THE RELATION OF SCIENCE TO THEOLOGY

by Edward O. Wilson

Science has demythologized most of human experience by disproving traditional religious accounts of the origin of the world and substituting in their place a network of precise and experimentally testable, materialistic explanations. The discussion of interest now is between scientists and liberal theologians. It consists of an exploration of the residual domain of ethics and metaphysics.

The possibility remains that the physical constants, the taxonomy of subatomic particles, and the exact initial conditions of the big bang are all expressions of a divine will. If such fundamental properties had not fallen within a certain narrow range of values, the universe would differ radically from its present form; neither solar systems nor sentient organisms able to contemplate the meaning of existence could have evolved. Surely then one can interpret the universe as the creation of at least a cosmological god who has fine-tuned the physical laws in order to achieve his own adoration. But on the other hand perhaps there is a Borgesian infinitude of universes, and sentience arose only in that infinitesimal subset which by a kind of natural selection among universes possesses the essential properties for its contemplation. At this level of reflection we deal with metaphysics in the true sense.

Another possible refugium of divine influence is in the deep recesses of the mind. Altered states of consciousness, such as *satori*, epiphanies, revelations, and perceptions of absolute unitary being, may represent not the mere adaptive functions of the brain as an organic machine but a closer approach to a supreme intelligence who dwells in a transcendental realm. This biological god is a great deal more vulnerable than the cosmological god since it lies in the direct path of current empirical research and is subject to disconfirmation.

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At the level of the mind the disagreement between the scientific materialists and the liberal theologians reduces to two competing hypotheses. On the one hand the materialists, finding new insights in neurobiology and sociobiology, contend that the brain is solely a survival machine. They suggest that however wonderful its products, however magical seeming its poetry and altered states, the mind is a biological phenomenon obedient to physical laws. Sociobiology has given religious exaltation a Darwinian function: It is the set of enabling devices by which the individual merges his will temporarily with that of the tribe, reaffirms the value of collectivity, and survives the rites of passage and stress of personal tragedy.[1] An honest god is the noblest work of man, as Samuel Butler said.

The theologians respond with the alternative hypothesis: The human mind may well be a fully organic process as claimed, but it has achieved free will, gained some awareness of transcendent phenomena, and is capable of union with the creator god.[2] Materialist explanations are necessary but not sufficient. The human species has a final purpose, a destiny beyond the mere chance of mutations and the necessity of natural selection. The universe is a machine for making gods, as Henri Bergson said.

A spirit of rival eclecticism exists in these two interpretations. Each side believes that its truth subsumes the other. Theologians share Francis Thompson's vision of the hound of heaven, the divine spirit that overcomes all evasions:

> I fled Him, down the nights and down the days;
> I fled Him, down the arches of the years;
> I fled Him, down the labyrinthine ways
> Of my own mind. . .[3]

If this hypothesis is correct, deeper research into the nature of mind can only lead to an increasingly clear perception of the shortcomings of materialism. Even the most skeptical will come to realize that a biological god exists in addition to a cosmological god.

For their part the materialists are convinced that a different spirit, the hound of science, will prevail. Every nuance of mental action will prove not only to have a physical basis but also to represent idiosyncratic adaptations to the special environmental and social circumstances in which the brain evolved. When these Darwinian isomorphisms include what has hitherto been explained as divine revelation, the biological god will disappear and the concept of a personal deity will revert to the category of blind faith.

Testing by Modeling Brain Action

At the risk of appearing presumptuous, I wish to suggest the ground rules for the testing of the two competing explanations. As the brain sciences and sociobiology grow from their current infant condition into mature disciplines, we will not find it sufficient for them simply to explain mental phenomena as a concatenation of physical events.[4] The larger requirement is a theoretical understanding sufficient to simulate species of minds different from the human, yielding different ethics, emotions, aesthetics, and perceptions of what are regarded as transcendent phenomena. This creation of varieties of synthetic biological gods could be accomplished by models of brain action, utilizing computer simulations and working progressively away from the cellular mechanisms of human cognition. One could then test, in the sociobiological mode, whether the peculiarities of the human perception match the exigencies of the particular environments in which the evolution of the human brain is inferred to have taken place. If such matching does exist, then the mind harbors a species god, which can be parsimoniously explained as a biological adaptation instead of an independent, transbiological force. The species god is perhaps more potent than a tribal god but unlikely to be the reflection of a universal deity.

To a degree not generally appreciated, even among biologists, some of the key theoretical problems have already been solved. Sophisticated models of consciousness at the level of the cell have been created.[5] While not experimentally confirmed, they at least demonstrate the feasibility of explaining subtle mental phenomena on the basis of neuronal anatomy and physiology already understood. Moreover, brain models are no longer limited to information storage and retrieval. They incorporate intentionality, goal seeking, emotional valuation, judgment, and decision making.[6] Thus exploration of the mind problem entails less of philosophy in the mode of centuries past and more of scientific theory, which is composed of specific models based on relatively elementary neuron behavior.

