He doesn't seem to grasp its deserved place in the general scheme of things. As an amanuensis-grade technical editor who has jousted with a few outstanding jargoneers during his career, I know that science needs jargon. Without it, everyone—even I—would understand science. This would be calamitous. Consider the consequences if the most elaborate scientific abstractions were perfectly clear to every man, woman, or child. Jargon gives us something to live for, to impress upon our friends and colleagues, and to deploy in undermining our enemies. It enables us to persuade our bosses and peers that we are doing something constructively with our precious time. It gives us a chance to convince our wives and innocent offspring that we have something on the ball even if we can't fix the light switch or mend a broken toy. You gotta have jargon, lots and lots of jargon, because it creates jobs like mine. Edit it out of the scientific paper and you cast serious doubt, to boot, on the author's credibility. Many a scientist's or author's reputation has slipped down the drain because he has stubbornly refused to integrate jargon into his work. . . .

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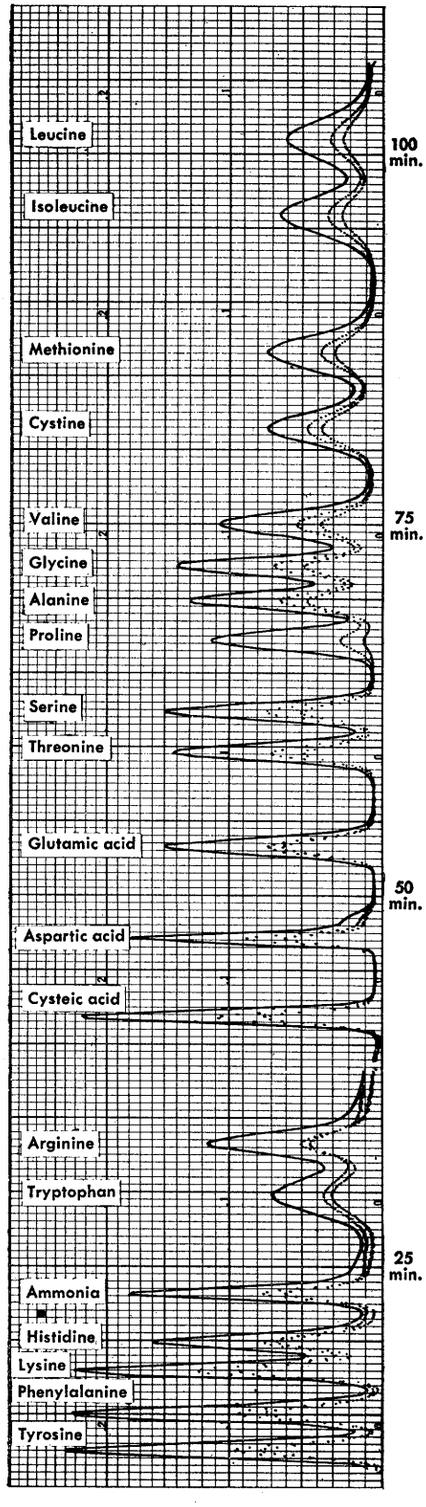
The editorial of 27 January incorrectly stated that Barbara Tuchman had "quoted the opening passage of a paper presented at the AAAS annual meeting as an example of bad writing." It was not Mrs. Tuchman but Fred Hechinger, the education editor of the New York Times, *who quoted that example. He used it in reporting Mrs. Tuchman's address at the meeting of the American Historical Association.*—ED.

Again, Classical versus Molecular Biology Studies

I should like to support Branson (Letters, 28 Oct.) in her concern at the prevailing attitude toward the teaching of high school biology as typified by the Biological Sciences Curriculum Study Blue Version. This attitude is expressed by Bonner (Letters, 23 Dec.) who implies that he regards so-called "classical" biology as neither "scientific" nor exciting.

I protest that classical biology has



This complete separation of amino acids in a protein hydrolyzate is made in 105 minutes using the Ligand Exchange System exclusive with Hitachi Perkin-Elmer's new Model KLA-3B Liquid Chromatograph. Unprecedented speed of analysis, excellent resolution, and a reliable flat baseline are all demonstrated in this run.

both these attributes and that it conveys them to the high school student more easily and directly than does cellular and molecular biology. The reason is this: any educational process should proceed from familiar matter and concepts into related ones which contain new features. In this way new experiences can be integrated and related with the individual's existing knowledge and understanding. This may seem a truism, yet a biology course which begins with amoeba or with the cell or with DNA comes very near to presenting the student with concepts and objects totally foreign to his experience and understanding. Too many modern biology texts do just this. It may be the logical sequence to the graduate biologist but it should be remembered that the student (who is only beginning the rigorous study of chemistry and physics) has limited experience and understanding and so is frequently compelled to accept many findings and concepts as articles of faith. "In the beginning was the Molecule. And the Molecule was DNA." Producing a rabbit from DNA can be as magical as producing one from a hat. However, if one starts with the rabbit, the nature and significance of DNA for the reproduction of rabbits can be shown in due course, when the student's experience and understanding of chemistry and physics are adequate for the task. It is perhaps significant that the BSCS Biology Teachers' Handbook has a section devoted to the physics, chemistry, and statistics necessary as a background to "the teaching and learning of modern biology."

