

**RECOMMENDATIONS:** As means of improving testing and evaluation in high school biology the Conference recommended:

- a. That all tests and other evaluative procedures be geared to the objectives stated in the overall plan for the course.
- b. That, in addition to facts, high school biology examinations include experiences in understanding and interpreting biological principles, problem solving, interpretation of biological data, evaluating hypotheses in the light of evidence gained from observation or controlled experimentation, understanding cause-effect relationships, and appraisal of situations that have biological implications and significance.
- c. That unstructured as well as structured or objective-type examinations be used in the evaluation program.
- d. That the evaluation program include examinations using specimens and experiments.
- e. That examinations requiring organizational procedures (i.e., essay examinations) be used primarily during the term rather than at the end of the term. Such examinations can be used, among other purposes, in developing composition skills.
- f. That structured or objective-type examinations be used primarily in the final evaluation at the end of the term. Examinations of this type have many advantages (wide sampling, quick scoring, and the like), especially when large groups of students are to be tested.
- g. That a chart of specifications be developed to serve as a guide in the construction of objective-type examinations. Such a chart will insure an appropriate distribution of items with regard to both content and objectives. (See Fig. 1, *Chart of Specifications*, p. 41).
- h. That, in addition to examinations, other evaluative devices be used. These devices may include laboratory and field work, performance ratings, anecdotal records, controlled observa-

tions, interest notations, statements made by students, behavior changes observed, conferences, and/or other procedures. All have their places in the total evaluation of student progress.

- i. That students participate in the evaluative process through self-appraisal. If properly encouraged and guided by the teacher, students can be highly effective in estimating their own progress.

*Summary by W. HUGH STICKLER*

## Section B

### The Teacher Training Program

10. *What constitutes a balanced program for the training of high school biology teachers? What experiences—subject matter courses, appropriate field and laboratory experiences, professional education courses—should be included in such a program?*

**COMMENT:** The Conference recognized that any recommendation for a balanced program will leave much to be desired if the teacher is to be prepared in four years. It was agreed, however, that a realistic view of the high school teaching situation as it exists now and will exist for some time to come required the Conference to think in terms of a four-year program.

**RECOMMENDATIONS:** In order to provide the best possible preparation in a four-year program, the Conference recommended that the prospective high school biology teacher have:

- a. A college major (i.e., a minimum of 24 semester hours) in the biological sciences, to include one year of general biology, or equivalent courses in general botany and general zoology (incorporating the subject matter areas treated in Part I—morphology, taxonomy, physiology and health, ecology and conservation, heredity and development, evolution and paleontology), with at least one-third of the total content devoted to plant

- science. Course work beyond the first year should include field studies.
- b. One year of chemistry, with laboratory work. It was recommended that this work include organic chemistry as it applies to living things.
  - c. One year of physics, with laboratory work.
  - d. One half-year of earth science.
  - e. One year of mathematics.
  - f. Education courses to meet state certification requirements, with a course in methods of teaching high school biology strongly recommended. Professional education courses should include experiences in the following areas:
    - 1) The nature of the learning process.
    - 2) Human growth and development.
    - 3) Professional laboratory experiences.
    - 4) Internship.
    - 5) Group dynamics.
    - 6) The secondary school program (the role of the school in society, curriculum, history and philosophy of education, and the like).
    - 7) Testing and evaluation.
  - g. Appropriate general education courses (humanities, social sciences, and communication skills) required of other high school teachers.

The above were recommended as minimum requirements in the training of an effective high school biology teacher. The Conference recommended that, whenever possible, courses allowing for certification in other sciences or related fields should be taken. (Specific courses and fields must, of course, be planned in the light of minimum certification requirements of the state involved.)

11. *How can specialists in biology and professional educators be brought into a better working relationship in the training of biology teachers?*

**COMMENT:** Effective high school biology teaching requires a teacher with a broad background of understandings in: (1) the subject matter of biology, and (2) the areas of adolescent growth and development, objectives of the total high school program and of the biology course, methods of working with high

school boys and girls, and techniques of evaluating student progress. Traditionally, the implementation of the former has been the function of the specialist in biology, while the latter has been the province of the professional educator. Too often each has operated independently, leaving the prospective teachers with the difficult task of integrating their teaching. Such integration would better result from cooperation of the specialist in biology and the professional educator. Integration in turn would result from the establishment of better working relationships. Biologists, like other arts and science specialists, too often criticize professional educators without becoming informed regarding the problems of education and without any effort to join forces with the educators. Biologists and educators can produce the best possible teachers only by working together.

**RECOMMENDATIONS:** In order to bring about effective working relations between biologists and educators, the Conference recommended:

- a. Work conferences at the local, state, regional, and national levels in which specialists in biology and professional educators can talk out their problems in face-to-face meetings.
- b. Giving biology departments the responsibility of providing competent members of their staff to teach the "methods" courses in biology which commonly carry education credit.
- c. Encouraging the specialist in biology to observe and work with student teachers of biology who received their subject matter training in his (the specialists) college classes.
- d. Drawing upon the background of experience of the specialist in biology in the planning of education courses, particularly as they deal with such problems as human physiology and genetics.
- e. Active participation in teacher training of both educationist and science specialist. This participation involves cooperative decisions concerning:
  1. Certification requirements.
  2. Advising students.

