REFLECTIONS ON THE PURPOSE OF LIFE

by Hudson Hoagland

The question of the purpose of life is a meaningless one to some, since no acceptable operational procedure has so far been devised for answering it. A variety of answers have been proposed over the ages by philosophers and theologians, but these answers are satisfying only to those with faith in certain metaphysical or religious doctrines. As the doctrines change and wane, many answers, once satisfying, lose their significance. Thus, the widespread Christian belief held for centuries that the purpose of life on earth is to prepare for a life hereafter has ceased to have much meaning for most professing Christians.

The following views are inevitably colored by my work as a biologist, and I make no claim for their originality. We all find ourselves struggling with great amorphous questions of this kind as we go through life, and there often seem to be as many answers as there are questions since, unlike the simpler questions and answers of science, there are no operational procedures for coming to grips with them. It seems to me, however, that certain emergent ideas stemming from scientific investigations may be helpful in our considerations.

The concept of purpose collides head-on with the ancient unresolved problem of free will and determinism, and I would like first to consider certain aspects of this problem before discussing some personal reflections on the purpose of life.

Freedom, Determinism, and Purpose

A scientist operates under the tacit assumption that there is order underlying the phenomena he is studying; otherwise his work would be pointless. He hopes to find the nature of this order. He also assumes that all forms of order, both static and functional, have determinants, and his job is to find these out and make sense of them. If he is studying behavior of either animate or inanimate systems, he seeks the mechanisms of the behavior of the systems. Since all natural phenomena, including living organisms and their behavior, are subjects of successful

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scientific investigation, the assumption that events are determined by antecedent conditions and by environmental factors has been empirically justified by the success of science over the last three centuries. This tacit assumption that events have causes, no matter how complex and obscure, is thus essentially a hypothesis that science has repeatedly confirmed. I know of no scientists who work today outside of a deterministic framework. But the meanings of mechanisms, of determinism, and of freedom have undergone some changes since the traditional materialistic views of the nineteenth century, and these changes have come about through advances in science itself.

The "billiard ball" concept of atoms as irreducible material particles has disintegrated, and in its place we have twenty or thirty "particles" —electrons, protons, neutrons, mesons, etc., that may, in terms of internally consistent systems, be described either as "particles" or as "waves." Matter and energy have conceptually fused, and energy seems to be the more useful concept for dealing with the very small in physics at the level of atomic structure.

Heisenberg's principle of indeterminacy has pointed out that the more precisely one describes the momentary velocity of a subatomic particle such as an electron, the less precisely can one define its position, and vice versa. This results from the nature of inevitable interference with the particle or wave form in the very process of observing it. In the minds of some this principle of indeterminacy, established in the submicroscopic, has been a license to discard determinism at the macroscopic level; and, by utilizing our ignorance (i.e., unpredictability) of an electron's behavior, some would transform it into a capricious Maxwell's demon to control the statistical laws of physics. Thus it is argued that by trigger action it may bring about capricious behavior in macroscopic molecular systems. This view has been proposed by those hoping to show that mind can control matter, and so escape determinism. It is argued that the atom is energy, that matter does not matter, that the individual behavior of single atoms is unpredictable, that there is such a thing as mental energy freed from determinism by Heisenberg, and that therefore the will is free. The objections to this are that to call atoms "energy" or "not-matter" changes nothing in observable nature. Ignorance of all the simultaneous properties of a single atom cannot justify positive conclusions about atomic activities. And, finally, mental energy is operationally a meaningless concept—it is an analogy only, taken over from physical science.

Thus I find no justification for this approach as a solution of the "mind-body" problem. This problem has been with us since antiquity, and the controversies of the dualists and monists have raged for a least twenty-four centuries. We still cannot agree as to what mind and consciousness are. For me, as a neurophysiologist, I have found it expedient to define consciousness as an emergent property of the integrated action of complex nerve nets composed of many neurons. In an analogous way magnetism is an emergent statistical property of the orbiting patterns of a specific number of electrons of iron atoms in mass. Gravitation is a property of mass in aggregate. The ultimate nature of gravity is as much a mystery as consciousness. Natural radioactivity is a statistical property of the internal instability of some atoms. In this last example, the radioactive decay curve for a mass of any given radioactive isotope (billions of atoms) is highly specific—so much so that the decay rates for substances are excellent clocks for estimating the age of objects. These decay curves are determined by statistical properties of the atom species, although we cannot say which atom of the many billions in a sample will decay at what moment. This individual unpredictability of specific atoms would not justify our speaking of freedom and escape from control of radioactive phenomena.

