ELEMENTS of MODERN CULTURE

science in the new humanism

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Reference to any standard dictionary reveals three definitions of the word "culture." The first defines culture as "the concepts, habits, skills, arts, implements, institutions, etc., of a given people at a given period." The second definition denotes the processes which promote the training and refining of the mind, skills, emotions, manners, tastes, etc. The third definition denotes the results of these processes, namely the refinement of thought, skills, emotions, manners, and tastes. We shall spend very little time on modern culture as understood in the first definition. I have no desire at all to discourse on the modern concepts, skills, habits, arts, and institutions of the United States as popularly understood. This would only provoke endless argument on good and bad taste and a lamentation in which the words vulgarity, sex and status symbols, materialism, parochialism, Madison Avenue, etc., might occur all too frequently. Rather, I wish to invite your attention to the second and third connotations of the word which emphasize refinement of thought and action, focusing on the best that can be done in a given time or place to bring out man's highest potential as a sentient being. Here we think of those aspects of the study of man which may be applied to extend and intensify his capabilities for thought and action in directions that not only add meaning, harmony, and pleasure to his interactions with his fellows, but are compatible with what he envisions to be the ultimate purpose of his life.

I take it as axiomatic that foundations of culture lie in the education, using the term in its broadest sense, of *individual* human beings. The Chart shows in block diagram form the various processes involved in the cultivation of mind and body and I call your attention at once to the fact that we are not dealing with straight-line flow but rather with a fairly complicated series of feedback loops. With the help of this diagram, I hope to set forth and discuss in the light of the New Humanism those elements which are important in the culture of individuals and groups in the modern world. I hope to bring out especially the part that science can play in the full culture of men and women to prepare them to lead their fellows with confidence in attacking the problems of today.

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The New Humanism

The theme of this meeting of the National Science Teachers Association is "Science—The New Humanism." The term *humanist* is, as H. W. Fowler says in *A Dictionary of Modern English Usage:*

> . . . apt to puzzle or mislead, first, because it is applied to different things & a doubt of which is in question is often possible, & secondly because in two of these senses its relation to its parent word *human* is clear only to those who are acquainted with a long-past chapter of history. The newspaper reader sometimes gets the impression that *humanist* means a great classical scholar; Why? he wonders, & passes on. Another time he gathers that a humanist is a sceptic or an agnostic or a free-thinker or something of that sort, you know; again he wonders why, & passes on. Another time he feels sure that a humanist is a Positivist or Comtist, & here at last, since he knows that Comte founded the Religion of Humanity, there seems to be some reason in the name. And lastly he occasionally realizes that his writer is using the word in the sense in which he might have invented it for himself—one for whom the proper study of mankind is man, the student, & especially the kindly or humane student, of human nature.
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> The original humanists were those who in the Dark Ages, when all learning was theology, & all the learned were priests or monks, rediscovered pre-Christian literature, turned their attention to the merely human achievements of Greek & Roman poets & philosophers, & historians & orators, & so were named *humanists* as opposed to the divines; hence the meaning classical scholar. But this new-old learning had, or was credited with, a tendency to loosen the hold of the Church upon men's beliefs; hence the meaning free-thinker. The third meaning—Comtist—was a new departure, unconnected in origin with the first two, though accidentally near one of them in effect, but intelligible enough on the face of it. As to the fourth, it requires no comment.

"It takes more than one mind to clear the noise from our communications or the dirt from our facts."

Without going into all the meanings, we come to the last one given by Fowler, namely a humanist is one for whom the proper study of mankind is man—the kindly or humane student of human nature. This is the sense of the word I feel sure we are asked to have at the front of our minds in this meeting. The other meanings given by Fowler might be quite startling in this context.

However, the adjective "new" adds something more. It asks us to study human nature not by itself, but in the context of the much larger system with which man interacts in ways that determine his destiny as an individual. Thus, in this day and age, the study of man involves the detailed study of a complex organism whose mechanisms, thoughts, and actions depend strongly on inheritance from the past and on external interactions with environments, present and future. It may be convenient for a time to distinguish among these environments. The distinction is an arbitrary one, but is justified for one reason at least, namely, the extent of our understanding of each differs enormously. First, there is the *physical environment* from which we derive all the food, energy, materials, and implements necessary for life and living. Second, there is the *social environment,* a corporate creation of man within the physical universe. On this we depend for the group memory that enables the individual to use the combined experience of the past to guide him through the perils and vicissitudes of the present, to realize the wealth of the physical environment, and to build for the future. Lastly, there is what I would call, for want of a better name, the *spiritual environment.* The reality of this environment is not easily demonstrable but its influence in motivating the behavior of individuals is very real.

