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ABSTRACT

Included is a preliminary report of the analysis of questionnaires returned by biologists teaching in two-year colleges. Data are provided on areas of training, type of previous employment, types of courses taught, measures of teaching load, journals used, and salaries and grants received. The reported information includes the following: two-year college biologists are a heterogenous group, but the majority are married males in their late thirties, who hold a Masters degree, have an average of 11 years teaching experience, teach two courses with 17 contact hours, have little opportunity to publish or attend professional meetings, and receive a salary of $10,000-$12,000. Two other articles concern the implementation of investigative college laboratory courses, including an account of the use of mammalian tissue culture. A reprint of a newspaper report of the discussion of the "ecology movement" at an American Institute of Biological Sciences meeting, and a description of a program to prepare small single topic instructional modules for training biological science technicians in specific techniques are included. A short illustration of the advantages of the discussion technique concludes the newsletter. (AL)

CUEBS

COMMISSION ON UNDERGRADUATE EDUCATION IN THE BIOLOGICAL SCIENCES

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A PROFILE OF THE TWO-YEAR COLLEGE BIOLOGIST

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The creation of a National Task Force of Two-Year College Biologists (NTF-2YC)[1] by the AIBS Office of Biological Education, a group co-sponsored by CUEBS, is evidence of the concern for the two-year college biologist (hereafter symbolized as 2YCB) and his role in the American biological community.

The first project to be undertaken by the NTF and OBE/CUEBS was the development of a survey tool capable of providing a picture of the 2YCB and his professional environment. Such information is not available from any other study that has come to our attention, yet there are several reasons for obtaining the information. The sponsors of the study need the information to be able to plan their activities to serve the needs of 2YCBs as well as those in four-year colleges and universities. The colleges that accept transfer students from two-year colleges and the two-year colleges themselves should find this study of use in improving intercollege articulation. The faculty members who participated in the study are certainly interested in how they as individuals fit into the total picture of the American biological community. And last, but by no means least, is the fact that the NTF will use the results of this study to plan regional activities to meet the needs of the 2YCBs in the respective regions.

A preliminary report presented at the 21st Annual AIBS meeting at the University of Indiana, August, 1970. The final report on this survey will appear later this year.

[1] Members of the NTF are: Evelyn M. Hurlburt, Montgomery College, Md., Chairman. Richard A. Dodge, Columbia Junior College, Calif.; Richard B. Glazer, Ulster County Community College, Stone Ridge, N.Y.; Arnold :. Greer, University of Denver, Colo.; Stanley E. Ownstream, Pasadena City College, Calif.; Terrance L. Higgins, Wesley College, Dover, Del.; Fred Ross, Delta College, University Center, Mich.; Gayle M. Weaver, El Centro Junior College, Dallas, Texas; John Zoharis, Miami-Dade Jr. College, Miami, Fla.

Methods

In April 1970, a questionnaire was mailed to each of the 2790 biologists whose names were on the American Association of Junior Colleges roster of two-year college personnel, and additional questionnaires were distributed by task force members. By July, 1255 questionnaires had been returned and the analysis of the data was begun.

Since the AAJC roster used in the mailout was prepared in 1967 and the two-year college enrollment has grown tremendously since then, there are undoubtedly many new 2YCBs not represented in these data. Likewise, since there was not time for a follow-up before the close of the academic year and since no attempt was made to obtain viable addresses for the nonrespondents, many individuals who have changed institutions since 1967 are not represented in these data.

Of the 2790 questionnaires mailed, 1164 were returned, of which 1143 or 97% were from full-time faculty members. An additional 91 questionnaires were returned from those distributed by the task force.

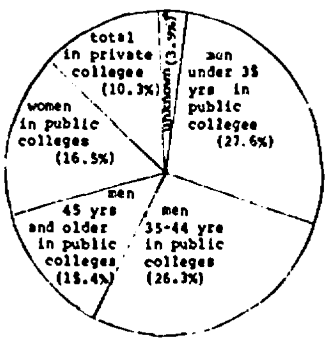
Rare indeed is the questionnaire in which the sample is known to be an unbiased, random sample of the population. In a population subject to rapid change such as the 2YC faculty, the ideal sample is especially difficult to obtain. Under sampling conditions where biases are likely to exist, it is desirable to attempt to understand the nature and extent of the biases and allow for these in the interpretation of the data. Because most of our questionnaires reached persons who were 2YCBs in the fall of 1967 and have remained in the 2YC since then, biologists who have taken faculty positions in 2YCs during the past two academic years and those who have changed institutions and did not get a forwarded questionnaire are under-represented in the sample. Thus the picture of the 2YCB and his environment that emerges from this study may very well be a "rosier" view than is justified by the actual situation.

Results and Discussion

A preliminary analysis of the 1255 usable questionnaires indicate the heterogeneous composition of those individuals

known collectively as 2YCBs. Figure 1 indicates the per cent of the sampled 2YCBs by age, sex, and type of teaching institution. The median age of 2YCBs in this study is 38 years. Compared with the 1967 National Science Foundation study of junior college teachers of science, engineering, and technology, which reported a median age of 42 years, our findings indicate that 2YCBs are somewhat younger than science faculty in general. There is some regional variation in the age of 2YCBs. The mean age of respondents from California is 41 years and from New York 37 years. The means for the other regions fall between these two extremes.

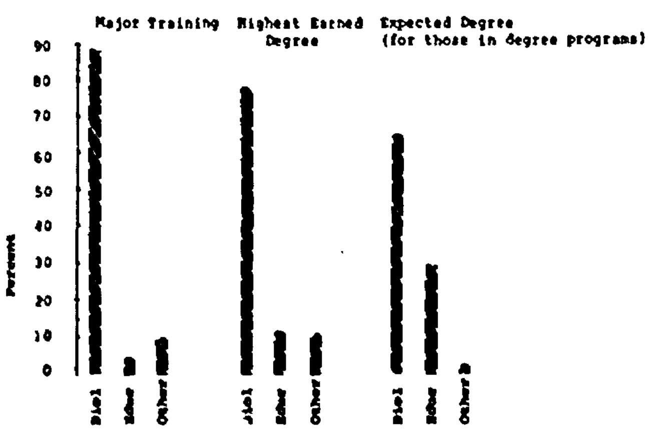
Fig. 1. Per cent of sample in various categories.



* unknown includes all cases with insufficient data to place in categories specified

A closer look at the collected data yields some very interesting facts concerning this heterogeneous group of biologists. There are 197 doctorate holders in the sample, 178 in public institutions and 19 in private institutions. Thus, 16% of our sample hold doctorates. The National Center for Educational Statistics indicates that 6.4% of 2YC faculty members are doctorate holders; the American Council on Education study shows that 7.5% hold doctorates. We therefore conclude that the proportion of doctorate holders in this sample is twice as great among biologists as it is among 2YC faculty in general.

Fig. 2. Comparison of area of major professional training and discipline of degrees, for all respondents.

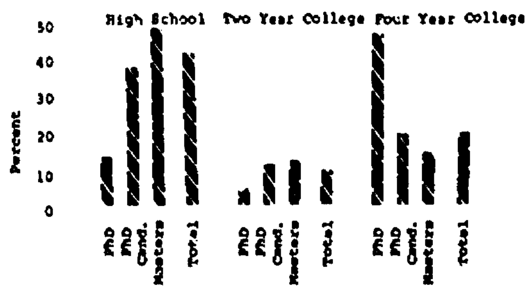


Beyond the concern with degrees is the concern with the subject area in which these degrees were earned. The major professional training of 88% of the respondents is biology. No other area is reported by more than 4%. In Figure 2, it is apparent that the proportion of biology training decreases as we proceed from training to highest earned degree to expected degree. There is a comparable increase in the proportion of education degrees. This would indicate that many 2YCBs obtain the undergraduate and perhaps Masters Degrees in biology and switch to education at some stage of their graduate training.

Previous Experience

Of all respondents in this study, about two-fifths were previously employed in high schools, one-tenth in another two-year college, and one-fifth in a four-year college, as shown by the last bar in each set of four bars in Figure 3. About 15% indicated some other type of previous employment and 15% did not respond to the item. Since we failed to include "graduate student" among the alternatives, we can only guess that some of those who reported four-year college as their previous employment were perhaps graduate students. Many who did not respond to the item may also have been students.