It must be stressed that modeling has not yet successfully characterized human consciousness and other conceivable forms of consciousness. Whether it can do so is precisely the ultimate test I propose for scientific materialism. But of equal importance, such a program has now been shown to be conceptually feasible, and its main outlines have been drawn. Philosophical dualism and transcendental ethical categories can no longer be persuasively defined by unaided intuition. They have been rendered vulnerable to empirical analysis

and await confirmation or disconfirmation by the instruments of scientific analysis.

Gene-Culture Coevolution

Another difficult problem now yielding to investigation is the relation between genetic and cultural evolution. It is an error to think of the two processes as independent in a stratigraphic sense, with culture having recently come to overlie the old, animal genes. Instead the two are linked in a coupled system. This "gene-culture coevolution" is conceived as proceeding in the following manner.[7] The cultural choices made by individuals are influenced by the epigenetic rules of behavioral development, which are based on distinctive properties of sensory screening, interneuron coding, memory, and other cognitive processes. The cultural choices are influenced further by observation of the patterns of behavior displayed by other members of the society. This sensitivity to prior usage can be measured from the data of social psychology. Both the initial bias and the responsiveness to the behavior of others are innate traits. The final behavior patterns they produce determine the genetic fitness of the individuals and consequently the direction and rate of evolution of the underlying epigenetic rules. Thus genetic and cultural evolution proceed as a coupled system.

When the data of individual choice probabilities in a particular category of behavior are transmitted into social patterns by the employment of mathematical models, the result is an ethnographic curve, which gives the probability that the members of a given society will possess a particular frequency of cultural choices. To take one of the simplest cases, a probability of 0.99 of nonincestuous mating yields an ethnographic curve for small societies in which most of the societies have no incest but a few have a single case in each generation, and still fewer have two or three cases. Conversely ethnographic data can be employed to draw stronger inferences concerning innate bias in the development of behavior. For the first time it has become possible to link the data of psychology, social sciences, and population biology in a precise manner to make testable predictions.

One of the conceptually most important results of gene-culture coevolutionary theory is the discovery that epigenetic rules can be rigidly determined by genes and still produce a diversity of cultures. A rigid genetic determination does not fix the culture; it fixes the ethnographic curve. When the rules are diversified within a population, through either genetic variation among the members or phenotypic flexibility of individual genotypes, the ethnographic curve may

take a different form, but it still can be defined in a way that conserves the essential relationships between genes and culture.

This brings us to the most serious concern expressed over the intrusion of biological analysis into the realm of the humanities: that it is reductionistic by nature and thus insensitive to art. This criticism is untrue. Science is not just analytic; it is also synthetic. In the models of behavioral biology it is possible to analyze individual behavior down to the level of genes and neurosensory cells. But in the synthetic phase even the most elementary behavior of these biological units generates patterns of great complexity and subtlety at the levels of the organism and of society. The major features of the patterns become functional traits. As these holistic properties emerge more clearly, their effect on our perception and emotions changes in dramatic ways.

Consider a King of Saxony bird of paradise (*Pteridophora alberti*) in the analytic manner. The developmental program that will produce such a creature is encoded within the chromosomes. The finished nervous system is an ensemble of fiber tracts more complex by far than any computer or other human artifact. We will find adventure and aesthetic pleasure in exploring it deeply. Our analysis permits us to trace the events that culminate in the electric commands carried by the efferent neurons to the skeletal-muscular system. Increasingly we will understand this machinery by focusing on its cellular operations, enzymatic catalysis, microfilament configuration, active potassium transport, and so forth. There will come a time when the bird of paradise can be reconstituted by the synthesis of all this hard-won information. Once again the glittering plumage is added and the total form appreciated at a distance of centimeters. Then we see the bright eye open, the head swivel, the wings extend. Now we understand more deeply and shed many misleading illusions. The boundary conditions of the species have been defined. The initial conditions of this individual are known; its unique history has begun. Our way of looking at the bird of paradise changes in scale and emotional flavor. New geometric perceptions and aesthetic valuations are employed. We see the bird no longer in micrometers and milliseconds but rather in centimeters and seconds, the accustomed physiological scale and time of our ancestors, and we respond in a fashion more nearly resembling their own. The excitement of the search for the true material nature of the animal has receded, to be replaced in part by the more familiar responses of the hunter and poet.