Clearly then, the New Humanism—the study of man—must entail an understanding of the physical universe and man's interactions with it; it must entail an understanding of what the social environment really is, an understanding of the interactions of individuals and groups within it. It must also be concerned with the urge to learn the purpose of creation and the purpose of the lives of individuals. Lastly, it must recognize the essential unity of all these environments. In the Chart, I have indicated to and from communications with two of these environments. All we know comes into our minds through our senses, firsthand experience being derived from communications with the physical environment, and secondhand information coming from our human environment, parents, teachers, fellows, books, etc.

Interactions with the Physical Environment

In the early 18th century, Alexander Pope wrote:

"Know then thyself, presume not God to scan;
The proper study of mankind is man."

This was really a statement of priority. By the 17th century, preoccupation with dogmatic theology and related subjects had rendered scholarship sterile and useless. But even before Pope wrote these lines, new methods of thought and action were being put into effect, starting a most productive era of intellectual activity, the era of modern scientific research. These new methods were applied most successfully in developing knowledge and understanding in the fields of man's interactions with his physical environment, giving us the body of systematic knowledge and understanding of nature we call *modern science.*

Let us take a quick look at what the first scientific revolution, with which the names of Galileo, Bacon, and Newton are associated, really accomplished. Before it there was no dearth of empirical knowledge. Astronomers had searched the heavens for centuries and accumulated a vast store of knowledge; the alchemists had uncovered numerous facts and developed all the basic techniques on which early chemistry depended; the artisans and inventors had vast technological lore—metals were mined, purified, and worked into ingenious devices; glasses, ceramics, and textiles were developed; animal and water power were common; agriculture was well advanced; architecture and the arts provided the media to immortalize the genius of individual artists. However, speculations on the meaning of it all fluctuated from one generation to another. A fruitful approach to natural philosophy was lacking; monotonic progress was unknown and the world of science was dominated by the opinion of the brilliant intellect and the powerful dialectician.

The first scientific revolution changed matters by emphasizing a number of new approaches toward the advancement of learning. First, it

brought together in equal partnership the thinker and the doer, the theoretician and the experimenter. Hitherto, the intellectual had regarded the experimenter with contempt—a vulgar artisan. Galileo, Hooke, and contemporaries raised experiment and the devising of instruments to a position of respectability in natural philosophy—the laboratory took precedence over the study.

Second, human authority and dogma were replaced by the authority of nature as expressed in validated facts. No matter how highly esteemed or advertised the man who propounded a theory (communications with the human environment), it stood or fell by its consistence with experimental facts. "Nullius in verba," we take nobody's word for it, was the motto adopted by the Royal Society. In terms of the Chart, the block named *Validation* was given highest importance since it was realized that raw experience, especially that coming from the human environment, is contaminated; gold must be separated from the dross. Only the gold—or valid knowledge—facts—could really provide adequate material for fruitful mental ratiocinations.

Third, and closely allied to the second, was the emphasis placed on quantitative thought and expression. A great deal of effort was spent in seeking units that could be defined in terms of some generally accepted standards so that observed phenomena could be expressed exactly in terms of units and numbers, and subsequently transformed by mathematical reasoning. The role of instruments in giving data in terms of units and generating numbers is well known to you. In terms of the Chart, communications were made as exact as possible. Mathematics became the logic vehicle for communication and deduction.