Fig. 3. Type of previous employment by degree status, for men in public colleges.

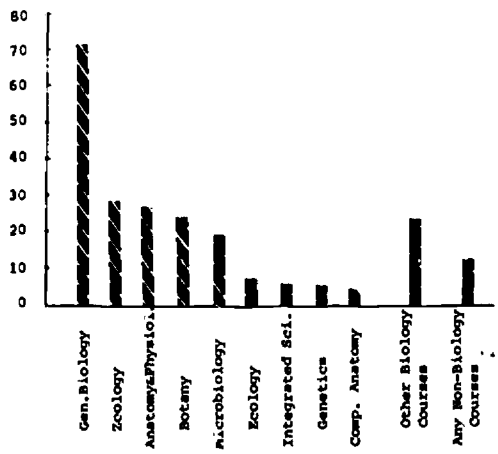


Teaching Activities

The typical 2YCB teaches two different biology courses per semester or quarter. About one-fourth of the respondents from public colleges indicated that in the current term had taught only one course. Further analysis of these data will be required to determine what proportion of those teaching one course have extensive administrative duties.

There has been much concern about what courses should be offered in the two-year college; we now have some hard data on what courses are actually being taught. Over 70% of the respondents are teaching general biology as indicated in Figure 4. Other frequently offered courses are zoology, anatomy and physiology, botany and microbiology. The observation that slightly less than three-fourths are teaching general biology and about one-fourth are teaching botany and zoology gives some idea of the trend toward integrated courses. The frequency of offerings in anatomy-physiology and microbiology probably reflect the strength of nursing programs in two-year colleges.

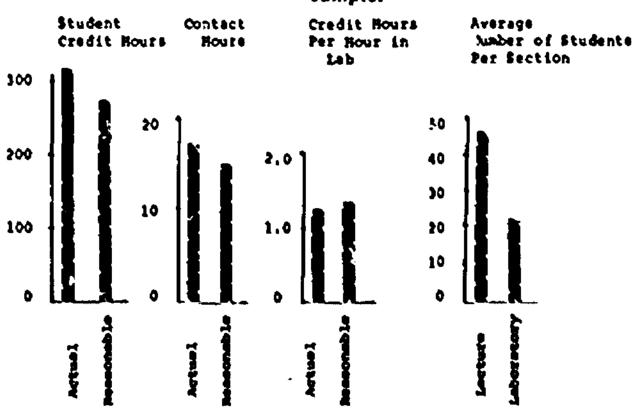
Fig. 4. Percentage of respondents teaching selected courses.



The fact that over 7% of the respondents are teaching a course in ecology is undoubtedly a result of the current concern with the environmental crisis and speaks well for the flexibility of the two-year college to respond to contemporary problems.

Teaching loads were assessed in several ways: (1) student-credit hours, defined as credit earned per student times the number of students in the class; (2) contact hours; (3) and teaching credit per laboratory contact hour. Faculty were asked to describe their teaching loads in these terms and also to specify what load they thought would be reasonable. These data are given in Figure 5. By any and all of the criteria for measuring teaching loads used in this study, the

Fig. 5. Measures of teaching loads, mean value for entire sample.

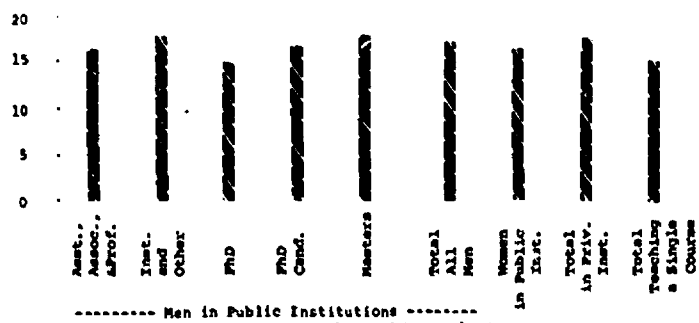


actual teaching load is larger than the faculty member considers reasonable. Comparing the overall average for all respondents, they feel that they generate about 50 student credit hours more than is reasonable, and that they have 2.3 contact hours more than is reasonable. These averages do not take into consideration individual differences; some individuals feel that their teaching loads are not unreasonable or overburdensome, while others are seriously demoralized by what they feel are extremely unreasonable teaching loads. This statement is documented by the actual data reported and from the candid comments of respondents.

The average number of student-credit hours is over 300. The average number of contact hours is slightly over 17. The average number of students per lecture section is about 45, per laboratory is about 22. According to the data presented in Figure 6, faculty members with rank above instructor have slightly lower teaching loads than instructors.

The American Association of University Professors recently prepared a policy statement indicating that for good undergraduate teaching, a contact load of no more than 12 hours per week was a maximum. The National Faculty Association of Community and Junior Colleges, a branch of the National Education Association, undertook to study teaching loads in the fall of 1969. Their view agrees with that of the AAUP that teaching loads should not exceed 12 contact hours. Yet their survey shows that only 8% of the colleges responding to the survey set their maximum credit hours at 12. One-fourth

Fig. 6. Actual mean contact hours for various groups in the sample.



of the respondents were teaching 15 credit hours, 45% were teaching 16 to 18 credit hours and 10% were teaching over 18 credit hours.

In rank ordering, a list of five items that would assist teachers in doing a better job of teaching, decreased teaching load was ranked highest. Other items in order of importance are: increased laboratory technician help; decreased class size; more opportunity for graduate work; and time and facilities for research.

The types of special programs in which a faculty member is involved offers a measure of another dimension of teaching activities. About one-fourth have independent study programs and one-fifth each self-paced instruction and audio-tutorial programs.

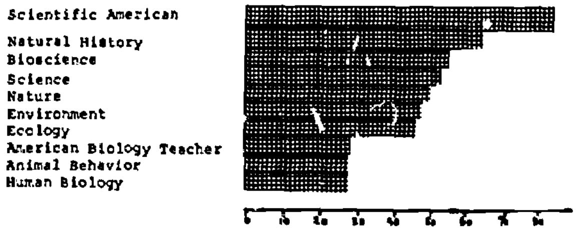
As the final item concerning teaching activities, faculty members were asked to rank a list of journals as to their usefulness for student use and for personal use. *Scientific American* ranked first on both accounts and is shown in Figure 7. *BioScience* ranked second for teacher use and third for student use. *Science* ranked third and fourth, respectively. Other journals among the "top ten" are shown in the figure.

Professional Activities

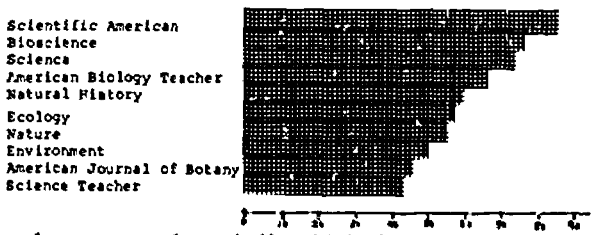
Publications prepared by 2YCBs are indicative of professional activity. Only one in seven respondents has published a book, one in three has published a laboratory manual, and one in two has published a pamphlet. However, 2YCBs aver-

Fig. 7. The top ten journals rated.

a. for student use



b. for personal use



age about two and one-half published journal articles per person.

In the four-year colleges and universities, grantsmanship is an important survival skill. In the two-year college, there apparently is less pressure to obtain grants. Nevertheless, an average of 13% of 2YCBs have obtained at least one grant, and 7% have obtained grants in excess of $10,000 as shown in Figure 8.

Attendance at meetings is also an aspect of professional activity. Two-year college biologists have attended an average of two meetings in calendar 1969. According to the respondents, their institutions provided an average of $75 per year per faculty member for financing attendance at professional meetings. The respondents thought that an average of $190 would be more reasonable. As a measure of the importance the respondent attaches to meeting attendance, we asked whether the 2YCB would be willing to pay 25% of the cost of meeting attendance. Two-thirds said yes!

Salary

The average salary of the 2YCB responding to this study is $11,200. However, only 88% of the respondents were willing to divulge information about their salary for the 9-10 months of the academic year 1969-70.