What are these ancient responses? We must consider the human being in the analytic manner. The developmental program that will produce such a creature is encoded within the chromosomes. The

finished nervous system is an ensemble of fiber tracts more complex than any computer or other human artifact—I deliberately repeat myself. The human observer is to be observed like the King of Saxony bird of paradise. In sweeping back and forth through analysis and synthesis within the domain of behavior in such a manner, we can conceive of the appropriate linkage between science and art. Neither displaces the other. Instead the material wellsprings of art are made visible, and science is perceived as a form of artistic endeavor. The spirit is able to analyze itself, without loss or disillusionment.

The metaphor of the hound can be extended to suggest where the converging endeavors of science and the humanities will lead them. In Greek mythology Laelaps was the hound destined always to overtake his quarry. One day he was sent by Amphitryon to capture the Cadmean vixen, whose fate it was never to be caught. Confronted by the dilemma inherent in these two natures, Zeus simply ended the episode by freezing Laelaps and the vixen in stone. But there exists a solution to the dilemma, which I believe will emerge in the relation between science and the humanities. It is first that the true pursuer is the hound of science; we will see with increasing clarity that the biological god does not exist and scientific materialism provides the more nearly correct perception of the human condition. And second, as the materialist pursuer draws closer to the spiritual pursued, both will evolve into something new, permitting the capture and the resolution. Science, in the form of behavioral biology, must become more sophisticated in synthetic theory, paying greater attention to the histories and idiosyncratic variations of individuals and populations than is now the case. For their part the humanities will incorporate the knowledge of the genes, brain function, and biological history of man. Because of the complexity and subtlety of this information, and the rich opportunities to metaphorize it as a technique of individual poetic expression, the stringencies of scientific materialism will enrich rather than pauperize the humanities.

Sociobiology and Ethics

The potential of the new eclecticism is very well illustrated in the domain of ethical philosophy. One of the most telling criticisms of sociobiology has been that it appears to arrogate to itself the judgment of ethical precepts, but its credentials are inadequate.[8] Sociobiology can help identify the evolutionary origins and ultimate adaptive meaning of innate moral predispositions, but such conclusions are not a certain guide for contemporary societies. The naturalistic fallacy has not been erased by improved biological knowledge, which still de-

scribes the "is" of life but cannot prescribe the "ought" of moral action.

I believe that this criticism has lost a great deal of its force in the last few years. An understanding of the roots of human nature now seems essential to ethical philosophy.[9] Any judgment concerning whether an act is natural or abnormal depends on such information, through behavioral categories as diverse as cousin marriage, homosexuality, territorial prerogatives, and cannibalism. All attempts to define "natural law" by unaided intuition are dangerously incompetent. This is equally true whether applied to such personal matters as the wisdom of birth control or to the supposedly inevitable trajectory of economic history.

Furthermore, a scientific analysis of human nature appears to be the only rational way to make a cost-benefit analysis of societal change. To take an extreme example, the relaxation of the prohibition against incest, which has been seriously recommended by at least one anthropologist, would exact a terrible price on many people.[10] The offspring of incestuous matings suffer a much higher incidence of genetic disease due to increased levels of homozygosity. In the case of sibling incest, at least, such matings are automatically inhibited by an epigenetic rule of behavioral development.[11] To express this aspect of social theory in a more precise form, social management consists of moving populations from less desirable ethnographic curves to more desirable ones. A society may wish to increase the probability that its members will all be nonincestuous from 80 percent to 99 percent or more. Appropriately developed techniques of gene-culture coevolutionary theory make it possible to estimate the degree of change in the epigenetic rules of development required to achieve this desired result.[12]

Some epigenetic rules are relatively rigid, in other words insensitive to variation in early experience; the avoidance of sibling incest is an example. Others, such as choice of diet, are less rigid and can be altered in desired directions by appropriate training. If the rules in a particular behavioral category are rigid and the decreed change is large, the cost will be correspondingly high. The degree of rigidity, the effects of alteration on the final social pattern, and the cost in terms of required education and individual suffering are empirical problems that can be solved only through studies in sociobiology and developmental psychology. If such information can be made available, it seems far better to make final decisions concerning social control by democratic consensus, not by religious or ideological dogma, and to weight these decisions in favor of patterns that are biologically natural in this more exactly defined, biological sense.

Role of the Humanities and Theology

This brings me finally to the role of the humanities and liberal theology. The concern has been expressed that uncompromising materialism would lead to the elevation of scientists to unwarranted power as ethical judges and social planners.[13] In my opinion, nothing of the sort can happen. By definition scientists are specialists who work on the frontiers of knowledge. Alfred North Whitehead's characterization is true: Scientists do not discover in order to know; they know in order to discover. The ideal properties of the scientific method include openness and vulnerability. Scientists judge ideas harshly when their creators fail to make them conspicuously mortal. The ambition of every scientist is to invent a brilliantly original and powerful explanation and follow it with the statement that "this hypothesis will fail" if such and such an experiment is performed and yields such and such an exactly specified result. (And then it is hoped the experiment is performed, and the hypothesis is upheld.) It is also the ideal to make the result as crystal clear to as wide an audience as possible. This function of scientific exposition is being strengthened by increasing numbers of skilled, well-trained, and vigilant professional writers. As a result of all these qualities, scientifically derived information is unlikely to congeal into dogma, certainly not during long periods of time, and it is open to questioning by anyone willing to acquire even a moderate amount of expertise.

