Evolution and Modern Man

In his article "The world into which Darwin led us" [*Science* **131**, 966 (1 Apr. 1960)] George Gaylord Simpson proposes a criterion by which we can judge the validity of a hypothesis in natural science. "Perceptions that are not materially testable," he says, "or that have been contradicted by adequate tests are not rationally valid." Among valid perceptions he includes that of the truth of evolution considered as a fact, not merely as a theory. He acknowledges that "the import of the fact of evolution depends on how far evolution extends, and here there are two crucial points: does it extend from the inorganic into the organic, and does it extend from the lower animals to man?"

At these crucial points we look for a careful application of the criterion for rational validity, and we find: (i) some experts consider the experimental production of life from the nonliving as something not only materially testable but also as "imminent"; (ii) no evolutionist has seriously questioned that man did originate by evolution, although some have maintained that special principles are required to explain human origins.

In other words, the hypothesis of evolution is materially testable, and has not been contradicted by adequate tests. No claim is made that evolution, at its crucial points, has been established by adequate tests, or that it has been unambiguously observed as an accomplished fact. Nevertheless, we are expected to perceive the truth of evolution, and the fact itself is proposed as "a matter of simple rational acceptance or superstitious rejection." It takes very sharp perception, indeed, to see all this as a matter of fact, however satisfied one may be with evolution as a theory.

Furthermore, Simpson insists that, although the world certainly has purpose, and directiveness is characteristic of vital process, still these are amply explicable by natural selection. "The hypotheses of vitalism and finalism are not necessary. Everything proceeds as if they were nonexistent." The vitalism and finalism which are here rejected are not the classical principles of Aristotle, the father of biology, or of Harvey, the founder of modern biology. Both Aristotle and Harvey thought that organs such as the heart or the eye, which are normally found in certain types of animals, are inner ends or goals of embryonic development. These great naturalists reasoned that whatever happens is either by necessity, or by chance, or for a purpose. Normal organs of vision and circulation are not strictly necessary, as we know from the fact

that they are sometimes lacking, and sometimes are abnormal in structure and function. Nevertheless, they are useful instruments regularly developed in many species of animals, and so they are not by mere chance, which is haphazard. Consequently they are the ends of specialized development.

The embryo proceeds by active and orderly stages of self-development toward the perfection of the whole, and in countless cases manifestly attains it. This is the classical meaning of vitalism and finalism in regard to the individuals of concrete experience, which are the ones we know best. Any other account of these facts in teleological terms is a travesty of the classical principles of natural science. To say that everything proceeds as if these principles were nonexistent is to say what is manifestly untrue. An eye is produced by matter of a very special disposition tending actively in a definite way and in a definite environment to a definite goal. If Simpson wishes to maintain that an eye can be produced by matter which lacks an active tendency of self-development oriented toward a definite goal, he should meet the requirements of his own criterion for what is rationally valid.

WILLIAM H. KANE
Albertus Magnus Lyceum for Natural Science, River Forest, Illinois

George Gaylord Simpson's "The world into which Darwin led us" has left me rather puzzled and a bit disturbed. It was difficult to determine just what Simpson's purpose was. He seemed to be reviving the 19th-century science-religion battle, which few mature believers have difficulty with today.

Simpson seemed to say that religion has no right to claim mechanistic explanation of observable phenomena. In effect, religion should stay out of the laboratory.

What Simpson seems to misunderstand is that few modern believers in his "higher superstition" will disagree with his thesis. Religion has left the 19th century, even if only a few naturalists have. The old war is over—evolution in all its scientifically valid aspects can be worked very easily into traditional Christianity.

Yet, I still am trying to understand what Simpson was suggesting. Was it that science has finally enabled us to outgrow religion? That religion is no longer needed? The fact remains, however, that any scientist with a mature concept of and belief in the supernatural—and who understands the limitations of science—knows that science can never disprove the existence of a transcendent state.

Indeed, the day science claims ultimate explanation will be the day it

loses its humility, and thus its vitality.

Some day I hope to hear a naturalist recommend that our lonely and pessimistic 20th-century man come to grips with what is often called his spirit. The "Dr. Simpson naturalist school" may be stressing man's responsibility to himself, but it nevertheless appears that, even though he lives in an age of self-reliance, abundance, and various brands of "freedom," modern man has become a goalless, lonely prisoner of his technosphere.

Perhaps Simpson meant that the "higher superstition" is still too much with us and must be shorn away completely. But here he would have to assume that religion (the higher superstition) has had no positive role in the shaping of our culture. This has never been shown—and, sadly, few will admit that it deserves study. Perhaps somebody besides a theologian ought to suggest bringing man's essentially spiritual nature back into harmony with his evolving, material nature—his continually greater consciousness.

WIL LEPKOWSKI
Department of Agricultural Biochemistry, Ohio State University, Columbus

Kane and Lepkowski have interestingly widened the discussion by consideration of things not actually said in my article.

