Labs

Reviews—II

Don Igelsrud
Department Editor

Need for Standards

Last time I ended by comparing the ratings of pre-college biology textbooks produced by analyzing the extensive reviews published in Science Books and Films and the ratings of two Texas reviewers. When one looks at these ratings it is clear that the reviewers have been careful and fairly consistent in their analysis, because similar books are grouped together. The difference in ranking is related to the use of different standards and not to being capricious.

In their *A Consumer's Guide to Biology Textbooks*, Wayne Moyer and William Mayer refer to a list of criteria for textbooks that was published in the *AIBS Bulletin* 30 years ago (November 1957, pp. 26-28) and also list their own, on page 11. These criteria are similar to those described as organizational and pedagogical in the AAAS report *Science Books and Films*, the ones which were not included in the evaluation tables. These qualities seem to include most of the concerns one has when choosing textbooks. Like SB&F's other criteria, these are good, but no standards are given.

For most qualities it should be possible to develop explicit standards which can be shared with reviewers and readers. When I look at a textbook, one of my primary concerns is whether it is easy to read while still doing justice to basic concepts by explaining them in clear and meaningful ways. I test this idea by looking up discussions of concepts I know students have difficulty understanding, e.g. allele. Compare these explanations:

(a) The third new word is allele. It is a Greek word meaning "belonging to one another." We use it to refer to the individual members of a gene pair.
(b) The possible forms which a gene may take, dominant and recessive, are called alleles.
(c) It is also proposed that alternate forms, or alleles, of a gene for a particular trait are located on homologous chromosomes.
(d) The different forms of a gene at the same position (locus) on a specific chromosome are called alleles.

Because students often go back to the text to look up terms they are unsure of, texts need to state concepts briefly and accurately. Even though some concepts need to be presented in longer discussions and developed gradually, failure to state them accurately will lead to misunderstanding. Explanations a, b and c, even though improving in quality, are inadequate alone, while d is accurate and clear by itself.

Glossaries are notorious for propagating misunderstandings. Compare these definitions of allele:

(a) Alternate genes that may be found at a particular locus on homologous chromosomes.
(b) Dominant or recessive form which a gene may take.
(c) One of a set of genes that control a particular trait.

When textbooks attempt to cover large amounts of material in a few pages, concepts must be clearly and accurately explained, otherwise confusion is the only possible outcome. Obviously, exceptional understanding and writing skill are required to do this effectively and efficiently in a field as diverse as modern biology.

If a list of criteria with clear examples of different levels of quality was developed for textbook writers, reviewers and readers, quality would improve. These criteria should be developed by the most experienced users of textbooks: biology teachers and students. Even though James Koevening was listed as a biologist in the SB&F's review, he was the only reviewer who indicated he had used the textbook with his students and considered the experience in evaluating the book. He pointed out that despite the fact he thought the book was one of the best, his students did not do as well as they had done with other texts.

Because textbooks play such an important role in education, because writing a textbook is one of the most demanding tasks anyone can become involved in, because such a large part of a student's understanding of the principles of biology is determined by the quality of explanation in textbooks, perhaps the only people really qualified to review textbooks are the outstanding teachers who use them and are committed to their improvement. Anyone who has used textbooks knows that the only way to know how good one is is to use it.

It is quite likely that many of these textbook issues have been resolved by local textbook committees. Perhaps we need another column in *ABT* to consider textbook problems, get interested parties together and develop review procedures?

Refereed Journals

Lack of standards appears to affect almost all reviews. My research colleagues often refer to the luck of the draw as their papers and proposals are reviewed. In preparing for this discussion of book reviews I read papers in the *Journal of Research in Science Teaching* and *ABT* that dealt with textbooks. I would have raised serious questions about these papers if I were a reviewer.

The paper "A Study of the Relationship between Emphasis in High School Biology Textbooks and Achievement Levels" (1984), by Cho and Kahle, was the source of the categories used for specific content evaluation in the SB&F's reviews. Consequently, I decided to look at it to see how categories were chosen. The only information I found was that they were determined by a "panel of 13 external experts." When I read the rest of the paper, I was amazed at its assumptions and conclusions. The paper is an extensive study of 1973 and 1983 textbooks and achievement data. It uses sophisticated statistical methods to analyze large amounts of data. One of the study's main purposes is to compare textbooks published a decade apart to see if there are "significant changes in the degree of emphasis placed on 10 commonly accepted conceptual areas."

