the greater rate of alcohol loss via excretory channels support the belief that the rate of alcohol metabolism is a function of its concentration in the body. Since the blood alcohol levels upon which certain of Newman's calculations are based are frequently exceeded in actual practice, it follows that higher metabolic rates also occur, and that higher levels of alcohol consumption than those deduced by Newman from the rates of alcohol metabolism quoted by him are therefore possible. It should also be pointed out that, in considering the "maximal consumption" of alcohol, cognizance must be taken of the extreme individual variations in alcohol metabolism that are manifest throughout both the purely experimental and the clinical literature.

It has been shown with rats that consumption of 10% alcohol as a sole fluid source may be less than half their consumption of alcohol under conditions of self-selection (Williams *et al. Arch. Biochem.*, 1949, **23**, 275). If this is also true in dogs, as seems likely, then Newman's estimate of the maximum human consumption of alcohol, based on the forced consumption of 10% alcohol by dogs, may be less than half the actual figure. However, many rats on self-selection diets consume amounts of alcohol equivalent to 1,500 ml of absolute alcohol/70 kg man/day without grossly apparent physical effects! This fact suggests grave dangers in assuming that the rate of alcohol metabolism in men and in dogs is the same, for it certainly is not in rats (or in mice). The fact that the basal metabolic rate on a weight basis in dogs is generally about twice that of humans is a reflection of a higher rate of metabolism of many specific substances in dogs, and there is no obvious reason to think that alcohol is not among them. Finally, the fact that the acute oral toxicity of ethyl alcohol for rats (7.4 g/kg) (Welch and Slocum. *J. lab. clin. Med.*, 1943, **28**, 1440) is approximately four times that for humans is indicative of a species difference, which in this case follows closely (and perhaps fortuitously) the reciprocal relationship between species size and basal metabolic rate. A number of practical considerations thus suggest that the *maximum* consumption of alcohol by a man of average weight is at least two quarts of 100-proof liquor, and may even be greater in some cases.

ERNEST BEERSTECHER, JR.

The Biochemical Institute
The University of Texas, Austin

Textbooks and Courses in General Biology

An unjustifiably harsh review of a textbook of general biology (*The World of Life*, Pauli, W. Houghton Mifflin, 1949) in a recent issue of SCIENCE (1950, **111**, 368) has raised several fundamental issues relative to the teaching of general biology and the subject matter that should be included in a textbook for such a course. The principal criticisms in the review include: (1) that the book does not instruct in the scientific method; (2) that the author assumes the general biology student has no knowledge of chemistry and physics, and consequently he has a "futile" section in the book on elementary chemistry and physics; and (3) that certain subjects such as autocatalysis, growth and morphogenesis in terms of chemical and physical changes, and the physicochemical nature of mutations are omitted. These latter subjects, states the reviewer, should be included in a college student's main reading source in biology.

One wonders immediately how the reviewer has managed to give general biology courses only to advanced students. The writer has taught elementary courses in several colleges and universities and has never encountered a class in which the majority had a working knowledge of chemistry and physics. Very few freshmen students have a good background in both these subjects, and many of them take college chemistry and physics in parallel with general biology. In view of these facts and the relatively high percentage of failures in the first-year courses in these physical sciences, it is believed that any author of a general biology textbook is fully justified in assuming that the background of most elementary students in these subjects is slight.

Admittedly, first-year students should have some exposure to the elements of the scientific method, but to what extent this can be successfully taught is certainly a debatable point. It seems to the writer that the scientific method represents a concept that is gradually acquired as one's training proceeds. It is not something that can be unceremoniously stuffed down untrained gullets by requiring the student to read a section in a textbook. Most teachers do not expect a textbook to do all their teaching for them. Indeed, of what value are lecture and laboratory periods if they are not used to give supplementary material? Any elementary textbook that considers detailed scientific experiments and the many failures attendant thereto will very shortly accumulate dust on the bookshelf.

One unfortunate aspect of many textbooks of general biology is the encyclopedic nature of the contents. Apparently the authors feel that more adoptions can be obtained if all imaginable subjects and minute details are included. The text is often not written in an interesting style, and frequently continuity and organization are sadly lacking. As a consequence the average student is soon floundering in a maze of unrelated facts, while he suffers from a bombardment of technical terms. If the present trend continues, many textbooks will be forced off the market, unless the publishers supply special means of transportation for these overgrown biological hodgepodges.