If we avoid the schism between Biology B.C. (Before Crick) and Biology since A.D. (Anno Watsoni), and if we have an equal regard for the scientific achievements of the molecular biologists, Watson and Crick, and the biologists, Darwin and Wallace, then the question at issue is—what is the most effective and balanced way of presenting biology to high school students? I believe that it is to proceed from the human organism to the concept of the cell and sub-cellular components via functional anatomy, histology, and embryology; from man as a primate, through related animals, to the less familiar animal and plant groups and so to the concepts of evolution, the mechanisms of heredity, and the history of life on earth; from man in his environment to ecology, behavior, and social biology. Incidentally, a course of this kind will fascinate and educate those children (the majority) who are going to be ordinary citizens as well as those who will also become professional biologists. Such a scheme is not new, and the interested teacher can find a complete course in *The Science of Life* [H. G. Wells, J. Huxley, G. P. Wells (Garden City Publishing, New York, 1939)], although it clearly needs revision and the addition of the proper amount of molecular biology. This book is the product of three exceptional individuals whereas the BSCS courses are the result of a cooperative venture. The danger with such enterprises is that they reflect the attitudes of the majority to the exclusion of the insights of talented individuals. . . . Perhaps I should also add that I am a zoologist, for I should not like psychologists to be blamed for these reactionary views.

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My two children are currently enrolled in completely different biology courses. My daughter studies the BSCS Blue Version with an enthusiastic teacher who helped develop this version and the well-equipped laboratory in which it is taught. She enjoys and is stimulated by this study even though science does not figure in her future plans. It is an excellent course and does all that Bonner claims. On the other hand, my son studies biology in a different school, and this course, taught by an experienced and competent teacher, is traditional in that many kinds of animals and their habitats are studied. Field trips to the beach and valley are frequent. Numerous creatures are kept around the laboratory for the students to observe. My boy loves it and is being stimulated to continue in science.

My point is that it is the teacher, his ability and enthusiasm, and to some extent, the facilities provided, which are important rather than a particular version. It would be as unfortunate for the student to study the natural history approach with a teacher who had little experience outside the laboratory as to take molecular biology with one who had not himself mastered biochemistry and cell physiology.

The Yellow, Green, and Blue BSCS versions were originated with the idea that a particular teacher might choose

the one or combination best suited to his training and facilities. Let us continue to encourage more good teachers rather than worry about the precise subject content.

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My son is a nonscience major, a boy born and reared in a large metropolitan area, far removed from personal experience with nature. His first science course was a course in molecular biology, offered to college-bound beginners, with no previous instruction in physics, chemistry, or biology, and it was a devastating experience, time-consuming, anxiety-producing, with rewards incommensurate to the time and effort expended. After a year of hard work, he is well versed in DNA and in the theory of evolution, but he is grossly ignorant of classical biology. I feel strongly that my son was short-changed by the BSCS Blue Version course. Had the same amount of time been spent on *Modern Biology* [T. J. Moon, J. H. Otto, A. Towle (Henry Holt & Co., New York, 1960)], he would at least have had some understanding of the world around him.

Why couldn't classical biology be offered as an alternative course to these students unprepared or uninterested in molecular biology? What possible use is there for details of DNA or the Krebs cycle in the lives of nonscientists?

If a course in molecular biology is to be the biology course for beginners in high school, then I suggest the two cultures be separated. Let the science majors have this "intellectually interesting and stimulating course." Let the humanities majors have their own stimulating program. The college entrance requirements are, at present, the dilemma.

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. . . Last September our department gave an examination to our entering freshman medical students, prior to the formal course, in order to assess their background for microscopic anatomy. For the sake of convenience, we arbitrarily divided the test into three major categories of structural and functional information: namely, cytology, histology, and organology. Over 80 percent of our entering students were

knowledgeable about the structure of DNA, the triplet coding system, as well as many other aspects of cellular biology. On the other hand, less than 15 percent had any appreciation of tissues and less than 2 percent were aware of organ structure or function! While I recognize that 164 students represent an extremely small and select sample, it is indeed curious that the vast majority of our "pre-med" students were thoroughly familiar with the esoterics of molecular biology while all had little or no appreciation for tissues and organs and the essential processes involved in their function. Why, for example, were they familiar with the theoretical role of messenger RNA but could not relate this information to higher levels of biological organization?

Bonner suggests that classic biology should be taught in elementary school and molecular biology in high school. I am not convinced that the elementary school student is competent to understand or correlate out of context the "anatomies, ecologies, and taxonomies" proposed by Bonner with subsequent emphasis on molecular biology in high school. Since only a very small proportion of high school students will continue on into graduate work in biology, it seems to me that the profundity of knowledge being imparted to the *majority* of students is unjustified as well as unwarranted. I would assume that the average high school, and for that matter, college graduate would be a better informed citizen if the curriculum included not only concepts of taxonomy, morphology, and cellular biology but an appreciation of our bios in general. Such a curriculum would put a proper perspective on *all* biology. Would not a mature insight into the methods of conservation, the problems of animal behavior and population explosion, as well as an understanding of ecological relationships be important in providing for an enlightened citizenry? Is it rational to include simply for the sake of novelty recently acquired information whose significance is lost to the student? I believe that the role of high school biology is to provide a *fundamental* background so that a student who decides to continue in biology can do so and the overwhelming majority can appreciate the important role of biology.

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