What is surprising is that three textbooks which were used by two-thirds

Donald E. Igelsrud began teaching biology at Delaware Valley College in 1966, became Biology Laboratory director at Northwestern University in 1973, and taught at the University of Calgary from 1976 to 1984. He is founder of ABLE (The Association for Biology Laboratory Education). Currently developing a series of biology videodiscs, he works through his consulting firm: LIFE Consultants, P.O. Box 3097, Postal Station B, Calgary, Alberta, Canada T2M 4L6. His main interests are in increasing awareness and understanding of living phenomena and in developing cooperation among biology teachers and institutions.

of the students enrolled in introductory high school biology in 1973 (BSCS green and yellow versions and *Modern Biology*) are compared with three 1983 textbooks that are in no way comparable. One of the 1983 textbooks, *Biology: Skills and Concepts*, appears not to have been published. *Biology: An Everyday Experience* is a book designed for below average students. *Biology*, a Scott, Foresman book, is the only one used by the market represented by the 1973 books, and it cannot be considered one of the most popular choices. The choice of these books for comparison to the 1973 books makes the results rather meaningless.

There is, however, an even more serious flaw. The results of this study are used to ascertain "the impact of the Biology Focus Group's recommendations on biology curriculum [sic]." The focus group refers to a paper titled "Biology Education in Secondary Schools of the United States" by Paul Dehart Hurd, Rodger W. Bybee, Jane Butler Kahle and Robert E. Yager, which was published in *ABT* in October 1980. This paper summarizes a large amount of information from NSF and NAEP (National Assessment of Educational Progress) studies of science education and includes many interesting statistics. It is an excellent source of information about the present state of biology education. The authors make a number of recommendations, including the following one about curriculum: "We concluded that the curriculum in biology (i.e., textbooks) should give much greater recognition to the central scientific and societal issues affecting students now and in the future. Briefly, the quality of life must be the focus of the biology curriculum."

The serious flaw in the Cho and Kahle study is that the biosocial emphasis recommended by the focus group is not reflected in the conceptual categories used to compare the textbooks. Therefore, it is difficult to understand how any conclusions can be drawn. Finally, the most surprising conclusion the authors make is that there has been no significant change in concept emphasis except in the area of "growth and development," which they separate from "cell theory" and "heredity." Any analysis which misses the current revolution in cell and molecular biology and is published must bring the review process into question.

The focus group study includes some of the best information I have seen about the current state of laboratory teaching. For example, "only 6 percent of teachers state that they had use for live plants or live animals (28 percent) in their life science classes." Needless to say, I was surprised that no recommendations were made to improve this situation, despite the fact that teachers thought there was a strong need to "hire and pay resource people to help teachers with their teaching skills." Again, I wonder what the reviewers had to say.

Another level of the review process that is never seen is the procedure for selecting what is reviewed. Because I feel the ABLE proceedings are one of the most comprehensive resources for laboratory teaching, I fail to understand why they have never been reviewed in *ABT*. The primary obligation of a review editor ought to be to see that materials that are of the most use to teachers are evaluated.

Because the AAAS and People For the American Way (Moyer and Mayer's *A Consumer's Guide to Biology Textbooks*) textbook studies are among the most thorough reviews of materials used by biology teachers, I have devoted most of this column to their analysis. The conclusions, however, apply to all review procedures and the message is the same: we need more well defined criteria so the general biases we all have can be included without influencing the whole review.

Criteria and Standards for Film

I began this discussion last month by talking about film reviews, and it is here that I hope I can make a more positive contribution. In 1979, I reviewed a film for SB&F that was developed for elementary school students. It was titled "Living and Nonliving Things." I thought the film was a good introduction to what characterizes living phenomena, but was surprised at the mixed reception it received from a half dozen dedicated elementary school teachers. Some thought their students would not be able to follow the rapid succession of ideas in the film, and others were concerned that it did not fit the process approach they were using in their classrooms. I wrote SB&F indicating that, because I saw a conflict between the views of the producers and the teachers, it might be best that films at this level be reviewed by a person more knowledgeable about the abilities of elementary students. As I look back on this experience, I realize that this problem is contained in some form in all reviews at any level. Every teacher has an opinion about what is appropriate for his or her class and students. Therefore, the best the review process can do is to objectively rank its subject in relation to a series of criteria that will help users determine how the materials may fit their circumstances.

One of the stimuli that prompted me to write about reviews was a review in the November/December 1986 issue of *ABT* of a film I had just seen, "The earthworm: Darwin's plow." It reminded me that each reviewer has his own standards. I would not have written the same review. Too often reviewers describe the contents of a film but do not give much information about quality. In my opinion, films should bring something to the classroom that cannot be easily accomplished there. This film uses what I would call home movie quality photography to demonstrate many activities that are easily and better shown in lab. It does contain some night pictures of earthworm behavior, and the hot wax cast of the burrow is interesting, but I would find it hard to justify the cost of this film—$350 for 12.5 minutes—given the number of other high quality films that are available.