In Figure 9, the salary ranges are reported for various groups of 2YCBs according to age, sex, and degree status for those in public colleges. The public and private colleges are also compared. Medians of 50th percentiles are indicated with a crossbar on a line representing the range of salaries from the 25th to the 75th percentile. The per cent of each group who have second jobs is also indicated in this figure. As would be expected, salary increases with age. The amount of increase is rather striking. Men in the under 35 category have a median salary of $9900 and men in the 45 and over category have a median salary of $13,800. The proportion with second jobs is highest in the 35 to 44 age bracket; this perhaps reflects a need to supplement income during the period of maximum financial responsibility, especially for those with families.

Women's salaries are lower than those of men. In public colleges the difference between median values is about $800 lower for women than for men. This is in spite of the fact that the median age for women is older than that for men and that the proportion of Ph.D.s among women is slightly higher than among men.

The most striking difference in salaries is between the public and the private colleges. The median salary in private

Fig. 8. Per cent of respondents who have obtained grants.

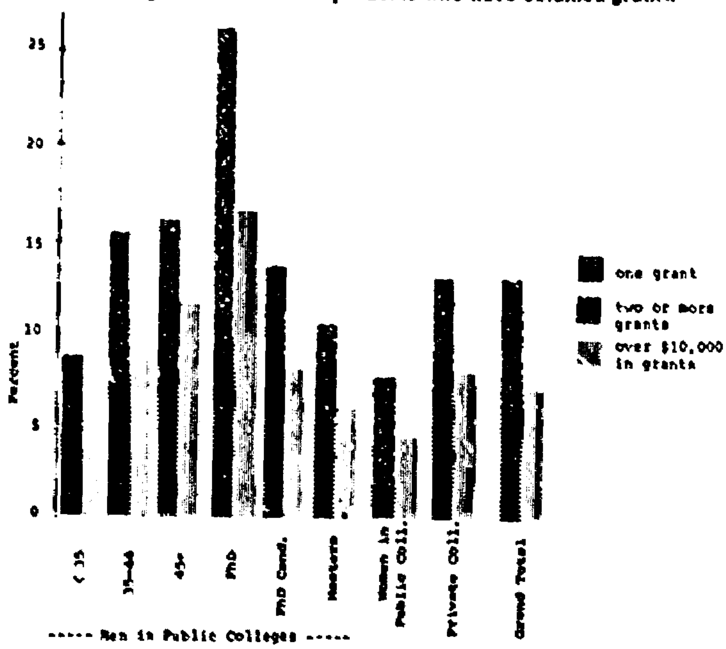
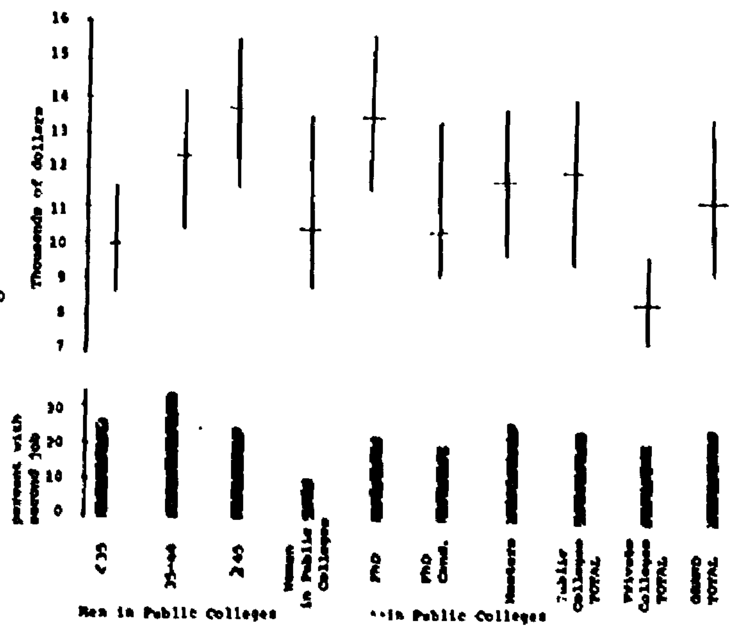


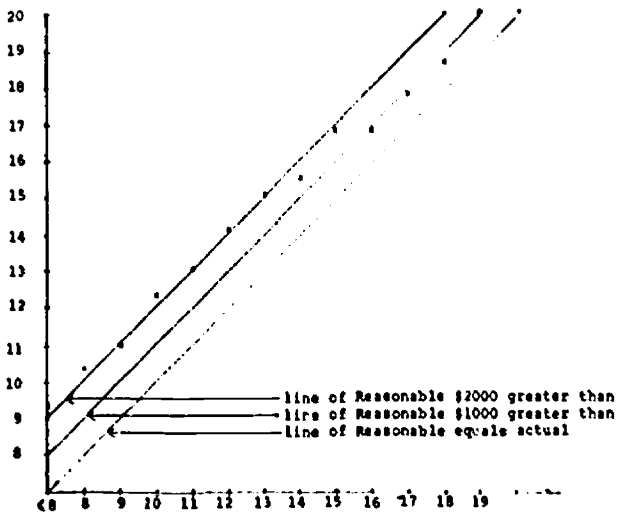
Fig. 9. Salary range (25th, 50th, & 75th percentiles) and per cent with second job for various groups in the sample.



colleges is $8600, that in public colleges is $11,500. The private colleges are faced with a real struggle to compete with the tax-supported institutions. In recent years, the overall enrollment in public colleges has increased rapidly while that in private colleges has dropped slightly, according to statistics from AAJC, thereby increasing the competition for the private college.

In addition to reporting their actual salary, respondents also indicated what salary they thought would be reasonable for their situation. The correlation between actual and reasonable salaries is shown in Figure 10. For the lower actual

Fig. 10. Comparison of median actual salary with median reasonable salary.



salaries, respondents seem to feel that at least $2000 more was required to reach a reasonable level. This relationship holds up to the level of $13,000 actual salary. Above that level, the reasonable salary is nearer $1000 more than the actual salary.

Programs of Interest to Respondents

In response to a list of six types of programs which were to be placed in rank order from most to least useful, the respondents indicated the greatest interest in subject matter workshops. Subject matter symposia and technique workshops received almost as high ratings as the subject matter workshops. Next in importance was the two-year/four-year college articulation workshop, and last were the faculty administration workshops and the grantsmanship workshops.

Institutional Data

The total number of colleges from which at least one questionnaire was received is 570. According to the 1970 AAJC Directory, there were in 1969 a total of 1018 two-year colleges, including 244 private and 794 public institutions. Thus we have information from 48% of the colleges in the total population.

Summary

Of the questionnaires mailed out to 2YCBs, 1255 or about 40% were returned. These questionnaires represent about one-fourth of the estimated total number of 2YCBs in full-time positions during the academic year of 1969-70. Factors which might bias the data in this survey have been considered and precautions taken in the interpretation of the data. Yet, the profile of 2YCBs and their environment that has emerged from this study is almost certainly a brighter picture than would be obtained if a complete representative sample were available.

Perhaps the one outstanding characteristic of the population of 2YCBs is their heterogeneity. While the average age falls in the late thirties, there are individuals under 25 and over 65. While the majority hold Master's Degrees, a few have only a Bachelor's Degree, many are in varying stages of completion of Doctoral Degrees, and a significant number have earned Doctoral Degrees.

The previous employment experience of the 2YCBs represents another aspect of their heterogeneity, although the largest single category of previous employment is the high school.

The teaching loads of 2YCBs, whether measured in student-credit hours, contact hours, credit for laboratory teaching, or size of lecture and laboratory sections, are, like other activities, best characterized by heterogeneity. The average of 17 contact hours is probably the best single measure of teaching load and serves to dramatize the heavy teaching load of the 2YCB. It was, in fact, decreased teaching load which most respondents rank first in the list of items that might be important to them in doing a better job of teaching.

Salaries vary from under $8000 to over $20,000, with the median value for the entire sample being $11,200. About one-fourth of all respondents hold a second job; many of these individuals receive salaries above the median.

According to the findings of this study, 2YCBs are a heterogeneous group but the majority are married males in their late thirties who hold a Masters Degree, have an average of 11 years' teaching experience, teach two courses per term in a public college, carry 17 contact hours, have little opportunity to publish or attend professional meetings, and receive a salary of $10,000 to $12,000. Their two strongest desires are to have their teaching load reduced and their salary increased.

Beyond the gross generalizations substantiated by the data reported in this study about the nature of the 2YCB and his role in the American Biological Community, all attempts to stereotype him should be resisted with a passion.

