement in some courses. Regular reports on the practice training must be made by the student and the cooperating employer. May mentioned that the New York City Department of Health has an in-service training program for its microbiologists. It is basic training for their needs and is relatively broad.

Unfortunately most industrial laboratories, for a variety of sound reasons, have not established a thorough in-service program which allows practical laboratory experience while on the job —the employee is on the job to do the job. Murray suggested that a return to an apprenticeship system might answer the needs of some. He said that years ago a beginning microbiologist did not have to have formal training; he did what his elders or superiors told him to do. He was an apprentice and thereafter he learned by discovery. After he became a trained worker, he could become a formal researcher. The question is whether the apprenticeship program can be adapted to modern times.

While Casida restricted most of his remarks to the content of teaching programs, he did say that one of the best ways to learn and understand general laboratory techniques was to practice them repeatedly by doing routine, hard-work laboratory exercises. Among other problems, each of his students is given two cultures to grow and study. They must make their own media (slant or plates), make their own transfers, examine the cultures and, if necessary, return them to a state of pure culture, and then return the cultures "intact" to Casida at the end of the school term. His remarks about doing the routine procedures were echoed by many and especially by Vera who suggested that most of the work in microbiology is good, sound, hard, routine laboratory experience and that the "glamour of research" stopped at the door. It is day-to-day, week-to-week experimentation that answers 99 percent of the problems.

While there was agreement on the need for some form of practical experience and a condescending reservation about textbooks, there certainly was no agreement on what classes should be offered to a student in microbiology. Murray felt there are too many different classes available. For the student, the choice or selection is based too much on the catalog descriptions and not enough on what the courses will offer his future needs. Furthermore, student scheduling is too hard to arrange into reasonable class schedules. He suggested there be just two classes, beginning and advanced, and that these be of sufficient length to include pertinent subject matter with laboratory for whatever field the student will choose.

Weaver's concern was that the lack of teaching laboratories for the first 2 years often discourages beginning students who come from high school courses taught around the biological sciences curriculum study (BSCS) core. The students then lose interest at college because the college has done little if anything to improve "beginning bacteriology." Casida attacks the problem by assigning each student five problems, the solutions or answers to which will take the length of the course and will require the use of methods the student will need when he leaves for an industrial position.

One complaint made by industrial representatives on the panel and in the audience was that too many graduates have not studied the basic taxonomic groups of microorganisms. Even their knowledge of the different types of microbial growth and morphology is

poor ("most graduates wouldn't know a pneumococcus if it hit them in the eye"). Another panel member said "a pseudomonas is a pseudomonas wherever it is seen and a graduate bacteriologist should at least have seen one and know how to detect it." Pleomorphism may be demonstrated once but usually is illustrated and a student gets the idea that of the several forms a microorganism can take, these occur simultaneously or nearly so. In many schools, the fungi are not even studied in the microbiology courses; a student must wait for a course in botany or plant pathology before he sees them.

Weaver suggested that the lack of emphasis on this basic kind of study in microbiology might be due to the failure of many colleges or universities to recognize that microbiology can or should be considered the most basic of all life sciences. By requiring it at the beginning of a student's program of studies, he could be exposed to most of the life processes usually described in courses of botany, zoology, or protistology.

San Clemente (Michigan State University) said he thought the school should expose each pupil to the basic ideas in the field and that no one curriculum would solve the problems posed. There are multiple objectives for teaching microbiology and each student must have a program tailored for him. Among other things unmentioned so far, each student must learn how and when to make decisions. Of course this means we must understand the student and his modus operandi. Do we? Can we? Now we're talking school psychology, not microbiology!

Murray suggested that training for industry or anywhere else stops at one place for one person and somewhere else for another person. Consequently, curricular programs must be customized as much as possible, taking into account the potential and limitations of each student. He reminded us that a college degree is a statement of education, not a statement of qualification. Commencement means beginning for the graduating student.