On the positive side, I think there are a couple of solutions to the above problem of variable standards. Because teachers are often looking for films that present specific kinds of information, it should be possible to solicit comparative reviews from people looking for high quality films. For example, I previewed a number of films trying to find one that showed most of the events in human reproduction and development using living materials. Current technologies made it possible to produce such a film, but where was it? There were many films available, but most either used animation or were more appropriate for prenatal classes. Educational film/video locator descriptions of three films which show many of these events are:

Everyday Miracle: Birth 1980. BBC. Color 32 min. sd 16 mm. Documents through advanced microphotographic techniques, the nature of birth and the development of the unborn child. Views, photographically, ovulation, the inside of the Fallopian tubes, fertilization of the egg, and the development of the embryo in the womb. Traces the nine-month pregnancy of a young woman, showing the three ultrasound readings taken at various stages of pregnancy. Concludes with the birth of her child.

Miracle of Life 1983. Time/Life Films. Color 57 min. sd 16 mm/v-v. Documents human reproductions [sic]

through color microphotography inside living human beings. Exploring deep into the male and female anatomies, presents the first-ever footage of the conception of human life. Photographed by famed Swedish photographer Lennart Nilsson, features breakthroughs as it tracks the perilous odyssey of the sperm to the ovum. (Nova Series)

The Miracle of Life 1976. Pyramid Film and Video. Color 15 min. sd 16 mm. The wonder of new life is photographed as never before in this study detailing the beauty and biological precision of the reproductive process. Utilizing live-action microphotography, the film details the sequence of fertilization, cell division, formation and development of the first heartbeat.

Comparison and critical comments

The quality of photography in all these films is excellent. The Nilsson film is well known because of its television exposure on Nova and with David Suzuki on CBC's The Nature of Things. Despite the "first-ever" claims, the other two films show basic reproductive events better. The Nilsson film presents a distorted view of reproduction, emphasizing the male reproductive system and artistic photography, e.g. crystalizing hormones which are unidentified. The Pyramid film was photographed by Rokuco Hayashi and contains the best photography of early reproductive events, e.g. time-lapse pictures of sperm development. Unfortunately, the film ends abruptly with the development of the heart. The narration by June Lockhart is sensitive, but does not show the biological insight of Sir David Attenborough in the BBC film. It is an exceptional film, sensitively combining the emotions of parenthood with the elegant biology of reproduction. Living examples of all major events are shown in a balanced and informative manner.

The BBC film may have missed the attention of some because it did not make the "Editors' Choice" list in the November/December 1982 issue of SB&F. Only one biology film was listed, the EBE film "Photosynthesis," which also received a good review. How does an editor decide which is best when one review describes a film as state-of-the-art instructional technology, referring to animation quality, and another is described as a film of exceptional educational value? They have to look at the films and, if they don't have time, they make a choice.

If reviewers cannot compare similar films then they need explicit standards. One way to begin to accomplish this would be for reviewers to look at films which characterize standards of quality and styles of organization and presentation. In the same sense that biology textbooks tend to take either a process approach or an encyclopedia approach, films seem to be organized in two general ways. They either present information in a didactic style or in the form of a relevant story. Because some prefer one approach over the other, these points of view need to be acknowledged, but they should not interfere with the evaluation of other qualities.

As I indicated last month, the EBE film "Work of the Kidneys" is my choice for best biology film. It uses time very efficiently and is a fine model of didactic style. The BBC film "Everyday Miracle: Birth" is a film of equal quality and is an excellent model of relevant story style.

These two films also serve as good models for narration. The style is clear and the language used communicates a considerable amount of basic information. Often films tell you very little about the biology you are seeing. Many popular television nature programs are good examples of this problem because they are designed to entertain general audiences. You must ask yourself whether the classroom time the film takes is justified.

Also, does the film bring an experience to the classroom that is difficult to acquire by other means? Again, the two models are good examples. The Coronet film "The earthworm: Darwin's plow" is a good example of a film that makes a minimal contribution. You should also consider whether the film presents a well developed lesson that conveys an understanding of basic concepts or if the ideas are incomplete. The two models serve well here; the Lennart Nilsson film is a good example of incomplete coverage. There seems to be a growing interest in producing programs which have a mosaic format, e.g. the program on schizophrenia in the brain television series. Because students seem to have enough difficulty understanding clearly presented material. I question the wisdom of this approach.

Accessibility

Some films limit their audience's understanding by using technical language or by making assumptions about audience experience—the antithesis of being too general. Both of these qualities limit access. A film should make its subject and goals as accessible as possible.

Some of the films in the "Aspects of Animal Behavior" series produced by George Bartholomew and Robert Dickson of UCLA overuse technical terminology. This is unfortunate, because when terms that do not provide additional insight into the events being shown are used, it limits the films' use in lower level courses. I found these films difficult to rate because the quality of narration and photography was slightly below higher budget films produced by the BBC, National Geographic and other groups. Because some of these films may be the best ones available on their subjects, comparison with other films is also important here.

Accessibility has another dimension as well. Most specialists are often more pleased with presentations outside their area of expertise than with more familiar subjects. Even though we feel strongly about the qualities of a film, it is important to evaluate how your audience responds to it.