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10 FLAVORS OF ICE CREAM

Gratton A. Barnhill
Sioux Falls College
Sioux Falls, South Dakota

If one were to mix ten different flavors of ice cream expecting one very distinct flavor, it would be quite difficult. This is how I would describe the workshop on the Investigative Laboratory.[1] Each individual brought to the workshop a particular philosophy of teaching biology in the laboratory. Because each of us represents a different flavor, it was not possible to agree on one particular method to use that would fulfill all the purposes of the lab. It would be fruitless to present this gathering a model devised by the workshop and assume it would fulfill all the purposes of the laboratory in any particular college.

I do think we agree that personnel of each biology department should make some decisions as to the purpose and should be capable of stating the objectives for the laboratory in one's respective college or university. The objectives and purpose will then determine the methods employed to carry out those objectives. The laboratory will reflect the purpose and objectives given it. *Most* students today perceive very quickly the "real" objectives.

Most individuals at the workshop indicated that presently the undergraduate laboratory as now used in their respective colleges did not seem to be relevant to needs of many students. They would like to investigate other methods.

After many discussions, we concluded that one very important purpose of the undergraduate laboratory is to help the student investigate how new knowledge in biology is generated. This statement indicates that a student should be allowed freedom to select a problem in biology which is within his or her realm of capabilities and to devise an experimental design that will result in data on which tentative conclusions can be formulated. We also agree that this is not the sole and only purpose of undergraduate laboratories, however.

I am quite sure that those of us in the workshop did not come away with the "Hawthorne effect." I believe each of us realized that to allow students to select and carry out a problem will not be an easy task. It will be very time-consuming. I am sure that we have not discovered the magic formula which, if applied at any university, will produce an instantaneously revitalized program in biology.

If one is going to implement a laboratory in which students will be searching for problems and problem-solving techniques, how does one begin? How does one direct and help students experience the generation of new knowledge?

At this point I want to emphasize that an instructor does not leave the student uninstructed and undirected in the laboratory. Learning the process of how new knowledge is generated means that the student will be aided and will have a close working relationship with the instructor. The instructor will have contact throughout the semester through small group sessions and individual conferences with the students. It means that students will be involved in aspects of the process in which the library becomes an integral part of the education. And I cannot overemphasize the concept of "involvement." During the workshop, we had the opportunity to visit with students who had been actively involved in laboratory as undergraduates and they say that most important was involvement. For them it was the motivating factor. Students learn more biology when they are active in the process rather than passive.

What kind of activities should take place during the semester if one is going to work closely with students and allow them to become personally involved? This requires flexibility and elasticity. It will require patience on the part of the instructor and, in the end, a modified approach to evaluation.

The tentative schedule which follows is not a unique model. It is one which can be modified and should be if it is to be used by very many biology departments. It is not specific, but general. It is directional, not dictational. The schedule assumes a 14-week semester and one 3-hour laboratory period each week. And as you will see this 3-hour block becomes very flexible.

First Week:

1. (1-1½ hours) Introduction to the Investigatory Laboratory.
   A. Brief outline of approximate goals and objectives.
   B. Introduction to the organization of the laboratory.
      e.g.: What possibilities and uses will be made of the laboratory from week to week.
   C. Statement about responsibility.
      Students should know what will be expected of them.

2. (1½ hour) First laboratory experience (second part of first week).

   This experience should be one in which meaningful data can be collected very quickly. Because of this, the kinds of experiences are somewhat limited. Several schools have found microorganisms most useful for this experience.

A paper presented in the symposium of the 21st Annual AIBS meeting at Indiana University, August, 1970.

[1] Workshop Conference on Investigative Laboratories, Marquette University, June 15-July 10, 1970. Mr. Barnhill was one of the participants in the conference.

Second Week:

1. Discussion of first week experience.

   Discussion should involve:

   A. Use of data to formulate tentative conclusions.
      Analysis of data

   B. Use of controls.

   C. Formulation of a working hypothesis.
      Concept of stating the hypothesis

2. Use of Library.

   Presentation by librarian on "How to Find Scientific Information." It is suggested the student be given an assignment that will actively involve him in the library. He will use the procedure presented by the librarian.

Third, Fourth, and Fifth Weeks:

1. Several formal laboratory experiences which involve techniques. These should be techniques that can be expanded or used by students in the following weeks. There should be as broad a scope of techniques as you feel comfortable in using. Let your own expertise guide you. They may be developmental, biochemical, ecological, or may involve use of particular equipment.

   e.g.: colormete, phmete, measuring devices, centrifuge, etc.

2. Discussion Groups. Involvement will revolve around small group sessions or individuals.

   A. The attention should be directed toward the formulation and selection of a problem. The problem may have come from the technique experiences or from a variety of areas, such as lecture sessions. Selection and narrowing of the problem may be a very difficult task and time-consuming for some. Aid and advice from peers and instructor will be important here.

   B. Small group and individual sessions devoted to experimental design that will lead to solution of selected problems. Discussion will include stating of hypothesis, adequate controls, analysis of data, use of library, and guidelines for recording and reporting the investigation.

Sixth through Twelfth Weeks:

This time is to be used by the student who has selected a problem and an experimental design to be involved in the solution. He is actively involved in a "wet" lab experience. During this time the student is not undirected and alone. Time should be allowed for sessions of discussion and/or help sessions involving the instructor.

Thirteenth Week:

Time set aside for writing the report that will be presented to the instructor. It is suggested the report follow the normal procedures for reporting in scientific journals.

Fourteenth Week:

Mini-symposium. Students give a short report to classmates, faculty, and friends about their investigations. Suggested time to be 10 minutes for presentation and 5 minutes for discussion.

I have wanted to do something like this for the past 2 years at Sioux Falls College. We have been working in this direction, but the experience at Marquette University this summer has given me new direction and new insights. I will be using this model this coming year and hope it will work as well in practice as in theory.

AN INVESTIGATIVE LABORATORY IN CELL BIOLOGY

by John W. Thornton
CUEBS Staff Biologist

Several years ago, it became apparent that at my institution it would become increasingly difficult to maintain a good laboratory experience as an integral part of the undergraduate cell biology course. One of the reasons was cost. We estimated that it was six times as expensive to teach one student credit hour in laboratory as in lecture. Because we had changed the course from an upper division elective to an undergraduate degree requirement, the enrollment was rapidly increasing. Although the increasing number of students could be accommodated in lecture with little additional expense to the institution, the same could not be said for the laboratory.

In addition to the economic difficulties of maintaining instructional laboratories, there were other reasons for taking a closer look at what we were doing. In all fields of biology, but particularly at the cell and molecular level, the increased sophistication of methods and equipment being used in actual research made it difficult to maintain currency in the instructional laboratories. Finally, the information explosion made it tempting to add additional lecture hours to the existing course. A convenient way to do this was to simply substitute lecture hours for laboratory hours.

In spite of these compelling reasons for eliminating the laboratory, I was reluctant to do so. The reason for my reluctance, I suppose, was because of my own experience, which indicated that people don't become scientists or even come to understand and appreciate science by reading or hearing about it. I believe that we learn science by doing it and, in cell biology, this means getting into the laboratory

A talk given at a CUEBS-organized Symposium on Investigative Laboratories in Action at the AIBS 21st Annual Meeting, August 1970.

and getting the glassware dirty. One does not learn golf by watching a tournament, even if it is narrated by Arnold Palmer and equipped with slow motion and instant replay facilities; likewise, one also does not learn cell biology by attending lectures and reading, even if the lectures are presented by excellent biologists equipped with the latest teaching devices.

Therefore, I committed myself to keeping a laboratory experience in cell biology. To handle the enrollment and cost problem, I uncoupled the laboratory portion of the course from the lecture and made the laboratory optional. Over half the students now take only the lecture, but those who wish to be participants as well as spectators of science have the opportunity to do so by enrolling in the laboratory course.

It was then possible to develop the laboratory in an independent manner. From the beginning, my conviction was that the laboratory should be investigative; that is, I felt that the course should not be designed to simply demonstrate principles or techniques described in lectures. Rather, I felt that this course should provide the environment in which the student could develop and carry out a small program of investigation, experiencing firsthand the processes by which scientific knowledge grows.