We know that behavior is determined by the brain, but even the simplest organized pattern of behavior cannot be mediated by the action of a single brain cell. Rather, the patterned actions of many thousands are required for any conscious act. In turn, each action of the brain cell depends upon its highly complicated submicroscopic anatomy and physiology involving the interaction of many millions of molecules. Thus, after the manner of the example of radioactive phenomena just mentioned, there is no support for a view that the basic determinants of our behavior, including our thought processes, escape the statistical concepts of physical science.

I think it was Aristotle who said that the soul of a boat is in its sailing, that is, the manner of its functioning in its environment of wind and water. To me the soul of a man is the manner of his functioning in his environment, social and otherwise, and this is correlated with the organization of patterns of nerve messages and molecular arrangements in his brain. The idea of a disembodied psyche of soul is as meaningless a concept as is that of sailing without a hull, rudder, keel, and sails—like the grin of the Cheshire cat without the cat. If mind is a function of brain action, then mental process on the one hand, and brain physiology and biochemistry on the other, are two sides of the same coin. It is as meaningless to ask which causes the other as it would be to ask if a sailboat causes its sailing or if sailing causes the boat.

Niels Bohr has pointed out in relation to the physics of the very small that there is complementarity between two apparently contradictory, basic views. One of these views holds that subatomic units are particles and the other that they are waves. The same particle "really" cannot be both at the same time, but either assumption makes an internally consistent physics for mathematical treatment of experimental observations. In like manner, human behavior can at least theoretically be described and explained either by the internally consistent system of the language of introspection—in terms of conscious and subconscious processes after the manner of many psychologists—or, on the other hand, in terms of physicochemical events in the body, especially the brain, correlating internal processes with overt behavior, including verbal behavior. Bohr has also considered these two systems of interpretation of behavior as complementary to each other, arising from the unresolved dilemma of mind-body relationships.

While, for the reasons outlined, I feel that the new subatomic physics has done little to change the status of the mind-body problem in relation to freedom and determinism, there appear to me to be other approaches that have been helpful.

Ideas about the nature of mechanism have undergone change. It has been customary for people to deplore nineteenth-century mechanistic-materialistic philosophy and its rigidities. Material has become energy, but for the above reasons this seems to me not important to the question of human freedom and determinism. Conceptions of mechanism have changed from the clockwork, push-pull type of thing to more sophisticated concepts. Thus the mechanisms operating on living organisms include such concepts as homeostasis and cybernetics. We speak of mechanisms of control whereby changes in some part of a complex system modify a variety of events in other parts of the system. These modifications by feedback then affect the part of the system that originally initiated the change. This is characteristic of organicism, but is not confined to living organisms and is seen in the nonliving world, for example, in the solar system and in systems of chemical equilibria and chemical dynamics. Other examples of such mechanisms are electronic nets of communication and computers and control apparatus of automation now displacing many white-collar workers in industry.

The basic principle of negative feedback, whereby energy from part of a system is fed back to regulate and control further energy release of the system, is the basic principle involved in cybernetic mechanisms. Simple examples are engine governors, the thermostat that regulates the heating of a house, the guided missile that bounces its own radar waves back from the target and uses this feedback to regulate its steering and power to make it home on the target. Of course, computers involve a remarkable complex of feedback processes, including the utilization of information storage and appropriate retrieval, which corresponds in us to memory and recall. Purpose can be defined operationally in terms of negative feedback mechanisms; for example, purpose in this sense is built into the guided missile and the computer and the thermostat, enabling these mechanisms to accomplish ends of varying degrees of complexity, and this meaning of purpose is also basic to the operation of the brain and to human behavior.

