## Human Individuality in Modern Civilization

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The accelerating tempo of modern scientific advancement is bringing us face to face with some newly recognized realities, some of which may at first glance seem disquieting. Examination of certain of these emerging discoveries and of the resultant opening vistas may have important implications for our understanding of the future biological and cultural evolution of mankind.

For some time now we have been increasingly aware of the relatively insignificant dimensions of the planet upon which we live, and of the incomprehensible vastness of the universe of which we are a part. Moreover, we are being jolted into the realization that the small sample of the universe with which we are familiar is not even a typical sample.

You and I have long been accustomed to thinking of matter as being in one of three states: solid, liquid, or gas. Now we are confronted with the disclosure that the great preponderance of matter in the universe is in fact in none of these phases, but exists in the plasma state, in the form of such units as free electrons, protons and ions. Moreover, the gravitational forces which have long appeared to us to be the dominant forces controlling the motions of matter in the universe may pale into insignificance when compared with the electromagnetic forces which regulate the plasma state of matter. The older concepts of our physical environment must be greatly revised and expanded.

With regard to our biological conceptions, too, we are meeting new and sometimes disturbing problems. After accepting the fact that much of evolutionary progress has come about under the impersonal influence of natural selection, we are confronted with the dilemma that modern civilization with its revered humanitarian impulses is often relaxing or removing such selection. Dire consequences are predicted from some quarters as a result of removing the selective process, and equally dire consequences are predicted from other quarters if the relaxation or removal should cease. Both physical and mental qualities of mankind have been included in the various expressions of alarm.

The increasing importance in our social order of organization and automation as opposed to individuality appears to some observers to offer a threat. There are those who foresee even creative literature, music, and art eventually being usurped by the principles of mechanization.

Are, then, the familiar and cherished things of our world, in which we were taught to believe, in danger of being depreciated by the advances in civilization, and especially in science, which are taking place so rapidly at present?

Perhaps the strongest indication that the picture is far brighter than some may have us believe, lies in the very fact that man has evolved to the point where he can perceive problems of this nature, acknowledge their existence, and seek the answers in the framework of his culture by the use of analytical reasoning and judgment. I propose to examine the aforementioned disquietudes one by one and to attempt to assay them objectively.

While frankly admitting the philosophical implications of the awesomeness of space, we must realize at the same time that here on this small sample of the universe, over eons of time, life originated and evolved, culminating in the development of the human mind which is capable of comprehending the universe and of adapting it to man's needs.

Natural selection in primitive man probably favored strength, aggressiveness, and freedom from physical and mental defect. In primitive environments the outstanding events were the constant struggle for food, shelter, and mates, and the recurring dangers from enemies, human and otherwise. But primitive man possessed a few unique specializations which were destined to forge his future development. These specializations included the fully upright position and its concomitants, the differentiation of hands and feet; and the exceptional development of the cerebral cortex of the human brain, most particularly of those areas involved in reasoning, abstraction, symbolizing and communication.

While the cerebral cortex of man was developing uniquely, the mid-brain remained much the same as in his vertebrate ancestors. In the mid-brain are contained the mechanisms for the control of certain primitive visceral and somatic reactions associated with emotional states. Thus man shares with lower animals through the mid-brain such emotions as fear, rage, and hunger. But, due to the development of his cerebral cortex, intelligence, judgment, foresight, and analytical ability are almost uniquely human qualities.

Because of these specialized mental endowments, together with the upright position and the remarkable development of the human hand, man was enabled to reorganize his environment in such ways as to provide ever more efficiently the essentials and even the comforts of life, and to minimize the imminent dangers. The result was the opportunity for the development of high attainments in such areas as literature, the fine arts, religion, statecraft, law and science: in short, culture. As culture developed, the selective advantages of sheer strength and aggressiveness undoubtedly declined.

In their place there must have been substituted other qualities, some of greater importance and some of less, but all tending to direct man's evolution towards intelligent and cooperative group behavior.