My initial ideas about what would be required of me, as an instructor, in facilitating student investigations were rather naive and I now realize that my students must have been very good sports to tolerate my inexperience. These initial strugglings may be worth repeating, however, for I gained a better understanding of what is necessary in order for students to successfully carry out investigations. In that first try at offering an investigative laboratory, I explained to the students at their initial class meeting that their assignment for the semester was to design, carry out, and report on the investigation of some problem, of their own choosing, in cellular biology. I explained that the first step was to identify and limit the problem and design an attack upon it. I gave them some tips on the use of the library and asked them to come back in 2 weeks with a project proposal complete with the materials that they would need.

Student response was something rather akin to cultural shock. Individually, they filtered into my office and confessed that they had no idea what to do or how to do it. Although they knew quite a lot about cell structure, composition, and metabolism, they couldn't identify problems worthy of investigation except for broad general ones such as "the cure of cancer." Moreover, the library had not been very useful. They felt that investigations similar to those reported in research papers were far beyond their capabilities to perform.

As I met with the students in an effort to assist them in preparing suitable proposals, I began to perceive that there was a single ingredient, which if supplied, would very often bring them out of shock and get them started on the process of investigation. That single ingredient which most students needed but were unable to provide on their own was a source of suitable cellular material on which to carry out controlled experiments.

As I thought about the process of biological investigation, I began to realize that breakthroughs in cellular research have often been made as a result of the discovery of biological materials which are particularly well suited to the investigation of particular types of phenomena. Examples are *Drosophila* and *Neurospora* for genetic analysis, *E. coli* for metabolic studies, and squid giant axon for investigation of the mechanism of nerve conduction.

It would certainly be possible and valuable for students to develop their own systems just as researchers often do. At the cellular level, however, this activity is so time-consuming for most students that it typically takes up all or most of a semester. Since I was more interested in helping my students have an experience in designing experiments, collecting and analyzing data, and drawing conclusions than in helping them develop techniques, I decided that it would be appropriate for me to take responsibility for developing the cellular system upon which they would conduct investigations. Perhaps a second investigative laboratory experience for students could put more emphasis on the identification and development of "their own" system.

At that point, therefore, I began to look for a system around which investigations could be built. The term "system" is used here to refer to a set of basic materials, supplies, methods, and techniques. It seemed to me that this "system" should have the following characteristics.

1) If possible, it should be based upon a reasonably homogeneous cellular population. This greatly facilitates the design of controlled experiments and reduces the number of variables to be considered. Although metazoan organisms are cellular, the variety of cells present and the extensive nature of their interactions limit their use for simple cellular investigation.
2) The cells need to be alive and reasonably easy to grow and maintain so that students can investigate dynamic phenomena as well as morphology. This means that a collection of stained slides, even though it is very extensive, is probably inadequate.
3) The cost of using the system cannot be excessive. At our institution, an initial investment of $5000 to equip the laboratory and subsequent expenditures of $10 per student per semester seemed like a reasonable limit.
4) The required supplies and materials should be readily available from commercial sources.
5) The time required to learn to use the system should be no more than half a semester, and preferably less. This is essential if the emphasis in the course is to remain on the investigative process rather than learning of techniques.
6) Students should enjoy working with the system. Mammalian cells probably have advantages at this point over microorganisms or plant cells.
7) Most important, the system must provide raw material for a wide range of student-designed investigations.

It also seemed desirable to develop a system which would help students obtain laboratory skills which have wide appli-

cal iury in the many diverse areas of current biological investigation.

In our search for a suitable material, we were attracted to in vitro cell culture. Permanent cell lines, cultured as monolayers on glass surfaces, have been used successfully for many years in the investigation of cellular phenomena by research biologists. Until recently, however, the techniques required to maintain cultures have been expensive and technically beyond the competence of undergraduates. With the development of suitable antibiotics to control growth of contaminants and the availability of cell lines, premixed media, and inexpensive, sterile, disposable supplies from commercial sources, it appeared that a simplified cell culture system which could be used by undergraduates in investigative laboratories might be developed.

We have tested several permanent cell lines and have found that most of them are satisfactory. Don hamster cells, obtained from the American Type Culture Collection Cell Repository, seem to be the most satisfactory because their chromosomes are large and constant in number. These large, fibroblast-like cells proliferate well on L-15 (a commercially available medium developed by Leibovitz, 1963) supplemented with serum and antibiotics. This medium is superior to other commercially available ones because it maintains proper pH in equilibrium with the atmosphere, thus eliminating the need for a CO_2 incubator. When purchased in large quantities, it costs only $0.25/100 ml. Typically, students will use only 100 ml/week during the semester.

We have also found that primary cultures from a variety of embryonic and adult tissue may also be established in this medium. Five-day chicken embryos are a very useful source of cells for this purpose. For many experiments, however, primary cultures are not as satisfactory as the permanent cell lines because of their heterogeneity and lack of proliferation after several transfers.

The cells are cultured in inexpensive, sterile prescription bottles and on cover glasses in petri plates. The bottle cultures are ideal for routine maintenance and analysis of growth, while cover glass cultures are more suitable for high resolution and phase contrast microscopic studies.

The permanent equipment required for the laboratory includes an analytical balance, incubator (egg incubators are satisfactory), water deionizer, Millipore filter, and autoclave. Also available in the laboratory are microscopes (phase, inverted, and bright field), dust shields constructed of plate glass supported by fruit jars, burners, and basic supplies such as petri plates, disposable syringes, and staining dishes. A laboratory could easily be equipped in this manner for $5000 and would accommodate 75 students per semester.

Currently, at the beginning of the course, I present illustrated lectures on the basic techniques required in preparing media and glassware; establishing, maintaining, and transferring cultures; determining growth rates; and preparing cells for microscopic examination. Specific procedures which can be used to examine cells with phase microscopy, to determine karyotype, and to show the location of organelles and macromolecules are outlined for students. Procedures for measuring metabolic activities would be desirable but have not yet been developed. We are in the process of preparing an illustrated handbook which will include a description of all these procedures.

Students are asked to practice, at their own pace, these basic techniques until they are familiar with them and proficient in their use. Most students spend about half the semester in acquiring the necessary proficiency. It is not necessary for me or a laboratory instructor to be present in the laboratory at all times during this phase of the course, but students do need to know where they can get in touch with the instructor for assistance.

Although this phase of the course is not unlike traditional student laboratory courses in techniques, it seems to capture a good deal more enthusiasm than the earlier courses did. There may be several reasons for this. The techniques of cell culture are challenging and new for almost all students. The techniques are not viewed as ends in themselves but as a first step to investigation. Students know that they can proceed at their own rate and realize that as soon as they develop proficiency they will be able to investigate a problem of their own choosing. This phase of the course is sufficiently "cookbook" and the ends are so obvious that no cultural shock problem is encountered. By mid-term, most students have developed enough self-confidence and understanding of basic procedures to be able to proceed with the planning and execution of an investigation.

Selection of a problem to be investigated does, of course, present difficulty for some students. We make available to them copies of *Tissue Culture Abstracts*, which leads them to the most current literature. Some of the student investigations grow out of observations made or difficulties encountered during the "practice" section of the course. For example, one student last term investigated the "Effect of Exposure to Room Temperature on the Average Number of Nuclei per Cell." The student doing this investigation had, during the initial part of the course, accidentally left her cultures out of the incubator for several hours. Subsequently, she noticed that although the cultures had survived the exposure to cold, there seemed to be a high frequency of multinucleation present. She felt that perhaps the exposure to cold had uncoupled karyokinesis from cytokinesis. Therefore, she designed an investigation to determine if there was any correlation between time of exposure to cold and levels of multinucleation.

Sometimes, investigations grow out of interest generated outside the course. For example, a student interested in tropical fish culture decided to use cell culture techniques to determine the chromosome number in two species of live bearers which were superficially very similar. He hoped, as a result, to determine if their similarity was due to close evolutionary relationship or convergence. Currently, students show great concern about the effects of drugs and environmental pollutants. Many investigations grow out of this concern.

Throughout this phase of the course, individual help is required in statistical analysis of data, redesign of experiments, and use of the library. By the end of the semester,

most of the students had progressed to a point where they were able to present an acceptable paper at our course symposium. If time permitted, I think an earlier presentation of results, at about the time when the first data is coming in, would be very beneficial to all.