While feedback devices of control have developed rapidly in engineering, especially in the last two or three decades, natural selection brought these mechanisms to a high order of development hundreds of millions of years ago with the evolution of synaptic nerve nets. Regulation of patterned contraction of muscles for orderly behavior at all levels, ranging from our breathing movements to posture and control of the limbs and to the muscles of speech, represent nerve mechanisms regulated by negative feedback. Thus the brain sends motor impulses to contract muscles. The contraction stimulates sense organs in the muscle that sends impulses over sensory fibers back to the brain informing it of the degree of muscle action. The control center responds by modulating, increasing, or inhibiting further output over motor-nerve fibers to the muscle. The constancy of control of our internal environment, the control of hormone balance, heat regulation, cardiovascular control, blood acidity, the balanced activity of groups of cells in the central nervous system (e.g., in the cerebellum, brain stem, basal ganglia, reticular formation, and cortex) are examples of mechanisms controlled by negative feedback. All coordinated behavior, conscious and unconscious, uses these mechanisms; without them organized behavior, including purposive behavior, would be impossible. By definition these are purposive mechanisms.

Feedback to the organism of information from its external environment determines learning and conditioning via "rewards" and "punishments" (i.e., reinforcing and aversive conditions). Behavioral scientists and neurophysiologists are making advances in understanding the mechanisms involved in behavior at the many levels of its manifestations. Throughout all these studies there runs the tacit hypothesis that behavior at all levels is dependent upon physicochemical events in the cells and tissues. Control by a disembodied psyche is a meaningless concept. There appears to be no reason to abandon this conclusion despite our ignorance of what we would like to know about the details of regulation of behavior and thinking by the brain.

For those behavioral scientists not interested in what goes on in the "black box" (the brain), there is held the view that behavior is regulated in a predictable way by suitable arrangements of aversive and reinforcing conditions, and this is empirically demonstrable. The psychiatrist dealing with problems of psychodynamics also operates on the assumption that his patient's neurosis is at least potentially interpretable by his past, especially his childhood experiences, and he speaks of psychodynamic mechanisms. There should be no conflict between the neurophysiologist, the brain chemist, the behaviorist, the geneticist, or the psychodynamicist. All are dealing with different aspects of the same behavior, albeit they use different languages in describing the mechanisms with which they deal. Mechanisms, as we have here been using the term, refer to any interdependent system of events. A clockwork mechanism is only a very special and highly simplified example of this larger concept.

To some students of behavior, free will is an epiphenomenon—an illusion, since all behavior is a resultant of our phylogentic development and the individual's experiences. However, the fact that we can never hope to know in detail the meaning to an individual of his plethora of past experiences, nor can we know the details of his genetic makeup and its impact on his brain function, for all practical purposes much of his behavior must remain relatively undetermined both to himself and to others. Thus, for all practical purposes, man may be considered to have free will. That this may be an illusion is unimportant. In any case, we shall probably never know whether it is an illusion or not. Anatol Rapoport has pointed out the paradox that if a person predicts his own behavior and then behaved the way he predicted, he concludes he has free will, that is, he decided on an action and performed it. But if that person predicted another person's behavior, and that other person behaved in the way the first person predicted, then the first person would conclude that the other's behavior was determined. Yet there is no logical difference in the bases for the two predictions.

In all human relations accountability is a necessity. Empirically, I cannot see how a modern society emancipated from magic, superstition, and animism can function unless the individuals *believe* that they are free and responsible for their actions, and unless society can hold them responsible. Certainly our deepest convictions tell us we are free to make choices. I believe that this intuitive conviction, regardless of its basis, has been important to our survival by processes of natural selection. The creation and advancement of societies and civilizations necessitate this assumption of responsibility of persons to make choices.

Purposes of Organisms Established in Evolution by Natural Selection

All complex plants and animals have descended from much simpler forms, and students of the origin of life have amassed convincing evidence that life on earth began some two to three thousand million years ago from the chance formation of large organic molecules, some of which, like those of the ribonucleic acids, were self-replicating. Were such an unlikely event as the spontaneous generation of such molecules to occur even once, evolution by natural selection could send life on down the ages. George Wald has pointed out that even an exceedingly improbable event of the "once to occur" variety may become a virtual certainty given a long enough period of time.