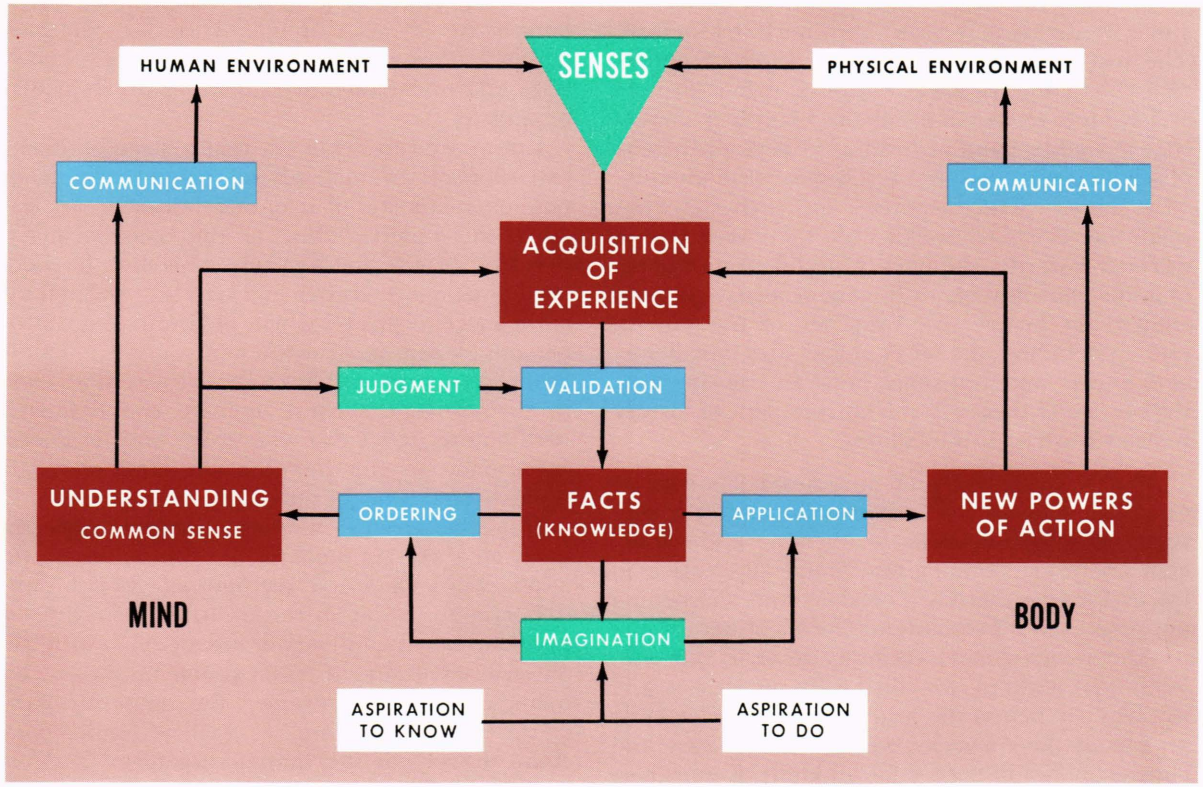
The fourth approach laid great emphasis on the ordering of facts through construction of mental models, whose validity was checked by the establishment of a detailed correspondence between the content and consequences of the model and the information about the physical environment that comes in through our senses. The success of these models gave us the power to comprehend and understand the complex phenomena of the physical world. Furthermore, the understanding sharpened judgment, which in turn fed back to new criteria for greater skill in *validation.* In order to produce viable mental models, the elements by which they were constructed were completely revised and chosen from the primary properties of matter—that is properties that may be regarded as intrinsic to matter itself and do not depend on interactions between matter and an observer. These properties were used in the construction of theoretical models of observed phenomena. Thus, particles, motions, forces, and geometry were used in theories rather than color, taste, even temperature.

For example, we observe the color of a star through information coming to our senses, helped by a telescope and a spectroscope. We observe that the star is redder than we would normally expect—this leads to the deduction, via the Doppler principle, that the star is moving away from us at a given speed. The motion of a star is something we can imagine it possessing, whether we observe it or not—the color depends on the interaction of the light from the star with the observer.

In seeking an understanding of the physical world, we have found it profitable to *abstract* certain features or variables from complex phenomena in order to derive rather simple relations that give a realistic description of the phenomenon, although not one that is complete in every detail. Inspired abstraction has been the mark of the great researcher.

Application of these approaches to learning set in disciplined motion all the processes shown in the Chart, and provided a very powerful mechanism for accumulating, comprehending, and systematizing human experience. For example, an inventory of valid knowledge gave a sound basis on which the powers of imagination could work, providing on the one hand a creative approach to the ordering of this knowledge into patterns of understanding which could not only be communicated to the human environment, but also used as a basis for more intelligent validation of new facts. On the other hand, as indicated on the right-hand side of the diagram, imaginative study of the facts suggested applications that enhance our physical powers through training, development of new skills, and design of instruments to interact more certainly and intelligently with the physical world, adding to the flow of new experience that comes in through our senses. This activity goes by many names, but I shall refer to it as "basic scientific research," or just scientific research. It begins when an individual's curiosity is aroused by the observation or description of natural phenomena. It is usually spurred on by an irritation produced by a gap in knowledge or a discrepancy between observations and preconceived ideas, whose objective is to seek out valid facts and fit them into the pattern of established sound knowledge. When this is done, we say we understand the phenomenon.