In conclusion, the development of a suitable system for use in undergraduate laboratory investigation courses in cell biology has produced the following results:

1) Students develop competence in skills which are applicable to a wide variety of biological phenomena. These include the preparation of reagents and media, cleaning and sterilization of equipment, sterile technique, microscopy, preparation of permanent slides, determination of population growth, design of experiments, sampling techniques, recording of data, statistical analysis of data, use of technical literature, and preparation of scientific reports. Students do not seem to consider the learning of these skills as "busy work," however, because most of them are learned as a natural part of preparing and conducting an investigation in which they are interested.
2) Students get a "feel" for cells as living, metabolizing units which are sensitive to their environment rather than simply as stained structures on microscope slides.
3) Students get to participate in an activity which is at the fore of current biological investigation. Since there is such an active literature in cell culture, they can quickly see that their own investigation is related to that of practicing research biologists.
4) All students have an opportunity to learn about the limitations, problems, and excitement of scientific investigation, and some are able to identify and get started on scientific problems which are worthy of further investigation.

Further development of the cell-culture system for instructional purposes could be greatly enhanced by feedback from other instructors who attempt to use it. We are eager to make available more detailed description of methods and materials to any who wish to give it a try.

ENVIRONMENTAL EDUCATION: E-Day Plus 128

The following article by newspaper reporter, Merv Hendricks, is reprinted from the *Daily-Herald Telephone* (Bloomington, Indiana), August 25, 1970.

It is a report on a panel discussion sponsored by CUEBS at the 21st Annual AIBS meeting. Participants are:

Luther J. Carter, News Editor, *Science*, Washington, D.C.

Alfred Forsyth, Lawyer, Forsyth, Decher, and Murray, New York

Denis Hayes, Coordinator, Environmental Teach-In, Inc., Washington, D.C.

ECOLOGY IS KEY TOPIC

Three men, three approaches, all striving for the same goal. Fear. Rights of the individual citizen. Personal commitment. Waste. Garbage. Villains. Ecology. Corporate responsibility. Ethics. Pollution. All these terms refer to a somewhat nebulous state—a state in which pollution would be just a bad dream, not the wide-awake reality it has become.

These were some of the things you would have heard Monday afternoon had you attended a panel discussion—"E-Day Plus 128"—sponsored by the Commission on Undergraduate Education in the Biological Sciences (CUEBS) in connection with the 6-day American Institute of Biological Sciences Annual Meeting presently being hosted by Indiana University.

The Ecology Movement, as it has come to be called, reached a high point of emotionalism at least on April 22 when millions of persons throughout the nation joined together and made known their collective concern over the problems of the environment.

That was E-Day (Earth Day) and now, more than 4 months later, three specialists in their own fields—a student leader, a respected lawyer, and a writer for *Science* magazine—spoke on the legalities and the illegalities involved in the pollution issue, as Edward Kormondy moderated the session.

"I'm afraid," Dennis Hayes (outfitted in blue jeans and cowboy boots) told the audience in the University Theatre. "I'm deathly afraid of what we're doing to the planet Earth," he said.

In well-chosen, precise words, he told of the work he has been doing for the Environmental Teach-In, Inc.—one of the major groups working for pollution control—furrowing his brow with each sentence.

"President Nixon has said he doesn't want to be the first American President to lose a war, but he may well be the first American President to lose a planet," Hayes said.

Then he got specific.

Hayes said 60% of the air pollution in the United States is caused by the internal combustion engine. "When a person says this," Hayes explained, "you're met with the unmitigated hostility of the vested interests of the millions of dollars in Detroit, from the millions in the oil industry, from the millions from the highway construction industry."

"In many cases the 'villains' are not so easy to come across.

This is one case in which determining the villain is a little bit more complex," Hayes said.

"It's difficult to find the villains because often they are very well-intentioned persons striving for what they think is the best interest of mankind—of America."

The vote on the controversial SST (Super-Sonic Transport) is due in the U.S. Senate within the next 3 weeks and Hayes used this as another illustration.

"As of yet there are no compelling reasons for the SST to be built, but there are possibilities it will pass," Hayes contended.

Answering his own question of "How can we stop it?" Hayes said, "We might stage a one-day moratorium on air traffic to do lobbying or we might have a banquet to try to convince waivering senators. That banquet will probably never happen," he sighed. "This nation will probably be spending $3 billion for the lack of $2,000 (the cost of the banquet). This is the kind of problem we've run into all the time."

"It'd be great," he told the scientists, "if we (the ecology groups and scientists) could establish a kind of bank so we could know what kind of research is going on at the various universities."

Hayes verbally lashed out at those who are uncommitted to the ecology movement, both those who make no pretenses about it and those who do. "I find myself terribly offended by the lack of commitment by the public in general, and I can't tell you how offended I am when I see someone drive up to an auditorium to give a speech on pollution in an eight-cylinder car emitting tons of garbage into the air. It's critically important that we as individuals strive for as ecologically sound a life as possible."

The next speaker, Alfred Forsyth, of the New York City law firm of Forsyth, Decker, and Murray, blamed the American ethic of land ownership for much of the abuse of the natural resources by Americans.

"The environment in Indiana undoubtedly was much better when the Indians ran it. The Indians didn't have the ethic of possessory use of the land. They didn't own the land they used, it was for the communal purposes of the tribe," Forsyth explained.

The white man, Forsyth said, changed that when he took over, substituting the Indian ethic with the philosophy that the "owner has the right to use the land as he darn well pleases; his home is his castle."

Only recently, Forsyth remarked, have the courts begun to question the uses of private land.

"Theoretically," he explained, "all of the protection of the environment was to be done through the duly appointed or elected official. It wasn't particularly the right of the citizen to say 'they ain't doing right by us.' It has taken us some time to see why the theoretical approach doesn't work."

This is so, Forsyth said, because the courts and the industries "tend to think alike after awhile. This has developed a recognized need for a third force . . . and that's the individual."

After reciting a list of court actions concerning ecological matters now pending, Forsyth said, "The courts, whether the Circuit Court around the corner or the Supreme Court in Washington, are not oblivious to the concern over ecological problems and I hope they will be hearing individual citizens who are questioning the activities of governmental agencies in regard to environmental matters."

Referring to the effect Earth Day had on corporations—the group which received much of the brunt of the ecology movement—Luther J. Carter, a writer for *Science* magazine and a member of the American Association for the Advancement of Science, said: "Earth Day was a way of arousing mass interest and had an influence on corporate behavior. But that alone was not of enough impact to get at corporate behavior from the inside.

"That is the pressure point which has to be used. . . . There has to be a willingness by the large companies to be responsible."

One of the avenues open to those wishing to get "inside" the big corporations, Carter suggested, is through minority shareholder actions.

Through this method, Carter said, influential universities such as Harvard and Massachusetts Institute of Technology can show large corporations "vulnerability" by being more aggressive in their use of shareholders' votes on the boards of these financial giants.

"My hope is that corporate responsibility will be built into the American system to become a routine thing, just as routine as a city council's consideration of paving a street," Carter concluded.

Letter to the Editor:

It is most unfortunate that CUEBS News has reprinted in the August 1970 issue, a factually erroneous article "Isn't This Classic?" from American Laboratory. If this case is classic it is certainly not of the "publish or perish" game, but rather of unchecked repetition of unverified and false information. Here are some of the *facts:* 1) It was not "the department head's decision" not to reappoint the assistant professor referred to, but instead it was the unanimous decision of a committee of six botany professors, including the chairman of the university-wide Section of Botany; 2) The decision was not a "publish or perish" matter. The number of publications was not judged to be inadequate; 3) In accord with established university policy the decision was based upon an evaluation of teaching effectiveness, research and scholarship, professional activities and general usefulness. Opinions of student majors who had actually been in the classes of this teacher were carefully considered; 4) At Rutgers, a second 3-year appointment does not imply that tenure would be granted at the end. However, it is the policy at Rutgers not to recommend reappointment if it is known that there would be no recommendation for tenure at a later time; 5) During the 3-year appointment, the teaching contacts of the person referred to were almost entirely with freshmen in the introductory biology course. During this period, only a handful of students enrolled in elective courses given by this teacher; and 6) Questions have been raised including in a letter published in the student newspaper as to how 4000 alumni or more than a few seniors could have either known of this person or have had any basis for judging teaching ability, and be able to offer the designation "Outstanding Teacher of the Year." (This is not the first instance in which the validity of the choice of "Teacher of the Year" was highly questionable.) You may be sure that genuinely good teaching, good quality research and professional attitudes are highly valued in this department.