The line between living and nonliving systems has become increasingly blurred in recent decades by the discovery that viruses are nucleoprotein molecules and by other advances in biochemistry. Moreover, students of cosmic evolution have pointed out that all the ninety-some elements that compose the molecules of chemistry evolved from hydrogen atoms, and we are thus thrust back in time in our evolutionary continuum far beyond the era of living things on earth.

If life, as such, manifests a purpose, it is that of its own multiplication and increasing complexity with the passage of time. Darwinian fitness means only fitness to reproduce and multiply, not, as J. B. S. Haldane has pointed out, fitness for football, piano playing, or higher mathematics. The variety of forms or organisms results from screening by natural selection for adaptation to varying environmental factors. The variety of species is the result of chance mutations of genes, of which a very few may enhance fitness of their possessors to reproduce and leave offspring. This concept of the primary purpose of life to multiply is not a very inspiring purpose.

Man's unique place as a spectator of the grand cosmic drama is, to some of us, a sufficiently rewarding purpose of life. In addition, and more important, are the deep satisfactions derived from functioning as effective members of the human adventure through understanding, loving, working, and striving. These drives are deeply ingrained as a result of millions of years of biological evolution, and their realizations constitute for most of us the major purposes of being.

All the pertinent evidence of science indicates that human life is entirely a part of the continuum of nature. Man's brain, responsible for his remarkably versatile behavior, has evolved by the same processes of natural selection that have operated to develop the smaller and less complicated brains of less versatile animals. Man's great cerebral cortex is a specialized organ facilitating his survival no less than the wings of birds, the flippers of seals, the sonar of bats, and a thousand other specialized organs and functions that characterize living things. These specialized organs and functions, including the cerebral cortex, are organs of adaptation.

Each of us is what he is today because of information passed on from preceding generations and from day-to-day experiences of living. The differences between a fly, a cat, a dog, and a man, and many individual differences between men, are the results of information passed from parents to offspring by a chemical code of instruction in the nucleus of parental egg and sperm cells. This code constitutes the genes, and, depending upon the species, instructs the developing tissue how to make a fly, a cat, a dog, or a person, as the case may be. One of the greatest developments of the last decade has been the discovery of the chemical nature of the genes and the nature of their codes. The code is contained in the pattern of self-replicating molecules of deoxyribonucleic acid, called DNA for short. The organization and chemical structures of the DNA molecules constitute the blueprints of biological heredity. As cells divide to form the embryo, the DNA molecules located in the chromosomes of the cell nucleus of the fertilized egg also divide and are distributed ultimately to each of the thousands of trillions of cells that form the body. These DNA molecular structures are templates or patterns. Through several chemical steps, they are responsible for the production of the thousands of different highly specific proteins of which our tissues are composed. These include the hundreds of enzymes that regulate the metabolism, growth, and life processes of each cell.

Francis Crick has estimated that the information contained in the chromosomes of a single human egg is equivalent to one thousand printed volumes of books, each as large as a volume of the *Encyclopaedia Britannica*. So much coded instruction packed in space a millionth the size of a pinhead is required for transmission from parent to offspring to tell the next generation how to make a person.

We share this same type of coded information with all forms of plants and animals. Mutations are chance accidental changes in the alphabet of the code, that is, sort of typographical errors that are then passed on from parent to offspring and are inherited. Ninety-nine percent of all mutations are either lethal or deleterious to succeeding generations. Less than 1 percent may confer an advantage to its possessor at a given time and in a specific environment, and it is such occasional, rare, beneficial "errors" upon which progress in biological evolution depends. Biological evolution by natural selection is thus a very slow and wasteful way of transmitting progress. It has taken over two billion years to produce, from simple virus-like structures, complex species, including ourselves, that now inhabit the earth. For each species here today millions have perished in the course of environmental screening by natural selection.