Undomesticated animals have developed evolutionarily by the adapting of their genetic characteristics to existing environments largely through processes of mutation, recombination and selection. Domestic organisms have had their characteristics adapted, by human manipulation of genetic processes, to environments which were themselves at the same time being adapted by man to the changing traits of the organisms. Husbandry is a complex art! Man himself, however, has developed by conciously and purposefully altering his own environment, by means of his own manipulations and inventions, to meet the requirements of existing human genetic constitutions.

Now human genetic constitutions are many and varied. The diversity of human individuality is almost infinite and practically incomprehensible. There are probably well over 20,000 gene loci on the chromosomes of each human being. Each of these loci is subject to mutation. Given a mutation at each of only 200 of these loci, the number of possible phenotypically different combinations would be  $2^{200}$ , or approximately 1 followed by 60 zeros, even if dominance were complete in all instances. If the heterozygotes were phenotypically recognizable, or if more than one mutation had occurred at some loci, resulting in multiple alleles, the number of distinct phenotypes that could result from combinations of genes at 200 loci might well exceed the staggering total of  $3^{200}$ , or approximately 1 followed by 143 zeros. Either of these numbers far exceeds the number of human individuals who have ever lived on the earth.

Mutations are now well known at far more than 200 loci on the human chromosomes. True, the mutant gene of the pair is often rare in comparison with the original gene, so that certain combinations of mutant genes will be exceedingly rare, but through the workings of Mendelian heredity all the various combinations are potentially possible, and many of them will occur with reasonable frequencies.

Each individual genetic constitution is subject to environmental impact, and variations due to such impacts may exist even within identical genotypes. Many and diverse are the modes of interaction between hereditary and environmental influences. And many and diverse are the resulting measurable human traits. The manifold combinations of these traits result in the almost infinite diversity of human individuality. No two human beings are, or have ever been exactly alike.

As the process of civilization or the self-domestication of man began, this diversity must already have been apparent. As a result many different lines of endeavor began to flourish. Some individuals turned their attention to the development of weapons for hunting, others to the equally important problem of domesticating dogs as aids in the chase. With only a crude understanding of the principles of genetics, astonishing progress was made in bringing under domestication many species of animals and plants.

Man, too, in the course of his self-domestication, has been subject to the usual evolutionary forces. Through geographic or cultural isolation and the concomitant effects of mutation, selection, inbreeding, and genetic drift, various populations have become more or less differentiated one from the other in respect to certain readily recognizable physical traits. It is improbable that such ethnic groups differ significantly in regard to mental traits, for reasons which will be discussed shortly. No. 1

Within ethnic groups are found smaller, more-or-less self contained breed-

ing units, known as isolates. These isolates are delimited by social class, religious affiliations, habitat, and other cultural and geographical isolating mechanisms.

Careful studies indicate that the relative proportions of various known major genes vary not only from one ethnic group to another, but from isolate to isolate. Even within isolates is found residual genetic variation. Some of this variation is the result of known single-gene substitutions.

The vast majority of the traits which are thought of as normal or nonpathological appear to be dependent upon multifactorial or "polygenic" heredity. The vast majority of the traits which are dependent upon single gene substitutions are on the other hand pathological in nature. Because of the viability impairment connected with them, the incidences of such anomalies, and thus of the genes responsible for them, are low. Under the restraining influence of natural selection, only a very few such traits have reached population incidences as high as one in 10,000, and the vast majority are much rarer than this.

Conditions of modern civilization, however, have resulted in a relaxation of selection against some genes, and in the subjection of other genes to new selective processes. The potential outcomes of these man-made shifts in evolutionary trends warrant thoughtful scrutiny.

One of the many consequences of man's self-domestication has been the phenomenal progress of the science of medicine. This progress has resulted not only in the control of numerous environmentally conditioned diseases, but in the alleviation of various genetically determined disorders and anomalies. The result is that some types of individuals who formerly died before reproducing, or before completing their families, are now enabled to live out a more normal span of life and are given the opportunity of more normal reproduction.

