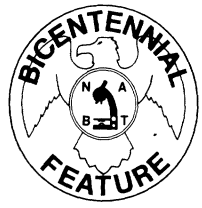
Science and Cultural Values



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SCIENCE AS AN EXPERIMENTAL PHILOSOPHY or a rational intellectual process is perhaps independent of culture and may be constant through time. However, the *role* of science in society is related to cultural changes. Various rapidly evolving disciplines and technologies associated with the respective disciplines are in response to societal problems and issues (see Ost 1974). Ecology, astrophysics, and polymer chemistry are components of science which have come into their own as a result of the interrelatedness of science and society. No longer can science be simply considered as those endeavors which are objective and free of values.

The importance of ethical systems in technological societies is becoming increasingly more evident. Glen T. Seaborg (1966) considers the issue when he suggests that man's system of ethics and his systems of science and technology ". . . have come face to face, where he can scarcely treat fact and value separately, and where he may see principles as diverse as the Second Law of Dynamics and the Golden Rule being considered side by side in the making of decisions which determine his future." Science does not exist in a vacuum. The norms of conduct for using an intellectual tool such as science should evolve as the norms of conduct for societal members evolve. Norms for the conduct for science must be modified in a manner consistent with the needs of the people and purposes of the culture. There is some indication of this occurring as evidenced by the 1975 Asilomar Conference of scientists and nonscientists. Although the issues are not clearly focused, the mechanics not well developed, at least the conduct of science is beginning to be monitored by the scientific community itself.

In the sections that follow, the role of values as related to pure and applied sciences will be discussed. In addition, an attempt will be made to relate the process of science to values in an educational context.

Effect of Values in Science

It is widely held that a major difference between science and values lies in the realm of objectivity. An often pointed to criterion or test of scientific objectivity is the exclusion of value-laden positions or value statements. In theory, pure scientists concern themselves with the discovery of facts and principles. The norms against which such facts and principles are tested are supposedly established in an objective plane. What is traditionally classified as pure science is the attempt to determine what is true in nature and to distinguish such truth from the illusory as well as the false.

There are fundamental errors in the position outlined above. While it is fine and good to speak of the objectivity of science, it must be remembered that science has its origin in human values and is itself a value system. Subjectivity systematically occurs in science; the establishment of statistical levels for accepting or rejecting hypotheses is so determined. Another problem lies in the fact that the direction science takes is determined in a manner less than objective. Norms established by the culture within which science operates are highly influential in determining the focus of science. Value-based norms determine the boundaries of scientific inquiry in social areas or aspects of life and death. In addition, the supposition that norms remain static in the dynamic social system is one cause of public mistrust of science. The science of one era could only appear to be magic to men of earlier days. At the heart of the public value-system about the progress of man is a shifting faith in the progress of science.

Still another notion that results in misconceptions about science is that there exists a pure science and a separate applied science which may be viewed as technology. In truth, there is little science being done today that is not to a greater or lesser degree being carried out for a specific purpose or intent. This scientific enterprise, both the pure and applied, is of course founded in a system of cultural values.

Seventeenth-century scientists would have had difficulty predicting the problems of pollution and overpopulation we currently face. They could not have imagined the modern weaponry of war, or the advances in psychology and pharmacology that make mind control a reality. Cultural values would seemingly have been a major preventive factor to scientists or anyone foreseeing the advent of genetic manipulation. It would have been unthinkable to seriously speculate in this area. To the seventeenth-century scientist such possibilities would have seemed more allied to sorcery than to science.

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Science as Subverted by Societal Norms

In our contemporary society the direction of science and its sibling, technology, are determined primarily by national priorities and by corporate economics. When governmental agencies are established and given large amounts of money to be used for some expressed purpose, the concept of value free science becomes as archaic as the theory of phlogiston. Private foundations are equally responsible for fostering goal-oriented science through their funding practices. Contemporary science is swayed to and fro due to political pressures and the modern method of "commissioning" studies through granting agencies. Examples of such forces can be seen in the focus on cancer research, the need to relate research results to national defense, and the recent political pressure brought to bear on the National Science Foundation. The result is that when research or development money is sought, the request for money must clearly illustrate how the proposal relates to the "priority" goals. Similarly, the request must not touch upon areas classified as "taboo." A narrowing of research results.