In the writer's opinion, an acceptable textbook for general biology should have certain definite features. It should be from one-half to two-thirds the length of the average textbook available today. It should consider the most important subjects necessary for a good biological foundation, omitting details and many technical terms. It should be written in a readable style and published in an attractive format. Such a book would be adaptable for a wide variety of courses, for any instructor worth his keep can elaborate in lecture or laboratory upon any specific subject that he feels should be emphasized in his particular course.

There are, to be sure, many different kinds of courses in general biology. There are courses designed for spe-

cial groups, such as premedical and predental students; others, for the general student who has not committed himself to a definite program of study. Then there is the course that is required of all students who select biology as their natural science subject under certain degree plans. Many institutions have only one course, which is of the latter type. Within this group will be premedics and history majors; students of mathematics and fine arts; boys and girls with extracurricular college "careers"; and individuals who will never be exposed to additional formal work in biology. Last, but not least, we must remember that here are our potential biology majors; we certainly do not wish to discourage them at this stage.

Teachers who have specialized groups, or those connected with institutions that rigidly limit enrollment to students with outstanding high school records, are doubtless justified in covering more material and in giving more details than should be done in the usual course. However, in view of the varied backgrounds and interests of the majority of students, it is believed that courses in general biology should be taught with two fundamental objectives in view: (1) to create an interest in biology, and (2) to give the student a biological background that will serve for future study, and/or help him solve certain problems of everyday life. Such objectives cannot be attained by erudite discourses on autocatalysis, the physicochemical nature of mutation, and morphogenesis in terms of chemical changes. There are enough interesting and worth-while subjects to be introduced without confusing the student with highly technical and controversial issues. It should, of course, be made clear, even to the elementary student, that many unsettled problems in biology do exist, but any detailed consideration should not be undertaken at this stage.

One of the outstanding faults of many young instructors is that they apparently try to impart all their knowledge to their students within a single year. Disillusionment eventually comes to many but, unfortunately, not to all. Obviously the best teachers are in the group in which this does occur.

OSMOND P. BRELAND

Department of Zoology
The University of Texas
Austin

May I comment on Ravin's criticism of *World of Life*, by W. F. Pauli?

My own textbook, *Life Science*, had its first edition in 1941, its fourth in 1949. Pauli's text is definitely a severe competitor, and you might expect me to welcome adverse criticism of it, but, in my considered judgment, the book does not at all warrant Dr. Ravin's condemnation.

Specifically, Dr. Ravin is shocked that Pauli does not stress "growth and morphogenesis in terms of chemical changes; the relation between genes and metabolic processes." He says that these serious faults make it unsuitable for college use, and he relegates it to high schools.

Many of us are alarmed at the utter ignorance of biology exhibited by many, even a majority, of university graduates. It is pitiful to find supposedly highly educated Americans adhering, as they now do, to unsound pseudomedical cults, and believing gross superstitions. This is largely the result of a university curriculum which offers only specialized courses. Biology as advocated by Dr. Ravin will reach extremely few. Do not those who specialize in other fields deserve to know something of geology? Do not they vitally need to know something about biology?

I have taught upper division general physiology, which is a course that delves deeply into such matters as those recommended by Dr. Ravin. We find that for this work the student needs first to have had general inorganic chemistry, then organic chemistry, and preferably also physiological chemistry and general physics, as preliminary studies. All this is fascinating, valuable, but only for specialists in biology. How about the others?

One could teach beginners the relation between genes and metabolic processes, although research specialists realize that they have only begun to understand it themselves. One could teach growth and morphogenesis in terms of chemical changes—but one would then spend so much time in chemical essentials that no time would be left for all the vast field of application of biology to everyday life. Majors in biology would obtain these other items later, in other courses, but how about those who take just one biological course?

An ancient, wise aphorism states that an educated person should know a lot about something, and a little about everything. Texts like those of Dr. Pauli (and mine) contribute toward this, and serve university students well. For this service they should not be abstruse, and therefore Dr. Ravin's condemnation is regrettable.

Can anything be done to balance the scales of justice in such matters?

M. W. DE LAUBENFELS

Department of Zoology
University of Hawaii
Honolulu