Letters to the Editor

• **Brief letters—one or two pages—are more likely to be printed than are long ones, which may be cut.**

Evolution vs. Special Creation

The following letters are in answer to "A Challenge to Neo-Darwinism," by Duane T. Gish (*ABT* 32 [8]: 495-497).

Duane Gish's article "A Challenge to Neo-Darwinism" questions the fact of evolution itself. He claims that "there is a significant minority of informed people" who disagree with the firm establishment of the fact of evolution and have therefore organized a Creation Research Society. Frankly, I do not know of a single well-informed person who questions the factuality of evolution. The simple truth that in every sexually reproducing species every generation differs in the composition of its gene pool from the preceding generation is such an irrefutable fact. Nor is there any longer any question as to the mechanisms of evolution.

It is, therefore, not surprising that every well-informed biologist shares Richard Goldschmidt's view (quoted by Gish): "Evolution of the animal and plant world is considered by all those entitled to judgment to be a fact for which no further proof is needed." It is among nonbiologists that there still seem to exist lingering doubts. Physical scientists, in particular, have always had considerable difficulties in understanding biologic phenomena. That the rate of speciation might be 10,000 times greater in one group of organisms (for instance, freshwater fishes) than in another one (let us say, blue-green algae) is one such biologic phenomenon. The fact that a population of sodium molecules consists of largely identical "individuals" while a population of sexually reproducing organisms consists entirely of uniquely different individuals is another such fact. It is such a lack of comprehending the nature of biologic phenomena and processes that has prompted recent attacks of physical scientists on the evolutionary theory. Gish, himself, bases his scepticism on the following evidence: the refuted assertions of a mathematician, an obsolete concept of the viability of mutations, a refuted concept of the origin of higher categories, and the negative evidence of a deficient fossil record. Let me explain this in more detail.

Gish quotes the mathematical challenge presented by M. Eden, a professor of electrical engineering; but he conceals the fact that Eden's basic assumptions were quite thoroughly refuted by the biologists present at the conference to which Gish refers (Moorhead and Kaplan, 1967).

Another one of Gish's assertions is "that all mutations seem to be in the nature of injuries." This assertion is based on a total ignorance of literally thousands of published scientific reports (Mayr, 1970; Dobzhansky, 1970). Mutations range all the way from highly deleterious to highly beneficial. Naturally, within a given gene pool most of the beneficial mutations possible for that particular genotype have already been incorporated. However, as soon as the environment changes, for climatic or biotic reasons, the potential contribution of a given mutation to fitness may be modified and a previously deleterious mutation may become beneficial. Likewise, changes in population size and in the genetic milieu will affect the selective value of gene mutations. Finally, with some 30 to 50% of the genotype heterozygous in a given population, as has been demonstrated for the majority of species so far investigated, the process of mutation itself loses much of its relevance for the evolutionary process. What is exposed to selection are whole individuals and their integrated genotypes. Consequently, it is genetic recombination that provides the material for selection.

Goldschmidt's claim that the higher categories appear abruptly in the fossil record has been thoroughly refuted by Simpson (1953) and many other paleontologists. The fossil record is less and less nearly complete as we go back in the geologic timescale, and the intermediate groups are more and more frequently still undiscovered. One of the great puzzles, which no evolutionist would want to minimize, is the rather sudden appearance of the invertebrates at the very end of the Precambrian and the beginning of the Cambrian. This was a period of drastic changes in the earth's atmosphere and presumably in the oceans, and it is probable that this geophysical revolution was responsible for the suddenness in the appearance of the invertebrates. I do not see how one can use the negative evidence of an undiscovered fossil record of the evolution of invertebrates as proof for their "creation." Gish would like to have no fossil record at all for the Precambrian; he, therefore, writes, "Barghoorn, among others, *believes* [italics mine] he has found fossil microorganisms in rocks dated from one to two billion years older than the Cambrian." As a matter of fact, these old fossils are so beautifully preserved that no one can question their existence, and their occurrence has since been substantiated by Preston Cloud and several other authors. There is now an impressive literature on this biota, which can be traced back at least to 2.7 billion years and perhaps to 3.2 billion years. This is about the time when the earth's surface acquired a "climate" suitable for the existence of life.