The presumed implications of the foregoing facts have aroused concern in some quarters It is feared that the accumulation of mutations in man may eventually constitute a serious threat to the public health. The argument runs somewhat as follows. Since mutation is a recurrent phenomenon, and since the mutant gene reproduces itself just as faithfully in its new molecular arrangement as the unmutated gene did in its original chemical form, the mutant forms would gradually accumulate in the species were it not for the fact that most mutations are harmful. This fact permits the tendency to accumulate to be opposed by the process of natural selection, thus depressing the frequency of each harmful gene to an equilibrium value at which the rate of elimination is balanced by the rate at which the mutant gene arises by fresh mutation in any generation.

The argument continues by asserting that the progress of civilization, and especially of medicine, has succeeded in ameliorating the effects of many harmful genes, so that selection against these deleterious genes has been relaxed, thus permitting their frequencies to attain higher and higher equilibrium levels. For those who present the argument in this way, contemplation of the longrange results of further successes in ameliorating the effects of more and more undesirable genes presents an alarming prospect.

I consider some aspects of this argument to be fallacious. The essential fallacy consists in the application of the epithets "deleterious," "harmful," or "undesirable" to the mutant genes themselves rather than to their effects. If, through modern medical, social, or economic progress, selection has been relaxed against any gene with harmful effects, this relaxation has been accomplished only because the medical, social or economic agencies have provided environments in which the effects of the genes are rendered less harmful or quite innocuous.

As to those genes that persist in producing detrimental effects in all known environments and despite all attempts at therapy, selection against them remains today as severe and effective as ever. And selection will again begin to operate against any gene for which it has been relaxed if the burden of providing the necessary therapeutic conditions begins to outweigh the social value of providing them. It seems reasonable to presume, however, that medical and social advances will continue to be made with ever-increasing efficiency, and that therapeutic or preventive measures which may now seem burdensome will be continuously improved and will become ever more simple, natural, and acceptable.

We need only contemplate some of the many commonplace procedures which probably were at one time burdensome but which have become quite comfortably incorporated into our daily lives. For example, we happily compensate for our loss of natural ability to control adequately the temperature of our bodies by providing ourselves with varying degrees of clothing and with temperaturecontrolled dwellings. We add vitamins to our diets, and take hormones when necessary. We successfully feed and rear infants in the absence of human milk. We wear glasses when indicated, we see our dentists at least twice a year, and we are reasonably happy under these restrictive derivatives of civilized existence.

I see no reason to decry further advances in medical and social science. In any event, I am sure that the alternative to our present practices would be not a return to *laissez faire*, but a gradual reduction in the births of the genetically defective as a result of an increasing awareness on the part of the general public of the facts and the implications of genetics.

Let us turn our attention to another dilemma presented by our developing culture. Not only have individual generations of men and women worked to improve their environments, but due to their ability to reason, to communicate, and to record their thoughts in writing, the improvement process has become a cumulative one. As a result there are increasing indications that social inheritance, or tradition, is rapidly surpassing biological inheritance as a social force.

The prospect that the forces of social organization may replace the mechanism of the chromosome and the gene as a major determinant of human behavior has elicited widely varying responses from various writers. Some take pessimistic views indeed. One author (Seidenberg) paints, in clear sure strokes, an engrossNo. 1

ing verbal picture of the result of the usurpation of the dominant role by tradition. It leads, in his view, to the approach to fixed perimeters: to a crystallized status of man within compelling forms of organized procedures. In the ultimate state of crystallization to which the principle of organization leads, conciousness will have accomplished its task, leaving mankind sealed, as it were, within patterns of frigid and unalterable perfection.

The subject is developed logically and inexorably, with frequent well-chosen documentation. The ultimate triumph of organization over individuality is presented as inevitable, and is a frightening prospect indeed. The terrible fascination of the author's logic holds the reader to the implaceable end.