Sydney S. Greenfield, Chairman
Department of Botany
Rutgers University at Newark

PROJECT BIOTECH: A MODULARIZED ANSWER TO A CRITICAL MANPOWER QUESTION

Elwood B. Ehrle
Associate Director
AIBS Office of Biological Education

The head of a biology department is likely to tell you that he has 30-40 applicants for the one Assistant Professorship open in his department and that he has been looking for a good greenhouse man for 2 years. The Research Director in a large biologically based industrial or government laboratory is likely to admit that he always has openings for well-trained technicians. So it goes across the country. That we are entering a time of real technician shortage is apparent to anyone who has had a chance to look around.

The Bureau of Labor Statistics of the U.S. Department of Labor reports that 53,000 "life science technicians" were employed in 1963. Their projections call for more than 100,000 in this classification before the end of this decade. If we ever decide to get serious about curbing the population, cleaning up the environment, and extending medical care to all who need it, these numbers will grow. Present projections will seem very small compared to the number of individuals who will be needed to attack the unfinished business of society.

It is somehow disquieting for scholarly types to think of their discipline as a labor pyramid. The academic mythology suggests that if we can only think deeply enough, ask the right questions, and write profound scholarly papers, Utopia will surely come to pass. Important as these things are, it is becoming increasingly evident that someone must be PREPARED TO DO SOMETHING. If the researcher-scholar-teacher (an infrequent combination in the real world, but a good model nonetheless) is to survive at the apex of the pyramid, a great many hands and heads will be critically needed in the supporting strata.

There are many institutions in the country well equipped to turn out individuals who compete for a place in the apex of the biological labor pyramid to direct the work to be done. Who is seeing to the need for people PREPARED TO DO SOMETHING in the rest of the structure? The greatest amount of activity is in the medical technology area. Here there are curricula prepared and many institutions, mostly two-year colleges, are involved in the education and training of technicians, ranging from nurses aides to inhalation therapists. Needless to say, these individuals have an easier time finding suitable employment than many recent Ph.Ds. When you look outside of the biomedical area, the picture rapidly changes. There are some programs in agriculture and forestry, a few in the marine sciences, and occasional specialized two-year programs like those in "Hay, Seed, Grain, and Farm Machinery Technology." It soon becomes apparent that the productivity of all these programs combined is insufficient to meet the middle manpower requirements in the biology of the Seventies.

What to Do?

Once the biological and scientific public becomes convinced that the problem is real, pervasive, and unlikely to go away, it begins to see that something must be done. The simplest solutions are easy to think of but difficult or impossible to apply. Raising salaries is one way to solve a manpower problem. If the technician were making as much or more money than those afforded higher status, we would see a rapid disappearance of a manpower problem with the status problem vanishing in its wake. Indeed, salaries for technicians vis-a-vis "professionals" will increase. Even so, this will not bring an easy solution. Sooner or later we must face the reality. There aren't enough people being PREPARED TO DO SOMETHING, no matter what the salary.

A second rank of easy solutions says, "Design a curriculum, line up the schools, and start pumping people through." This might work in an area with a fairly homogeneous work need, but it is clearly impossible in biology and biology-based endeavors. Imagine a curriculum that could adequately prepare a technician to assume responsibility for the maintenance of a greenhouse and an animal colony; to assist a researcher in an election microscope laboratory and at the same time be equally facile with electrophoresis or column chromatography; to monitor insect populations in experimental field or garden plots and be as well prepared to monitor fungal populations in the giant fermentation tanks of much of bioindustry; to serve as a departmental preparator and stockroom and inventory guardian and also be able to detect DDT in the parts per billion range; to run phosphate tests on lake and river water while filling in by pinning insects in the museum and pressing plants in the herbarium; to prepare specimens for C-14 counting, develop autoradiographic slides of tissue sections, run an ultra centrifuge, and get the labs at the field station ready for a herd of summer scientists. This list could be enlarged by several orders of magnitude. What a curriculum that would have to be!

How about several curricula? If you think about it, you will begin to realize that blue, green, and yellow curricula with different emphases won't begin to cover the diversity of skills required. Even if one employed a whole rainbow of different curricula, many areas would be completely untouched.

There is a way out of this dilemma. Rather than preparing curricula, we have decided to prepare teaching-learning materials that are the foundation of a nearly infinite variety of curricula. Hence, the modular basis of Project BIOTECH. As individual modules are developed, they can be used to

create a variety of courses in two-year and four-year colleges, by themselves in on-the-job training situations, and in many other ways.

The Nature of Modules in Project BIOTECH

One of the most difficult aspects of preparing the way for Project BIOTECH is to get people to think in smaller terms. The modules needed to accomplish the diversity of training needs alluded to above aren't one credit-hour limits. They aren't a sixth or an eighth of a course. They are much smaller units than that. They are self-contained, instructional packages involving programmed instruction, Kodochrome slide sets, audio tapes, film loops, or perhaps just the printed word. In any case, they will have a single behavioral objective and will guide the student through the completion of a single specified task to a predetermined level of competency in a few hours or days. If the level of competency isn't reached the first time, the student can easily start again and again until the task is mastered. Does he want to become really proficient in handling an analytical balance? That's AIBS BIOTECH module number so and so. Does the job he wants require the preparation of sterile agar media? Use module so and so. Is it necessary for him to be prepared to handle lambda pipetting or to make good root tip smears? In each case, an AIBS BIOTECH module will probably be available to help him become PREPARED TO DO SOMETHING.

Where Are 230 Modules to Come From?

Probably the least desirable way of generating this type of module is to hire a project staff, lock them up somewhere, and tell them to write until they've finished the job. The designers of Project BIOTECH see a much better way. Identify the individuals at the bench actually using a particular technique and, assuming that the individual can write or is at least willing to try, encourage him, financially or otherwise, to assemble a rough module designed to help someone else learn how to do the job he does so well. He'll need some help in terms of divining the best possible behavioral objective and competency measure, that's for sure. The BIOTECH Council will have worked this out for him in advance and also will have provided him with a set of guidelines on the design of modules. Armed with these, he will be encouraged to try his hand, test it out on the fellow who works next to him or on the new technician who just came on the job, and keep in touch with Project BIOTECH until he thinks he has something that will do the job.

Rough drafts and partially tested packages have a way to go before they become AIBS BIOTECH modules. Each summer, the modules under preparation will be worked over by a Summer Editorial Work Session. The letters SEWS are indicative of what this group will do. Modules will be taken apart, stripped down, and rethreaded into finely polished single behavioral objective instructional units designed to help someone learn how to do one thing very well. If funding is secured so that the major effort can start July 1, 1971, it is assumed that there will be 30 modules in the SEWS of the summer of '72 and 100 or more in the summer SEWS of '73 and '74. As rapidly as the modules can be redeveloped by the summer working groups, subjected to further testing in pilot institutions, and approved by the Council, they will be turned over to commercial channels for distribution. In mid-summer, 1975, when Project BIOTECH closes down, it should have left behind a legacy of 230 useful modules, many of which will already be in second or third revision stages and a set of plans for producing second generation materials as the need arises.

How Will the Modules Be Used?

The answers to this question are probably as diverse as the training needs present in the country. They will be designed for use in two-year college programs for the preparation of biotechnicians earning Associate degrees. There will undoubtedly arise certificate programs of one year or less. It is also anticipated that one-the-job training programs will use modules as single units or in various limited combinations to provide training for a particular job, as well as an upgrading device for the technician pool working for a particular company or agency.

Another use that is already apparent will be by students involved in inquiry or investigative work in the liberal arts tradition. Quite often, such students discover the need for a particular technique halfway through the exploration of a particular problem. This is just as true for high school students as it is for undergraduate and graduate students. As Project BIOTECH fulfills its mandate, the modules that students will need to acquire expertise in the particular techniques germane to their investigations will be ready and waiting.

Are BIOTECH Core Programs Possible?

The planners think so. As the BIOTECH Council develops the "laundry list" of skills to be translated into modules and assigns priorities to those which are most critically needed, this question will be returned to again and again. A preliminary guess suggests that it should be possible to identify about a hundred modules which could provide the basic training needed by a biotechnician, regardless of the kind of work he might do subsequently. If a prospective biotechnician can master these core modules, he is not only better prepared to undertake the 20 or more additional modules which will lead him into a specialty area but he is also equipped with maximum flexibility, making it possible for him to grow and shift as job opportunities unfold before him.