The absence of "missing links" between higher taxa has always been used by creationists as evidence against evolution. Hamann (1892) claimed that mammals and reptiles are so utterly different, particularly in their jaw and ear regions, that an intermediate stage would be totally inviable. Now, 80 years later, so many intermediates between these two classes of vertebrates have been found in the fossil record that there is a major battle among the specialists about where to draw the line between reptiles and mammals and indeed whether it is even

possible to draw such a line. The oldest ancestral forms of most animal phyla were apparently small aquatic forms without much or any skeleton. The chance of finding specimens of such organisms in the fossil record is infinitesimally small; and, even if they were found, such soft bodies would presumably not show enough detail to permit reconstruction of the morphology of such an ancestor. As far as *Archaeopteryx* (between reptiles and birds) and *Ichthyostega* (between crossopterygian fishes and amphibians) are concerned, they are such ideal missing links that Gish's remarks fail to convince. What Gish apparently looks for is an intermediate archetype. Simpson, Rensch, I, and others have shown conclusively that such intermediate stages are always a mosaic of advanced and ancestral characters. *Archaeopteryx* was a bird with respect to its feathers, but it was a rather orthodox reptile with respect to many of its other structures (Mayr, 1970).

The world of evolution is full of wonders. There are evolutionary lines in which hardly any visible change occurred in 200 or 300 million years. There are others in which whole new higher taxa evolved in a period of less than five million years—indeed, in less than two million years. Increasing evidence indicates that the most profound evolutionary innovations do not occur in widespread, populous species but in rather small, peripherally isolated populations. The chance that such populations would leave a full fossil record of their evolutionary changes is virtually nil. However, even where the fossil record is missing it is usually possible to reconstruct the evolutionary change through combined functional and comparative-anatomic studies.

Even though the basic principles of the evolutionary theory have been confirmed by literally tens of thousands of scientific investigations, this does not mean that the evolutionary process is known in all of its details. There is still a great deal to be learned about differences (in evolutionary phenomena) between animals and plants, between microorganisms and higher organisms, and between sexually and asexually reproducing organisms. A study of *Evolution, American Naturalist,* and similar journals of evolutionary biology in other countries shows how much detail still remains to be filled in. It proves that evolutionary biology is anything but a dead field; indeed, it is perhaps more active now than it has been in its entire previous history. The discovery of the enormous genetic variability of populations and of the effect of population size on rate of evolution, the question of the possible effect of regulatory genes on evolutionary phenomena, and the study of the phylogeny of macromolecules are some of the recent developments that have led to entirely new lines of research.

It is these kinds of problems the evolutionists have in mind when they speak of the incompleteness of the evolutionary evidence. However, Gish seems to be a little uncertain as to the nature of scientific evidence. What the scientist accepts as "truth" (a word virtually never used by scientists themselves) is that which is consistent with the best available evidence. As Karl Popper has said so often, it is virtually never possible in science to "prove" anything. However, if a scientific theory is not correct, evidence will be found sooner or later that will permit us to "falsify" (refute) such a theory. In the light of this, let me emphasize that Gish has not brought forward a single piece of evidence that would "falsify" the theory of evolution as now accepted by the biologists. This theory is consistent with all the known facts to a far greater degree than any other interpretation of the organic world, and this is why it is accepted by every well-informed biologist.

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The fundamentalist point of view on evolution has not changed since the publication of *The Origin of Species*: the arguments presented today are essentially those of 100 years ago. That they have been refuted time and time again seems not to prevent their periodic re-surfacing. Therefore a general view of the fundamentalist strategy may help interpret Duane T. Gish's statements and similar writings to come. All of the antievolutionist polemics have a number of things in common.

The antievolutionists seem always to ignore the simple, irrefutable fact that mutations occur in populations. As long as mutations occur, populations will

Teachers who wish to become more familiar with creationists' arguments should read *Did Man Get Here by Evolution or Creation?*, published in 1967 by Watch Tower Bible & Tract Society and available locally from Jehovah's Witnesses. This 192-page book includes an extensive bibliography.—*The Editor.*

vary and species will change; and change is the material of evolution.