It is an activity of heavy *private* responsibility—the responsibility that falls on a man who professes to search for truth. This responsibility demands that no pains be spared to separate the signal from the noise in the acquisition of information; to separate the gold from the dross in mining the



nugget of truth from nature. The establishment of the validity of one set of facts may take years of hard, exacting work. The fitting of valid facts into a viable, comprehensive, and aesthetically satisfying pattern is an artistic achievement of the highest order. The responsibility also carries with it the duty to communicate valid facts and sound theories to sophisticated colleagues (human environment) for their scrutiny, criticism, and reproduction should doubts arise. It takes more than one mind to clear the noise from our communications or the dirt from our facts.

Premature publication for the sake of publicity or newspaper fame is a violation of this responsibility of the seeker after truth. It is a professional crime that adds noise and dirt to knowledge by those whose responsibility is to eliminate them. I realize that these comments may be hoplessly out of fashion—the mutterings of an old man. However, I still think some traditions are worth preserving and I take hope from the remark of the old Mammy to her young charge: "Mind your manners, honey, someday they'll be coming back in style."

The success of scientific research in broadening and deepening man's understanding and knowledge of his physical environment is now one of the established facts of history. In the area of man's interactions with the physical universe, scientific research has produced at an exponentially increasing rate a fabulous amount of sound systematic knowledge during the past 300 years and has ordered this knowledge into powerful and viable patterns of understanding. We have developed theoretical structures into which myriads of facts can be neatly fitted, facts ranging from studies of the very small—atoms and subatoms—to the very large, e.g., the extra galactic nebulae. The job is by no means finished. Indeed, it would be unwise to say we have acquired anything like a complete understanding of our physical surroundings. We have a very satisfactory and viable systematic view of knowledge that gives a good *partial* understanding, but as we penetrate further and deeper into the universe, we discover *facts* that lead us to suspect that changes in our theories may be expected. The old questions, namely the nature of the cosmos, the nature of matter, and the nature of life still present intriguing problems that challenge our highest powers of imagination and skill.

However, even this partial understanding has had a revolutionary effect on the rate of progress of *exploratory development and engineering*. You will remember that exploratory development and engineering used to be known under the name

of the "useful arts" and has been practiced since civilization began and perhaps before. The realization of a human need, or an opportunity for gain, has always inspired ingenious men and women to marshall all the empirical knowledge available, valid or invalid, to devise a means of fulfilling this need by a technique, a commodity, or a service. The incentives for such activities might be selfish or unselfish but they were always directed towards supplying a useful or profitable tangible contribution to human security, welfare, comfort, or luxury. All branches of the "useful arts," including the mechanical arts, medicine, agriculture, and transportation, are replete with the success of these efforts, but the path of history is also strewn with the failures.

After scientific research in private laboratories or studies had been in progress for almost a century and a half, it began to uncover valid knowledge and understanding that found application in the useful arts, thereby increasing and sharpening our powers to manipulate the forces of nature and use them with greater certainty to serve our will. With these powers, we can fortify our senses and muscles to penetrate into hitherto inaccessible regions of the universe; we can obtain vast and cheap supplies of energy for all kinds of purposes. The whole range of materials available to the artist, the architect, even the dress designer has been extended beyond previous imagination; by our understanding of the motion of individual electrons in vacua and in solids, communications among ourselves and with the physical and biological universe have been revolutionized. We have freed mankind from the scourges of many diseases; we can spy and kill with staggering efficiency. We could spend all morning and not exhaust a catalogue of powers acquired from the application of science—powers that have literally changed the whole character of human society.