Heritage and Progress in Sociocultural Evolution

Our second information system came into being when man became a species distinct from his apelike predecessors in the last million years. This information system is that of socially transmitted symbols, including communication by speech and later by writing. This system of transmitting a heritage from brain to brain is unique to our species. It is enabled by the organic evolution of the human cerebral cortex and of our bipedal posture, freeing our hands for purposes of manipulations. In contrast to the slowly modifiable chemical code of information transmitted by the genes, the verbal transmission of information from generation to generation by words and written symbols is cumulative and rapid. The father can teach the son new skills his own father never knew. This has made possible a new kind of evolution—social and cultural evolution. Social heredity of this kind has rapidly changed man's way of life and modified his environment, and it has had a feedback furthering biological evolution of the brain by processes of natural selection. The invention of agriculture about 10,000 B.C., and the invention of city-states five thousand years later, are examples of the result of this kind of evolution. The most remarkable example is perhaps the acceleration of change represented by science which, in three hundred years, has modified the human situation to a far greater extent than has happened over any other period in history.

There is an interesting analogy between biological evolution by genes, on the one hand, and social evolution by ideas, on the other. A creative scientist is one who has many ideas and who is free to test and develop them. Many of these he discards as worthless, but some withstand the rigor of experimental testing and may constitute valuable advances. Several writers have pointed out that new ideas are analogous to new mutations of genes.

Henry A. Murray has coined the term "idene" in relation to social evolution analogous to gene in biological evolution. As I mentioned, most genetic mutations are lethal, harmful, or worthless—a very few constitute the basis of advancing biological evolution by appearing at a time when the environment happens to confer an advantage to the organism possessing that particular mutant gene. There is environmental selectivity not only to favor the viable gene mutation producing biological progress, but also social environmental selectivity to favor certain ideas contributing to social progress.

Like mutant genes, an idene can be "before its time," that is, the social climate may not be right for its acceptance—and many ideas are harmful and may even be lethal to the individual and to society. Here one might mention nazism, facism, militant communism, McCarthyism, and other forms of chauvinistic nationalism. Just as many mutant genes may be lethal for a species, so ideas, such as those that may produce nuclear war, can be lethal to the human race unless suitably controlled. The nation-state is a relatively recent social invention. But if its sovereignty continues uncontrolled by enforceable supranational law, it may soon, in the environment containing nuclear and biological weapons, become a truly lethal idea for our species.

Ideas thus may be considered to be to social evolution what genes are to biological evolution, and selective processes operate upon both. Societies are built by ideas and, within limits, the more new ideas to compete with each other for social acceptance, the more effective social evolution is likely to be.

Freedom of individuals to express and develop many ideas is necessary for progress in social evolution just as many mutations must be screened by natural selection for the development of an improved, or a new, species of plant or animal. In the case of social evolution, the impact of idenes is measurable in years or at least in centuries, while in biological evolution the time scale for mutant genes to establish new forms is more nearly measurable in millions of years.

While novelty, in the form of mutations and new ideas, is necessary, respectively, for biological and social progress, the environmentally tested genes and ideas must have stability and continuity to maintain stable species and stable societies to resist effects of lethal genes and idenes. In other words, conservatism, as well as plasticity and novelty, is necessary for progress.

A free society is one that is open ended and pluralistic and that encourages the development and testing of new ideas, and it is at the level of selection and development of significant ideas that science is most valuable.

The selection of ideas by controlled experiments and scientific observations is rapid and is responsible for the vastly accelerated changes in the human situation that have occurred in the last three centuries. The application of the behavioral and social sciences to testing the values men live by is in its infancy, and I believe has great potentialities for the advancement of social evolution.

If we think of a time scale for measuring life on earth as equal to one year, instead of two billion years, then modern man as a species has been on earth for only about a little less than an hour of that year, and he has lived in cities, that is, been civilized, for about two minutes. He has practiced science for only about one second of the year, and lived in the nuclear age for only a tenth of a second.

When we consider the potentialities of progress by social evolution given velocity by the booster rocket of science, what a future man can have if he can learn to control his two-hundred-million-year-old instinctive aggressions and his group hates and so refrain from committing nuclear suicide and becoming another extinct animal. It is possible that our generation may have to make this great choice—and the choice could be a final one for our species.