3. Evaluation of program and outcomes.
  4. Evaluation of the teaching in both areas.
  5. Science specialist leading field trips and participating in other activities involving the education student.
  - f. Making provisions for and encouraging the observance of college biology classes by professional educators and of college education classes by specialists in biology, with the end in view of eliminating unnecessary duplication and making courses more effective.
  - g. Providing for greater mutual action by educators and biologists in promoting and working with Junior Academies of Science and similar organizations of high school students interested in science.
  - h. Encouraging schools of Education and State Departments of Education to consult with competent biologists in planning the biology subject matter requirements necessary for graduation and certification of the high school teacher.
  - i. Provision for exchange teaching assignments between biologists and educators.<sup>1</sup>
  - j. Having biologists and educators make joint appearances on radio and television programs.
12. *How can colleges and universities contribute effectively to the in-service Education of biology teachers? Particularly, how can colleges and universities provide biology teachers with appropriate subject matter courses (especially extension courses and summer school offerings) which will carry appropriate college credit and at the same time apply toward certification?*

<sup>1</sup> *One discussion group recommended joint appointments in the Departments of Biology and Education. It was recognized that such a plan could be highly effective, but that adjustment of teaching load, red tape, allocation of responsibility and various administrative difficulties would preclude such a plan in most institutions.*

**RECOMMENDATIONS:** The Conference recommended:

- a. That consideration be given to the offering of a larger number of biology courses during the summer sessions; further, that institutions explore, with the aid and cooperation of certification agencies, the possibilities of extension courses where facilities and demand make them feasible.
- b. That annual one-week conferences be operated for biology teachers giving:
  - 1) Help in using simple materials for experiments.
  - 2) Demonstrations of new types of experimental work.
  - 3) Additional background and new developments.
- c. That appropriate credit be given to teachers for courses at any level. It is recognized that graduate students with teaching experience should not be in classes with college freshmen, but this does not preclude graduate credit for fields, e.g., general botany, which have traditionally been organized for presentation at the freshman level.
- d. That special subject matter courses be designed for the teacher and that these courses be scheduled at appropriate times.
- e. That full residence credit be given for workshops and work conferences which are comparable in length and quality to standard courses.
- f. That opportunity be provided for outstanding high school teachers to assist in the teaching of college courses, so that theory and practice may be more closely related.
- g. That consideration be given to the possibility of a special degree which will recognize the breadth of training needed by the teacher.
- h. That each science specialist be encouraged to feel intensely the responsibility to work with his colleagues in the high school on every possible occasion.
- i. That scientists prepare articles for journals designed for teachers.

- j. That science camps be operated for students and teachers.
  - k. That provision be made for substituting suitable extra course work, projects, and activities for the thesis requirement for the master's degree.
13. *How can colleges and universities effectively recruit and select secondary school and college teachers of biology?*
- i. By adjusting academic loads of college teachers to allow for extra-college contacts.
  - j. By distribution of attractive brochures, with frequent revision, on the teaching of biology as a career.
14. *How can colleges and university teachers of biology improve their educational philosophy and their teaching techniques?*

**RECOMMENDATIONS:** The Conference recommended recruiting and selecting secondary school and college biology teachers:

- a. By assigning the best teachers on the staff to teach the introductory college courses in biology.
- b. By encouraging research on the part of college teachers so that undergraduate students may become imbued with the desire to do creative work.
- c. By working toward salaries more nearly comparable to those in industry, government agencies, and other fields of science. Professional status, advancement and salary of college teachers should be based as much on teaching success as on products of research.
- d. By acquainting capable college graduates with the variety of scholarships and loans which are available for graduate study, with special reference to students in smaller colleges.
- e. By increasing emphasis on meetings at which competition in biology projects and problems at the high school and undergraduate college levels is emphasized, such as science fairs, science camps, and local science programs.
- f. By urging universities and colleges to increase their stipends for graduate assistantships in science.
- g. By soliciting from individuals and industries interested in promoting science at the undergraduate college level, scholarships in biology available to above-average high school graduates.
- h. By a more extensive use of aptitude tests in identifying and selecting potential teachers.

**COMMENT:** The college or university teacher is obligated to contribute to the advancement of knowledge through research, to teach, and to participate in the solution of regional and university problems related to his science. Any training of the college teacher must take full cognizance of these obligations.

The college teacher may extend his knowledge of educational problems through library research, study, and exchange of information with his colleagues in other institutions. The potential college teacher may be best provided the essential background in education, philosophy, history, and techniques through seminars and apprentice teaching under the direction of biologists.

**RECOMMENDATIONS:** The Conference recommended:

- a. That colleges and universities recognize and appropriately reward the good teacher through advancements in rank and salary.
- b. That joint seminars covering topics of mutual interest be scheduled for students and teachers of both biology and professional education. It was emphasized that in many institutions all the necessary machinery for such seminars already exists and that all that is necessary is a desire to use facilities already available.
- c. That teacher training institutions work as closely as possible with state departments of instruction, since these departments can only implement what is wanted by the institutions and by the public.

*Summary by* JOHN BREUKELMAN