It is not clear how specific research areas become "taboo." No doubt much of the concern is a result of values existing in the culture. Since much of science is federally funded, the citizenry feels it has the right and responsibility to make its feelings known. The controversy surrounding research on the genetic basis of intelligence, public interest in the cause and cure of cancer, and the focus on the dynamics of sickle-cell anemia are evidence of the response of science to such influences. While science should serve society, it is not always clear what avenue of research would best serve the interests of society. What appears to be most readily acceptable to most members of society is that science must clearly relate to the day-to-day problems of the moment.

The public responds favorably to science activities that concern the development of alternative energy sources. It is easy for people to identify with high prices for gasoline and heating fuel. However, it is clear that a major national push for solutions to short-term problems is detrimental to the long-range advance of science. Although quick answers to temporal problems are politically valuable and economically remunerative, narrowly focused research programs are costly in that parallel basic research programs in other areas are shortchanged. Generally, major scientific breakthroughs and the development of satisfactory solutions to problems result from interaction of all areas of science at the levels of both basic and applied.

Effects of Technology

Goal-oriented science produces much technology. When a "goal" is established, the technology must be developed to attain that goal. Thus, in striving to attain an objective, the technology may be even more generally able. Putting a man on the moon resulted in the development of countless technological devices which were used specifically for that purpose but which had a use and value to basic scientific research as well. In this manner technology provides direction to science.

Many problems studied in pure science are more a function of the available technology than of the research interests of scientists. In this sense, pure science is a luxury—a dividend paid for by technology or applied sciences. Witness the roles of the computer, the electron microscope, and the cyclotron. Their effects on scientific endeavors have been startling. Much can be learned of reality and nature by employing these pieces of modern technology. However, it is doubtful that such technologic apparatuses would have been developed had there not been a need for their efficiency or utility.

Science, in a broad sense, is a search for orderliness or structure in nature; it is an intellectual tool for knowing, viewing, and controlling nature. Orderliness and structure of reality are directed by natural forces. The individual masters these forces through understanding; this in turn leads to the discovery of additional hidden patterns of natural phenomena. An increased understanding of the laws of nature makes it easier to apply scientific principles, laws, and patterns to practical and humanistic needs.

Although science and technology have advanced by this hand-in-hand approach, preoccupation with progress as defined by technologic goals and values has resulted in a situation in which the human race is endangered. A few short decades ago it would have been unthinkable that economic growth and expanding technology could be a source of human problems. Since then the nature of technology itself has changed. The building of machines to do work has given way to apparatuses which process information, alter human consciousness, and influence human behavior. The evidence is found in computers, electronic media, the shift to a moneyless society, and the focus on a technology of human behavior by principles of behavior modification and drugs.

People, Science, and Values

The emphasis on individuality has always been a cornerstone of western thought. There is, however, no reason to believe that this value as reflected in the conduct of cultures is a positive attribute. "Finders keepers, losers weepers," "First come, first served," "Last hired, first fired"—all seem to be natural characteristics of such a belief. It would appear that in the evolution of cultures, attributes that provide short term gains but really do not express altruism or insure the long term survival of the culture are naturally selected for. Although cultural evolution has been super-

imposed upon the biological evolution of man, to assume that these evolutionary processes also provide value norms is an oversimplification. Evolution also produces many blind ends; values may be one mechanism to destroy the less fit.

If one makes a brief survey of political institutions, the relationship of tolerance with the success of the scientific community becomes apparent. In order for the scientific enterprise to be successful—to thrive and grow—value-related actions such as dissent, challenge, and questioning must not only be tolerated but encouraged. Societies that hold to such values seem to provide the freedom necessary for creative and independent thought. The Greek city-states are historical examples. When looked at as a whole, the thirteen colonies also afforded their members these luxuries. In such an intellectual climate, the poet, philosopher, and artist all benefit in an amount equal to that of the scientists. However, it is public scientific rationality within the society which sets the stage for such intellectualism. It appears that only when such an atmosphere exists can humanistic values of love, concern, and personal interaction develop and become part of that society. The role of science in communistic nations is of interest in considering this point. The significance of public scientific rationality in evolving communistic countries has been explored by Allen (1974), Woodward (1974), and Bugliarello (1975).

The problem of the self-renewing society is addressed by many authors (Gardner 1965; 1969), (Glasser 1972), (May 1975). Self-renewal could be viewed as an evolutionary process similar to adaptation by cultures. A symptom of societal stagnation frequently pointed to by such writers is the emphasis on acceptance rather than doubting. The making of dogmatic declarative policy statements which invoke closure and cut off debate provides evidence of such rigidity. As a society matures, as it becomes increasingly adapted to a niche, it tolerates dissent less and less. Values associated with culture maintenance gradually replace those that have instigated and brought about a dynamic social institution. On the other hand, a self-renewing society fosters open questions leading to inquiry and investigation.