Derek de Solla Price has pointed out that knowledge grows at a faster rate than does the population of scientists, so that with the passage of time individual scientists control ever smaller shares of scientific knowledge.[14] Indeed the very nature of the scientific endeavor places a premium on specialization. Intense concentration is required to create salients on the scientific frontier. It follows that few scientists know enough, or care enough, to synthesize information, and still fewer are prepared to translate general knowledge into ethical philosophy and social action. While that role is open to them, and especially to the elder statesmen of science who are no longer fully active in original research, it seems to be the more appropriate province of the humanists. Scholars in the humanities and liberal theologians in fact concentrate on just those human issues that now are being so profoundly affected by the scattered enterprises of specialized scientific research.

The future I foresee is one in which the humanities gain power and responsibility by the absorption of scientific knowledge concerning human biology and behavior. No one will deny that to understand culture it is necessary to dwell, for example, on the early years of

Marcel Proust, syndicalism in Mexico, and the history of modern art. But mankind also must be understood on the scale of micrometers of neurons and milliseconds of neuronal activity and on the vastly larger scale of gene-culture coevolution. Proust, Mexico, and art are embedded in that larger reality and can be explained in more interesting, accurate ways by appropriate reference to it.

Liberal theology can profit from the same expertise, and conversely humanity will benefit if theology will undertake a clear-headed scrutiny of scientific materialism in each stage of its advance. Bitter experience has taught us that fundamentalist religion, which in its aggressive form is one of the unmitigated evils of the world, cannot be quickly replaced by benign skepticism and a purely humanistic world view, even among educated and well-meaning people. The reasons are the immaturity of the scientific study of mankind (which is being remedied rapidly) and the power and rigidity of the epigenetic rules that tend to draw people into dogmatic religions and religion-like political ideologies. Liberal theology can serve as a buffer. In one direction it can challenge scientific materialism by the deep questions it raises concerning the human mind. In the other direction it can compete with fundamentalist religion in serving the undeniable spiritual needs of a majority of the people, while strengthening its mission through the new truths it perceives with the aid of scientific knowledge.

NOTES

1. See my *Sociobiology: The New Synthesis* (Cambridge, Mass.: Harvard University Press, 1975) and *On Human Nature* (Cambridge, Mass.: Harvard University Press, 1978).

2. J. W. Bowker, "The Aeolian Harp: Sociobiology and Human Judgment," *Zygon* 15 (September 1980): 307-33; J. R. Nelson, "A Theologian's Response to Wilson's *On Human Nature*," in this issue.

3. Francis Thompson, *The Hound of Heaven* (New York: Dodd, Mead & Co., 1945).

4. These two fields are cited for the following reason. The brain sciences constitute a set of disciplines based on molecular and cellular biology. Sociobiology is the behavioral discipline based on population biology. Thus between them the two fields incorporate principles derived from the systematic analysis of the principal levels of biological organization.

5. See, e.g., G. M. Edelman and V. B. Mountcastle, *The Mindful Brain: Cortical Organization and the Group-Selective Theory of Higher Brain Function* (Cambridge, Mass.: M.I.T. Press, 1978).

6. George Edgin Pugh, *The Biological Origin of Human Values* (New York: Basic Books, 1977).

7. C. J. Lumsden and Edward O. Wilson, *Genes, Mind, and Culture* (Cambridge, Mass.: Harvard University Press, 1981).

8. Charles Frankel, "Sociobiology and Its Critics," *Commentary* 68 (July 1979): 39-47 (reprinted in *Zygon* 15 [September 1980]: 255-73); Bernard D. Davis, "The Importance of Human Individuality for Sociobiology," *Zygon* 15 (September 1980):

275-93; Alexander J. Morin, "Sociobiology and Religion: Conciliation or Confrontation?" ibid., pp. 295-306.

9. Wilson, *On Human Nature*; Mary Midgley, *Beast and Man* (Ithaca, N. Y.: Cornell University Press, 1978); Peter Singer, *The Expanding Circle: Ethics and Sociobiology* (New York: Farrar, Straus & Giroux, 1981).

10. Y. Cohen, "The Disappearance of the Incest Taboo," *Human Nature* 1 (1978): 72-78.

11. Lumsden and Wilson.

12. Ibid.

13. Frankel; Davis; Morin.

14. Derek de Solla Price, *Science since Babylon* (New Haven, Conn.: Yale University Press, 1975).

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