In that article I gave a criterion (obviously only one of several possible) for "perceptions . . . not rationally valid." That is not at all the same thing as a criterion for the correctness of a scientific conclusion, and the issue is obscured by Kane's assumption that they are the same, or that I thought they were. It has of course happened repeatedly that rational perceptions have been contradicted by subsequent scientific discovery. Two centuries ago it was rational for man's perception of himself to be based on the postulate of his special creation. Now it is known that the postulate was incorrect, and therefore its acceptance is no longer rational.

Kane further and even more significantly confuses the issue as to criteria for the truth of evolution. Evolution has in fact been established by adequate and positive tests, quite distinct from any negative criterion for validity of perception. I did not enumerate those tests because that was not my subject, because they are far too numerous and complex to summarize in an article, and because the more important of them are known or readily accessible to an educated American audience.

On the topics of vitalism and finalism Kane has changed the subject. I carefully defined those terms as they are understood by modern evolutionists in their relevance to phylogeny and evolution. Surely it is beside the point that Aristotle and Harvey, who of course knew nothing of evolution and whom I purposely did not mention, held different views. The obvious directiveness of individual ontogeny is another matter, one to which I did call attention and for which I mentioned the evolutionary explanation that makes vitalism and finalism (as I defined them) unnecessary hypotheses.

That, as Lepkowski puts it, "religion should stay out of the laboratory" is, on the other hand, a pertinent inference from what I actually said. It does not follow and was neither stated nor implied that all religion is incompatible with science or has no role in modern life. I expressly recognized the inability of science to solve the ultimate mystery. I also emphasized that quasi-religious concepts of vitalism and finalism (in the evolutionary, not Neo-Aristotelian, senses, please) cannot be scientifically disproved but are simply unnecessary and inappropriate in the laboratory.

Both Kane and Lepkowski are evasive as to the real point of such of my remarks as had any bearing on religion. That point is that opposition on solely religious grounds to well-attested scientific conclusions about the material universe is superstitious and impedes human progress. Evolutionists recognize that religion, in a suitably liberal sense, can be compatible with a rational, evolutionary concept of man. Lepkowski's suggestion that communicants of dogmatic religions now generally share that view is unfortunately not true. Even if other evidence were lacking, a look at my mail for a

week or two would disillusion him. A few sects, including the Roman Catholic, do conditionally permit the accommodation of evolutionary fact to official dogma. Even in those sects many pastors and most laymen nevertheless reject evolution on superstitious grounds, and it is well known that other sects forbid acceptance of this and some other facts established scientifically.

G. G. SIMPSON
Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts

Meetings

Program for Collecting Meteorites

The urgent need for a scientific program for collecting meteorites was a key topic at the 22nd meeting of the Meteoritical Society. Attended by 50 members and guests, the meeting was held at the Harvard College Observatory, Cambridge, Mass., 10 and 11 September 1959, under the auspices of the Smithsonian Institution. A symposium was conducted on the ages of meteorites and on the effects of the bombardment of meteorites by cosmic rays. During the regular sessions, participants read technical papers on the spectra of meteor trails, electron-probe microanalysis, meteorite craters, micrometeorites, cosmic dust, and tektites. Of particular importance was a conference held to discuss the critical shortage of meteoritic materials for research purposes and to outline a cooperative program to improve the situation.

A scientist working alone can do fruitful research on meteorites if he has suitable and adequate specimens. However, the efficient collection and proper distribution of meteorite samples requires the cooperative efforts of many people.

The amount of meteoritic material available in the United States is rapidly diminishing as specimens from private and institutional collections and the meagre supply from new falls are rapidly being used up in research. Meanwhile, our need for such material is growing rapidly. At present, researchers receive samples from only about one new fall a year, an amount far less than that required for the many investigations now being carried on. As a consequence, some important research cannot be undertaken, and some investigations presently under way are starved for material.

Importance of Meteoritic Research

Results important both to astrophysics and to our national space program have been obtained from the study of the chemical, metallurgical, and mineral composition of meteorites and from measurements of the amounts of radioactive and stable isotopes produced in meteorites by cosmic rays. These results have contributed significantly to our knowledge of cosmic rays in the far regions of the solar system; the frequency of collisions among asteroids, comets, and cosmic dust; the history of the temperature and pressure to which meteorites have been subjected; the abundances of the chemical elements; the ages of meteorites; and the time lapse between the formation of the elements and the formation of the meteorites.

Measurements of the abundances of long-lived radioactive isotopes in meteorites tell us the average of the cosmic-ray intensity in the same region of space at different times; measurements of the abundances of short-lived radioactive isotopes tell us the intensity of cosmic rays in different regions of space. Recently, the amounts of tritium (half-life, 12.4 years), argon-37 (half-life, 34 days), argon-39 (half-life, 260 years), and chlorine-36 (half-life, 3.1 $\times 10^5$ years) produced in meteorites by cosmic-ray bombardment have been measured in a few samples. The ratio