Although this topic has been variously developed by several writers, other authors, among whom I number myself, hold quite contrasting views. It is true that man's ability to control and alter his surroundings has brought about more and more uniformity of the physical environment. At the same time, however, it has resulted in greater and greater heterogeneity of the social environment. Not only are human social environments different from place to place, but they have in the course of the history of mankind been extremely varied, and in terms of evolutionary time have succeeded each other with considerable rapidity. As a consequence, man has been subjected to much of the external variability required for molding the frequencies of whatever genes may be involved in various aspects of behavior.

It is obvious that there were two possible responses to this continuing variability of social surroundings. One would have been the selection of ever more precise specializations which would fit man to cope in stereotyped ways with specific environmental situations. The other would have been the development of increasingly plastic responsiveness to any of a variety of environmental circumstances. Mankind apparently made the latter response. It can well be imagined that the one strong selective pressure to which man has been continuously and unremittingly subjected during his period of domestication and in all social environments is selection for educability: for the capacity to benefit from experience and from reasoning. Just as one of man's striking physical assets resulting from morphological evolution is the relatively generalized human hand, which can be put to a variety of uses, so plasticity of responsiveness, permitting adjustment to a variety of situations, has been characteristic of man's psychic evolution.

It seems highly probably that in all human social situations plasticity of response, and emotional and temperamental resilience, have been of sufficient value as to have had a selective advantage. If this be true, it is highly improbable that any particular population ever developed significant genetic differentiation with respect to specific response patterns; temperaments, personality types, or intellectual capacities. In other words, despite the exceptional diversity of genetic constitutions among human beings, the plasticity of individual response to the social environment is even more remarkable. As determiners of specific and temporal social roles and attitudes, genetic factors are, on the whole, of limited significance.

In the long range outlook, however, the genetic endowment takes its place as co-equal with the social millieu in the forging of societies. From the vantage point of history one may observe the rhythm of the growth and decline of civilizations. And perhaps it is, after all, the historian who can successfully bridge the gap between the viewpoints of such writers as Seidenberg and Orwell on the one hand, and Dobzhansky and Montagu on the other. Toynbee, for example, develops the concept of "etherialization," an overcoming of material obstacles, leading to the release of the energies of society to make responses to challenges which are thenceforth internal rather than external, spiritual rather than material. Although Toynbee writes with theistic overtones, there remains when these are stripped away, an important basic historical truth in the concept.

Throughout history the process of cultural acquisition has resulted in bursts of growth and development of societies, alternating with their crystallization and ultimate degeneration. Toynbee epitomizes this by concluding that, just as differentiation is the mark of growth, so standardization is the mark of disintegration. Thus history furnishes some support to the view that organization will ultimately triumph over individuality, in that standardization has indeed been the culmination of many societies in the past and may well be so again in the future. But history provides at the same time the clue to the answer to the dilemma.

It lies in the very fact that whenever standardization of thought and social organization has from time to time threatened the existence of civilization, new lines of behavior and of development have sprung up out of the tremendous potential of variability of response inherent in the human species. And with the increasing ability of social psychology to provide effective technics for the management of interpersonal and intergroup relations, we may look forward hopefully to the ever more efficient use of the really enormous constructive potentialities which are biologically characteristic of mankind as it exists today.

The disquietudes aroused by the rapid scientific advances going on all around us are basically social problems, and must find their solutions in the social sciences. We must in all sincerity pin our hopes on the better management of social relationships, especially at the international level. Changes in human social and political organization have taken place at unbelievably rapid rates in the past, and probably will continue to do so into the future. On the other hand, man's biological evolution has been, and will surely continue to be, very slow indeed. There has been little or no anatomical change in man over the last half million years, and there is no good evidence that intelligence has changed either. I doubt that the development of interplanetary space vehicles is the manifestation of any greater innate mental capacity than such creative efforts, largely buried in the vaults of antiquity, as the invention and employment of the wheel or the bow and arrow. The social scientists today face a tremendous challenge. With their newer technics, reinforced by modern genetic knowledge and augumented by an educated and informed public, may they be successful in their efforts to enable mankind to use more constructively the vast latent biological potentialities which exist in all peoples everywhere.

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