In the area of our knowledge of ourselves as animal organisms, scientific research has built up a rapidly growing store of systematic knowledge and understanding of the mechanisms by which this organism functions, the disturbance that causes malfunctions, and mechanisms by which it interacts with its environment. We are now beginning to understand how such a mechanism is controlled through the brain, and also the inheritance that gives such a variety and range of potential to the separate organisms that make up the "living" world. It is hard to assess the present or future of the products of basic research in this area; the increase in systematic knowledge of the origin, development, and functions of the human organism is truly explosive—to use an overworked word—and it is most difficult to obtain perspective inside a fireball. How far can basic research carry us in developing systematic knowledge and understanding of man as an individual organism?

I think we can safely say that a straightforward extension of the methods of thought and action now characteristic of scientific research can lead us to an understanding of the mechanisms of heredity, of the mechanisms whereby the body itself functions in growth and viability, and indeed, of the mechanisms by which the brain and central nervous system control the actions and reactions of the organism, interpret the signals that come in through the senses, operate the defensive mechanisms, remember, catalogue, and reassociate experience in the imagination, and translate sophisticated thought into sophisticated action.

However, serious students of science raise the question of certain fundamental limitations to the applicability of *present* methods of thought and experiment to acquire an understanding of problems arising in man's interactions with the physical environment. Such problems involve the boundaries of the universe,[1] the limits of space, or the beginning of time as well as fundamental characteristics of the human organism, such as consciousness and free will. Vannevar Bush[2] states his view clearly. "Then it (science) comes to questions of consciousness and free will—and there it stops. No longer can science prove or even bear evidence. Those who base their personal philosophies or their religion upon science are left, beyond that point without support."

If this view is correct, and I have no reason to doubt it, it seems that present scientific methods of thought and experiment will require thoroughgoing revision and extension before we can accept the phrase, "Science—the New Humanism," as meaning the *complete* study of man, but we can certainly regard science as occupying a key place *in* the New Humanism.

Interactions with the Social Environment

In those fields of study that deal with the interactions of man and his social environment, there is no dearth of empirical knowledge and experience. People have observed these interactions for thousands of years, pondered deeply and speculated about them, trying to discern patterns by which the complex observations could be at least

[1]See C. Hinshelwood, President's Address to the British Association—"Science and Scientists," *Nature* **207**, 1965, 1055–1061.

[2]Vannevar Bush, *Science is Not Enough,* William Morrow & Co., New York, 1967, p. 27.

partially comprehended. Our own heritage from the Chaldeans, the Jews, the Arabs, the Greeks, the Romans, and the Europeans is rich enough. When we add the constant output of the anthropologists and the ethnologists, the wealth becomes overpowering. Libraries have been filled with observations of and speculations about the interactions of man with social environments. The situation is reminiscent of the state of our knowledge and understanding of the interactions of man and the physical environment prior to the advent of modern scientific research. We know a lot but understand very little. Theories rise and fall, human authority has not yet given way to the authority of valid facts, controlled experiment is still in an elementary state, and units of measurement permitting quantitative expression and mathematical treatment are not yet common, although much emphasis has been placed on nonrationalized units and statistics. Finally, it is hard to find concepts inherent in social systems, such as the masses, motions, shapes, and sizes, and arrangements in physical systems which may be regarded as intrinsic properties of the system and not dependent on interactions of the systems with an observer. Can the methods of basic research which have been so powerful in developing an understanding of natural phenomena be applied to develop an equally fundamental understanding of social phenomena? Are we willing to devote time and energy to the study of very simple and seemingly irrelevant questions, confident that eventually we can arrive by steps from the simple, to the understanding of the more complex, following the centuries of slow monotonic progress of the physical sciences? Anthropology, ethnology—critical studies of real facts in the history of the rise and fall of human societies—may lead us towards a more basic understanding of social problems.

A basic understanding of man's interactions with his social environment is imperative, if we are really to develop a new humanism. It is a very noisy environment where the signals of truth are drowned by the noisy clamors of selfishness and human perversity. This makes the task difficult but, I hope, not impossible. We can try to apply the techniques used in developing an understanding of the physical environment. Otherwise, we must look for new methods of thought and action, at present as unexplored as were those now familiar to us before the times of Bacon and Galileo.