The antievolutionists never consider all of the evidence; rather, they attend only to the parts that fit their interpretation best. Because of the admitted gaps in the fossil record, paleontology is usually subject to their most critical fire; comparative anatomy, physiology, biochemistry, embryology, genetics, and the experimental aspects of evolution (including laboratory-produced mutations) are conveniently ignored. The favorite theme of the attack *via* paleontology is not what the fossil record does show but what it doesn't show—the thesis evidently being that the gaps in the record serve to damn evolutionary theory. (I am of the opinion that if the fossil record were complete in every detail, evolutionary doctrine would still be unacceptable to fundamentalists.)

A second favorite ploy is to take phrases out of context. In the 1930s I was privileged to take a course from Richard Goldschmidt, then at the University of California at Berkeley. No one who knew Goldschmidt could doubt that he was a confirmed evolutionist. To find his words used against the theory of evolution is equivalent to hearing that Paul spoke disparagingly of Christianity. Straining as they do to find tidbits from the evolutionists' table, fundamentalists lose sight of the fact that their quotations are taken mainly from articles debating the *mechanisms* of evolution—not from articles deprecating the general theory. Macroevolutionists and microevolutionists disagree not on evolution but on the means of evolution. This is the way science makes progress: proponents of various hypotheses rebut one another and continue further experimentation.

Fundamentalists take refuge in adjectives that purport to give validity to their statements. For example, Gish's aricle says "Not a single, *indisputable* fossil has ever been found in Precambrian rocks!" If one takes indisputable to mean unquestionable, then perhaps the author is correct: few things are unquestionable. In this light, the known Precambrian fossils obviously are not indisputable, for the author does indeed dispute them. Semantic dodges of this kind serve to becloud the issue and need to be challenged, as by the New Englander who said, "It is correct, but it ain't right."

Still another gambit of the fundamentalists is to present no evidence or data of their own but simply to quote enough people out of context to make them appear to be in conflict with one another. It is like editing a collection of audio tapes, taken at different times and in different localities from different speakers, to make it appear that the speakers were in colloquy—when in fact the conversations never happened.

A newer development in the fundamentalists' antievolution drive has been to attempt to equate religion and science. The establishment of a Creation Research Society implies that matters of faith and belief are subject to experimental research. But religion is a matter of faith and deep personal conviction, and science is a matter of ordered hypotheses capable of experimental analysis: to make the assumption that either is strengthened by the philosophy of the other is as ridiculous as trying to make an elm tree out of an automobile. The Creation Research Society will hasten the demise of religion if it persists in the attempt to transmute religion from a matter of unquestioned faith into one of *ersatz* science.

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"Let No Man Fear . . ."

The grounds upon which Christian scientific men can stand secure were admirably stated by Professor Dana in his recent lecture before the seniors, in which the subject of Darwin's theory was considered. In the course of his remarks he stated that belief in a development theory was not atheism, that the facts of science clearly indicate some plan of development, that Darwin's book was a work of great merit and that his theory accounts for the origin of some species. As for genera and higher groups, there will probably be found other laws to account for them. Let no one fear scientific investigation, for its results are only another name for God's truth. Such belief, enunciated by men of science whose position as men of Christian faith is unquestioned, should calm the fears of those who tremble before every new discovery, and show no faith in the strength and majesty of truth.

—*Scientific American*, July 1870
(reprinted in the July 1970 issue)

Enhancement-Effect Experiment

Regarding the article in the September issue, by W. E. Rauser, on the Emerson enhancement effect, permit me to quote C. D. Sculthorpe (1967: *The Biology of Aquatic Vascular Plants*, St. Martin's Press, New York; p. 115):

> . . . these early experiments may be criticised for their use of the bubble-counting technique for estimating the rate of photosynthesis. This technique, which still survives as the notorious "*Elodea* experiment" of elementary textbooks, is inherently unsuitable for its alleged purpose. Bubbles are only evolved when the internal gas pressure reaches a certain value and even then their composition may vary enormously in a single species, under apparently similar conditions, and over a very short time. The rate of bubbling is thus a highly inaccurate estimate of the rate of photosynthesis, even if corrections are made for the varying oxygen concentration of the bubbles.