As our society increases in complexity due to population growth and the reliance on technology, values take on another dimension. An increase in population places greater burdens on the economic structure and the technologies that support it. The problems of energy sources and pollution are two obvious results. As the population increases, additional social structures are needed to maintain order. "First come, first served" is not an adequate value to provide social structure. The cost is a reduction of individual freedoms. Whereas science frees the individual, technology demands greater dependency and decreased personal latitude. Man cannot add to the social structure without relinquishing some personal freedoms. It is impossible to maximize two mutually contradictory variables at the same time; freedom and order cannot both be maximized. One must give ground to the other. The value structure must therefore accommodate to the inevitable trade-off as solutions are optimized in an increasingly complex society.

Some evolutionary theories suggest that there is no natural mechanism available to redirect what might be considered as technological overspecialization, characterized by a reduction in variation by increased selection and reduced "mutation" of ideas. There is hope that these theories may not apply to cultures. Man has evolved the ability to choose, the intellectual tool of science, and considerable cognitive plasticity. The increased dependence upon forms of technology which would lead to the atrophy or selection against what might be described as human qualities may yet be tempered. The answer does not lie in less technology but in more. Social structures must insure human dignity; institutional technologies can provide the regulation, the rules, the information to provide for individual autonomy as desired by Jefferson.

And Education

Those who have studied science are aware of the advantages this intellectual tool can provide for the individual. Scientific rationality can be used for the development of solutions to problems ranging from personal anxieties to those associated with technical endeavors. Science offers the individual a systematic mechanism for objective analysis of physical reality as well as the reality of the individual mind. Values are part of the reality of the individual; science could be a vital ingredient in the process of value clarification (Kuhn 1973; Samples n.d.; Creager 1975). Science could provide the individual with a systematic mechnism for identifying values that are operative under specific sets of circumstances. The concept of Reality Therapy, as developed by Glasser (1965), is but one example of rationality being systematically employed to better understand an individual's personal reality. It is one aspect of a technology of human behavior (see Skinner 1971). As with any technology it may be employed too quickly to foresee the problems associated with it. Wide-scale use of behavior modification techniques such as are being employed in the schools may be premature. The spinoffs may be as dangerous to the society as pollution.

And the Future

The classical view of value education seems to be one of inculcation of current values. Yet there seems to be no objective basis for determining which values should be passed on to the next generation. The values of today are very much a part of tomorrow. Yet the fu-

ture will not simply be a reflection of the present. Testing and experimenting with the value concepts of today, even if it were possible, would not prepare the individual completely for tomorrow. Values have a quality that is inaccessible to empirical analysis. This is, no doubt, due to the individuality of value perception which is not verifiable under classical scientific scrutiny. However, the individuality of value perception does not preclude using science for identifying values and using an empirical approach to search for cultural similarities and differences. Knowing evolving patterns and structures of value systems might be useful in the process of value education.

Herein lies a rationale for science education. Science education has long been focusing on reductionism in science. Synthesis of ideas, the looking for structure, the identification of complexity levels occasionally occur in science education programs. However the analytic component of science usually is highlighted—a pyrrhic victory. Patterns and relationships are perhaps the better picture of reality. Man is part of a system. What he does is related to all of life. Why he does it may also be a pattern. The ability to identify patterns can be gained through science education. Rather than stopping with the identification of values, through value clarification, an awareness of the pattern or system might better benefit the student. Thus, the analytic and synthetic components of science would be employed for a more complete picture of reality.

Encouraging the asking of questions and the search for solutions might be the best preventive measure against future societal stagnation. As Peter Abelard suggests (in Bronowski 1956), "by doubting we are led to inquire and by inquiry we perceive the truth." Cultural values will not evolve if future generations are not trained to challenge their predecessors. Science can be the objective approach for such a challenge. Instead of a narrowing of alternatives a broadening of choices would result. As has been suggested by George Gaylord Simpson (1949): "Plan, purpose and goal, all absent in evolution to this point, enter with the coming of man. Man alone knows that he has evolved and is still doing so. . . . [He] has increasing power to choose. . . . Choice may sometime lead to what is good and right for man. Responsibility for defining and for seeking that end belongs to all of us."

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