THE SOCIAL ARTS—We have seen that through the useful arts empirical knowledge was applied to enrich the material life of mankind. In the absence of basic understanding of the physical world, the progress of the useful arts was slow and uncertain but nevertheless there was progress. We have noted how understanding generated by scientific research sharpens our abilities to pursue the useful arts with greater certainty and speed. However, we should also note that it is only in fighting against time in a competitive world that the combination of scientific research and the useful arts (engineering) really reaches its highest importance. From time immemorial attempts have been made to change the interactions of the individual or of groups of individuals with their human environment in order to remove conflicts and tensions, and promote the welfare, happiness, and harmony of a majority or a minority of the individuals concerned. Remedies were based on what could be deduced or surmised from past experience. If there were a systematic body of knowledge built into a coherent and aesthetic structure by basic research on the interactions of man with his social environment, we might well call these activities "Applied Social Science," but in the absence of such a background, it seems best to use the term "Social Arts," or if this is ambiguous, "Social Engineering." The interactions of the individual with his environment may be changed in a number of ways: we may adjust the individual's outlook and aspirations by education; we may prescribe individual interactions by legislation; and we may change the environment by political means. Indeed, we can discern many fields of social engineering. In order of age, we may mention a few of these. The first, and undoubtedly the oldest, is that of education; the second is probably that of military organizations; the third, that of priestcraft; the fourth, that of politics and statecraft; the fifth, the formulation, study, and practice of law; the sixth, the study and practice of economics; the seventh, industrial organization and management. You could supply many others. All of these activities are primarily concerned with the solution of practical problems arising from man's interactions with the human environment.

It may be worth noting several differences between studies of the physical environment (including biology) and the social environment. First, basic research has progressed far in the physical sciences in its scope and power to deliver valid systematic knowledge and understanding; basic research is still in its infancy in the social sciences, having barely progressed into the descriptive stage.

Second, and largely as a result of the first, the studies of the physical world (science), its applica-

tions and the philosophy behind it, have acquired a basis of *worldwide* acceptance, whereas the philosophies underlying studies of interactions in the social environment differ widely and almost irreconcilably as we pass from one region of the world to another. Thus in Russia, China, India, or Africa those who study man as an organism and his interactions with his physical environment have the same objectives and use the same methods as do those in Western Europe or the United States. Occasionally basic differences in philosophy arise but they are evanescent. The results all contribute to *one* structure of systematic knowledge. The same cannot be said about the philosophies, objectives, and methods fundamental to the studies of man and his social environment. These differ widely from one area to another, and while they add to variety of experience, they cannot be said to lead to understanding or an integrated body of knowledge.

Spiritual Environment

We come now to the world of the spirit. I had considerable difficulty in selecting a name for this environment. The term "Metaphysical Environment" was considered but rejected. "Cultural Environment" suggested itself but there was some ambiguity possible in the light of the first definition of culture that I gave. I have chosen the term "Spiritual Environment" hoping that you will understand that its meaning is much broader than the predominantly religious connotation that has been associated with the spirit. I am using the term "Spiritual Environment" to describe the world of the intellectual and spiritual products of man's imagination and experience. However, I would also have you understand that this is the world in which the implements of refinement of thought and action reside, the seat of the motives that lead to the highest cultivation of man's potential. In other words, it is the place where we look for elements of culture, the essence of Humanism.

It may seem strange to some of you that I distinguished the spiritual environment from the social environment, for the two appear to be closely intermingled. However, I do so deliberately because I believe it aids our thinking to separate for the moment the intangible atmosphere of ideas and ideals from the seething ferment of interactions of man with man, nation with nation from which it is distilled.

The spiritual environment that permeates our lives is intangible but nonetheless real. It comprises the domain of the "immediately apprehended," to use a phrase of Northrop, a domain where the emotions responding to beauty or ugliness, harmony or discord, sacrifice or selfishness, play a large part. It is a world created by the imagination of the singers, the writers, the players, the painters, poets, musicians, the dreamers, and other creative thinkers who consciously or intuitively evaluated raw experience, extracted from it a nugget of truth to communicate to their fellows. In particular, man's interactions with his physical environments have greatly enriched this metaphysical environment, an idea that was often submerged in the *old* humanism, which regarded scientists as a soul-less crew devoid of any real imagination or interest in human problems.

As primitive man became conscious of the vastness and complexity of his physical environment, his attitude towards it was one in which wonder and fear were intimately mixed. His imagination, working on crude, unrefined experience, populated this world with creatures made in his own image, and clothed it with superstition—his first attempt at understanding. When experience became more refined and he realized more fully the grandeur and the order, as well as the complexity, of the system of which he was a part, he became more and more attracted to the conviction that this system was constructed according to a master *pattern* and for a *purpose*. Late in time came the idea of the unity of the pattern and the purpose, suggesting a single author, called God. The unfolding of this pattern and comprehension of this purpose have inspired man's noblest thoughts and actions. It may be noted that through our interactions with our physical environment we seek to discover the pattern; through imaginative philosophy, we seek a purpose or objective for man's existence that is compatible with a master purpose of creation.