What Does the More Distant Future Hold?

The farther ahead one looks from the vantage point of 1970, the less clearly one can make out the outlines of what lies ahead. A few things can be predicted by projection. It appears likely, for instance, that there will be developed B.S. and M.S. programs for the preparation of Biotechnologists and Master Technologists for those who have the ability and inclination to move beyond the biotechnician stage.

Another possibility foresees the breakdown of the either-or

dichotomy between liberal arts-trained biologists and practically trained biotechnicians. It foresees the redevelopment of the CUEBS concept of a core program as a result of this shift. CUEBS present attention to the investigative laboratory as a major ingredient in undergraduate biology courses seems to lead in this direction.

If the CUEBS Core Concept of a several semester unit with its own beginning-to-end internal integrity and controlled redundancy does replace the individual course method of instruction in the lower division of a general biology program, the stage will be set for a new amalgam with the investigative laboratory. There is no reason why the theoretical (Bio. 1,2,3,4) base of our science can't be blended with the practical (Techniques of Biological Investigation: BIOTECH 1,2,3,4) to yield the best of both worlds.

Crystal ball-gazing avails nothing, scoffs the cynic. Maybe so. CUEBS, on the other hand, has made it abundantly clear that curriculum matters in biology are never at rest, that there is no one best way, and that the entire area of biological education is constantly evolving. About the only sure thing we can predict for the future is that it will be different from the present.

What Can You Do?

There are several ways in which you can become involved in helping to determine the future of biological education. First, and most important, think about what you are doing and ways you can either do it better or find better things to do. Second, get in touch with CUEBS or the AIBS Office of Biological Education and share your thinking with us. An inquiry into the programs being conducted by CUEBS or OBE might be helpful to you. With particular regard to Project BIOTECH, let us know what modules you would like to see prepared or what modules you may have in preparation yourself. Who knows? You may be holding the key to more than one of them. Project BIOTECH and the other programs being conducted or planned will need a lot of creative input and committed involvement. May we hear from you?

MAN AND ENVIRONMENT

First National Biological Congress

**Sponsored by the
American Institute of Biological Sciences
and the
Federation of American Societies for
Experimental Biology
Cobo Hall
Detroit, Michigan**

November 6-10, 1970

Many of the unprecedented threats to man and his environment, which, in turn, determine the future of the nation and the world, require the expert knowledge of biologists for definition and resolution. Biologists have the ability to attack these problems in an effective manner. The reasons they have not done so are twofold: an inability to communicate to others the urgency and danger inherent in the rapidly advancing imbalance in the ecosphere and apathy on the part of the general public. In a very real sense the former has done much to bring about the latter. Moreover, biologists have been outside their specialty and with important figures in government and business.

This communication gap has resulted in a lack of government and public support for research in the biological sciences, which has led, in turn, to interruption of research programs, dismantling of long-range plans, and disillusionment among students at both the graduate and undergraduate levels. The First National Biological Congress starts a new trend to correct these deficiencies. Invited speakers have been sought with special qualifications; they have unquestioned scientific standing, and they possess the ability to communicate effectively with government officials, biological scientists, teachers, students at all levels, science writers, and a reasonably informed public.

The Basic Science Symposia, to be held each morning, deal with subjects which are currently important to biology, and are relative to the state of science and to the interests of people. They will contain hard science presented in sufficient depth to interest the specialist, while remaining at a level which the nonspecialist can comprehend.

The afternoon sessions will be devoted to scientific societies. Many societies in various biological disciplines have assumed the responsibility for preparing symposia, workshops, and exhibits compatible with the theme of the Congress. These societies represent the unifying element of the Congress.

The Evening Symposia, devoted to Man and Environment, will be more general in nature. Knowledgeable and articulate speakers, able to interact with the invited public, students, teachers, professors, biological specialists, and the news media, will participate in discussions with panels of leading representatives of federal, state, and local governments.

For further information, write:

Dr. Max Ben, Secretary
American Institute of Biological Sciences
3900 Wisconsin Avenue, N.W.
Washington, D.C. 20016

Viewpoints!

Staid vs. Freeman

Joan G. Creager
CUEBS Staff Biologist

Scene I—In the student lounge, one of Professor Staid's graduate students is talking with a student from Professor Freeman's class.

"We had a really lively discussion today in Freeman's class."

"Don't you always?"

"Yes, but today was one of the best. He presented some data on population cycles and from that we got onto the topic of population control. The notion of cycles and how they are regulated is a fascinating thing to think about."

"Yes it is. Staid lectured on cycles, too. The life cycle of the Chinese liver fluke, but it didn't seem to make any sense to know all that. We never have a chance to discuss anything anyway. We're too busy taking notes to even think. The discussions in Freeman's class really leave you with some ideas to think about."

"Yes, and we have been trying a technique he calls 'simulated situations'."

"What's that?"

"Oh, in the simulated situation, one of us takes the role of teacher and he assigns roles to two or three other students. The one who is teacher doesn't know what roles have been assigned. That's to see if we can deal with unexpected problems. Like, how do you gently handle the 'know-it-all' student, yet give other members of the class a chance to get in on the discussion?"

"That sounds great, I'd like to teach when I finish up here, but I don't get any training in how to teach."

"Maybe you could sit in on our class. I'm sure Freeman wouldn't mind."

"I doubt if that would work. Staid says this discussion business is all bunk. He thinks Freeman wastes an awful lot of time discussing when he ought to be covering the subject."

"Well, we could get a group together in the lab some afternoon on our own, and try some simulated situations so you can get the feel of it. It's best in a small group anyway."

Scene II—In the laboratory. Professor Staid happens along the hallway and catches a few words.

"Let's try a simulation using that liver fluke bit. If we can get a discussion going on that topic, we can do it on any topic!"

(Group leader selects teacher who leaves room while students are assigned roles. Student A likes his facts predigested, like the security of knowing exactly what is going to be on the test. Student B is fed up with being lectured to, wants to do his own thinking.)

"OK, what happens if you get rid of the snails?"

"I guess that flukes would eventually die out."

"Maybe not, it depends on whether there is some other host the parasite can adapt to."

Students engage in some further discussion of this point.

Student A—"Dr. Staid said yesterday that such a complicated life cycle has evolved over millions of years and is so highly specialized that it is not likely to change."

Student B—"Dr. Staid says. I'm tired of what Dr. Staid says. We want to do a little thinking here for ourselves."

"Yes, of course we do, but we need to ferret out our own information if we don't want to be lectured to."

"That's part of the excitement to find our own information. But let's get back to the fluke. You can interrupt the life cycle by getting rid of any one host, can't you?"

"If that's true, then there must be a balance between snails, fish, and fluke populations. What keeps these populations balanced?"

(Discussion continues in the vein for a half hour.)

Scene III—Staid's class the next day as he begins his lecture.

"In the last class we were concerned with the life cycle of the Chinese liver fluke.

What do you suppose would happen if the snails were all destroyed in a fluke-infested area?"

* * * * *

Dare we hope that Professor Staid has begun to discover the pedagogical possibilities inherent in the open-ended discussion? We hold that hope for all the Professor Staids—the hope that they shall become free men, free and open to their students. The technique of simulated teaching situations provides a route to this freedom.

The technique itself was developed by Dr. David Lehman for the preparation of secondary school teachers and is described in CUEBS Publication #25.[1] It is based on the assumption that the teacher will make extensive use of open-ended inquiries and will attempt to create a classroom atmosphere in which students can discover for themselves those principles and concepts that might otherwise be transmitted to them secondhand. In simulated situations, the prospective teacher has the opportunity to develop a keen perception of individual feelings and interpersonal relationships and thus to foster an atmosphere of mutual respect and open communication.

[1] The Pre-Serivce Preparation of Secondary School Biology Teachers, edited by Addison E. Lee. Available on request from CUEBS.

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20. * Testing and evaluation in the biological sciences. November, 1967.
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24. Preservice preparation of college biology teachers: a search for a better way. November, 1970.
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2. A working conference on source material in physics-biology-agriculture and natural resources. June 1970.

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Council on Education in Geological Sciences. 1970. Audio-tutorial instruction: a strategy for teaching introductory college geology.

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