One problem which was mentioned frequently and which has gained fresh importance in this age of materialism was that of job satisfaction—satisfactory performance (the employer's concern) and enjoyment of what one is doing (the employee's concern). Too frequently, due to the faddishness of research, newer areas like DNA-RNA or

molecular biology ("breaking the genetic code") sound more appealing than the "humdrum" study of water pollution biology. Of course we have heard about this problem before and a big reason for its existence is the pressure on our teachers and their students to make new breakthroughs and to publish. These pressures are usually exerted by administrators, not for the benefit of the classroom but rather to attract the eye of the public. Vera said that a person who does a good job of teaching is of equal or even greater importance to the academic institution than the person primarily concerned with research projects. This philosophy is most important at the undergraduate level where basic principles and practices are learned more by directed observation than discovery. As long as teachers are under pressure to publish or to obtain grants, they will be forced to use the fads to maintain themselves.

All of the foregoing, the agreements and disagreements on what a student's training for industry should be in college remind this reporter of two previous SIM symposia on the subject. The first was held at State College, Pennsylvania, in 1959 and the second was held in Boulder, Colorado, in 1964. Certainly there has been progress since those two earlier meetings. Agreement on the need for laboratory experience by the student was not expressed before, at least not in the context of the way to carry out routine laboratory exercises. Second, the awareness by industrial people of the pressures and demand on teachers is much greater and better understood than it was a few years ago.

Our panelist from the Canadian universities described a very interesting trial in professional education now beginning in Ontario. Approximately a dozen 2-year technical colleges have been established in those urban centers close to where job opportunities are greatest. The students in these schools will be given specialized training in the work areas which predominate locally; thus, fermentation sciences near distilleries, water sciences near the Great Lakes or working rivers.

One hopes that the academicians will place greater emphasis on leading their students into the correct fields for their qualifications and that university leaders will recognize that they have a responsibility to train students adequately and correctly for the fields they select. Perhaps we in industry should consider the suggestion of Robert Fuerst (Texas Women's University) that we draw up

a list of qualifications for those students who will go into industrial employment. These can then be offered to the academicians as a guide for their design of course offerings.

Unfortunately, there does not seem to have been much change in the feeling toward the kind of research done in industry or university. There has not been a recognition that all fields of microbiology are of equal "social-professional" status. Indeed, the glamour of certain research areas seems to have invaded the industrial laboratory too so that jobs in microbiological control or technical service do not hold the same importance as basic research. Whether this problem will ever be resolved resolved remains to be seen. In an aside, one panelist remarked that a change in attitude will take place only after the pressures to solve practical problems become greater and more costly than the pressures to examine new places and new things.

BRINTON M. MILLER
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Calendar of Events

National Meetings

June

2–7. American **Water Works** Assoc., Cleveland, Ohio. (E. F. Johnson, The Association, 2 Park Ave., New York 10016)

3–5. **Aerospace Instrumentation,** 14th natl. symp., Boston, Mass. (K. Foster, EG&G, 160 Brooklin Ave., Boston 02215)

5–9. **Marine Technology** Soc., Miami Beach, Fla. (Conference Coordinator, Div. of Continuing Education, P.O. Box 8005, Univ. of Miami, Coral Gables 33124)

7–9. Society of **Biological Psychiatry,** Washington, D.C. (G. N. Thompson, 2010 Wilshire Blvd., Los Angeles, Calif. 90057)

8–12. American **Therapeutic** Soc., Honolulu, Hawaii. (R. T. Smith, The Society, Norbeth, Pa. 19072)

9–11. American Assoc. of **Neuropathologists,** annual mtg., Atlantic City, N.J. (S. M. Aronson, State Univ. of New York, Downstate Medical Center, 450 Clarkson Ave., Brooklyn, N.Y. 11203)

10–13. American **Proctologic** Soc., Denver, Colo. (J. A. Ferguson, Secretary, 320 W. Lafayette, Detroit, Mich. 48226)

10–13. American **Vacuum** Soc., Beverly Hills, Calif. (L. W. Sink, Bldg. 290, Pratt & Whitney Aircraft, Middletown, Conn.)

10–14. Society of **Photographic Scientists and Engineers,** Boston, Mass. (The Society, 1330 Massachusetts Ave., NW, Washington, D.C. 20005)

12–14. **Disaster Planning,** Chicago, Ill. (American Hospital Assoc., 849 N. Lake Shore Dr., Chicago 60611)