In the last few centuries the disciplines, methods, and discoveries of science have added greatly to our spiritual environment by constructing a model of the pattern of creation which, as far as it goes, is consistent and comprehensive. We must always remember that this model is not complete—that it is undergoing rapid extension and that modifications will be required to keep it consistent and comprehensive. While, therefore, we avoid dogmatic assertions about the eternal truth of the pattern science is revealing, we *can* have considerable confidence in believing that it has provided viable elements which are now integral parts of the spiritual environment. Vannevar Bush states the situation as follows: "Science proves nothing absolutely. On the most vital questions it does not even produce evidence. But is all the labor of science vain to the thinker . . . ? By no means. Science does two things. It renders us humble. And it paints a universe in which mysteries become highlighted, in which constraints on the imagination have been removed and which becomes even more awe-inspiring as we gaze."

Not only is the pattern of creation being revealed by scientific research an element of our spiritual environment, but the processes by which this pattern has been developed deserve an *equal, or even more prominent, place, in this cultural heritage.* Referring again to the Chart we emphasize that scientific research has taught us the value of strict *discipline* in using direct means to ensure that we extract really valid facts from the experiences which come to us through our senses from the human and the physical environments, facts that are not contaminated with irrelevant noise, and furthermore to use indirect means through the judgment channel to confirm the validity of these facts by consistency. It also suggests the power of the disciplined imagination nourished by valid knowledge to put the facts in aesthetic order on the one hand and to apply them intelligently on the other. It also emphasizes the paramount importance of exact communications, particularly with the human environment, if for no other reason than to keep noise, fallacy, and irrelevance from the loop involving *facts, understanding, communications, human environment,* back to *facts.* Surely this discipline in the acquisition of knowledge, in the imaginative ordering, application, and communication of it are elements of our cultural environment which, though derived from man's interactions with his physical environment, are applicable in studying his interactions with the social environment as well.

The symmetry of this diagram is meant to suggest another thought, namely that the cultivation of imaginative practical skills to interact with the physical world takes precedence alongside and not behind the mental processes leading to understanding and communication. We can never be truly cultured as long as it is possible for a man to admit without shame that he cannot drive a nail or a woman that she can't cook, when they would be extremely embarrassed to admit inability to read or write.

Earlier in this section, I suggested that another great quest in man's interaction with his environment is the search for a purpose or objective for his existence that is compatible with a larger purpose of creation. The existence of an overall purpose for creation probably requires a greater act of faith now than does the belief in an overall pattern. Furthermore there is much greater unanimity throughout the world concerning the value and methods of scientific research, than there is concerning the value and methods for ascertaining the *purpose* of man's existence. Indeed, there is no agreement on this latter subject at all. Contemplations of the long-range purpose of man's existence has led to entirely different philosophies in different parts of the world. This is very significant in our approach to the overall topic of this meeting, "Science in the New Humanism," for purpose and philosophy are intimately connected with *values,* and problems of value loom large in studies of man's interaction with his social environment, especially in the application of the social arts. Values such as "good" vs. "bad," "benign" vs. "malignant" have meaning only in terms of objectives and purposes, and *absolute* meaning only in terms of *universal* objectives. When we speak of objectives we naturally assume the presence of a system designed to attain these objectives. Anything that enhances the capacity of the system to attain the desired objective is, by definition, good and anything that poisons the ability of the system to do its job is, by definition, bad.

You see, therefore, that when we open up the question of values we are immediately forced to think not only of objectives but also of the grand system through which these objectives are achieved. In particular, when we consider value judgments in man's interaction with the social environment, we immediately think of this environment as a system with an objective and perhaps part of a larger system with whose grand objective the local ones must be compatible. Fragmentation of objectives and philosophies throughout the social environments of the world poses very difficult problems to the humanist, and particularly to the social engineer who takes a broad view of his subject.

We are apt to bandy around the terms *good* and *evil* in a very cavalier fashion, without thinking much about systems and objectives. For example, I have been asked often whether scientific research has had, on balance, a good or bad influence on society. If you have followed what I have been saying, you will recognize at once that the wrong question was being asked, for scientific research, being a purely intellectual pursuit in search of knowledge and understanding, can have only one kind of impact on humanity—if it has any—namely, a good one. No one can long sustain the argument that ignorance and superstition are objectives of man's existence. The question that might have been asked is: Have the *products* of technology had a good or bad effect on mankind? To answer this question, one has to consider the effects of these *socially inspired* products on the system as a whole. We really do not know whether a technological advance is good or bad until we have determined how the whole system reacts to it or can be influenced to react to it and what its short- and long-term effects may be. For example, the prolongation of human life by the technical advances in medicine and public health are

regarded in many quarters as "outstandingly good," if not exemplary. This is so in a system that can react by increasing food supplies, opportunities for profitable and satisfying use of time by old as well as young, without a runaway expansion of population. However, in a system where prolongation of life leads to lower and lower standards of existence, condemning millions to starvation, we may question its "goodness" and, indeed, make a case that in such cases the results are bad.

On the other hand there are many who consider the large-scale release of atomic energy, particularly in the form of bombs, as being something "bad." Here again, the answer is by no means clear-cut unless we can determine it in the light of its effect on the complete system of which we are a part, including past, present, and future. If society uses these weapons for purely destructive purposes, one answer comes out. If, on the other hand, the presence of atomic bombs deters irresponsible people from waging wars at all, another answer comes out.

We are now learning, with the help of models and high-speed computers, to follow the effects of changes in parts on the overall behavior of a complex system. It is too early to predict how far these techniques will lead us in the study of the interaction of man with his social environment. It may lead to better value judgments in terms of *assumed purposes* but we still come up against the baffling problem of what is the actual purpose of the universe and man's part in it.

About the important components of the spiritual environment that come from revealed religion, I must needs say very little here. However, three points arising from a faith in the essential unity of this environment may be mentioned.

1. Boundary problems in the physical universe, problems of the nature of consciousness and free will in man, problems of purpose and values in society, all call for the exercise of *faith*. We turn to the philosophers and theologians to provide us with a faith that can satisfy our intellects and inspire our wills.
2. Believing that man and the environment with which he interacts form one large system, it seems incumbent on the philosophers and the theologians to couch their teachings within the framework of the patterns of the universe being unfolded by scientific research, at least until another more consistent and aesthetic pattern is revealed by methods not now known to us.
3. The number, variety, and often incompatibility of the religions of the world arise largely from the fact that they were products of local environments filling the needs of people who inhabited the region, and expressing their ideas of purpose and value. Technological advances such as rapid air travel and a widespread network of swift wideband communications have made the world a very small place, broken down barriers to geographic isolation. Will these communications bring about more unanimity on problems of purpose and values or will they accentuate to the breaking point tensions caused by present differences? The answer to this question poses one of the greatest challenges in the study of Science and the New Humansim.

Conclusion

It has become fashionable, through the influence of C.P. Snow, to speak of a world divided into two cultures between which an ever-widening gap exists. We must admit that there is such a gap in our intellectual life but we might as well give it its proper name. It is the gap that separates those who think precisely and communicate clearly according to a rigorous discipline from those whose thoughts and words are neither exact nor disciplined, in other words, loose. To borrow a phrase from the bankers, it is the gap between the areas of *hard* intellectual currency and *soft* intellectual currency. It is the gap between those who refine the dross from their experiences before feeding them into their imagination or communication channels and those who do not. It is not a gap between the physical and biological sciences on the one hand, and the humanities on the other. Representatives of both these, and indeed all other walks of life, are to be found on both sides of the gulf. The invigorating climate of the hard intellectual currency areas has, however, nourished the growth of the systematic knowledge we call science. It has cultivated the power of man to develop a broad and viable understanding of his physical environment and to supply a store of material and intellectual riches to fill the needs and desires of the social environment, and to adumbrate a pattern of creation that becomes part of his spiritual environment.

As teachers of science, you have the privilege of being able to pass on to your students an enthusiasm for, and a desire to live in, the bracing atmosphere characteristic of the regions of hard intellectual currency with the attendant satisfactions it brings. Not only is this discipline essential for those who seek careers in science—it is equally essential for the education of all who aspire to enlightened leadership and service in any walk of life.