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## Criteria for an Optimum Human Environment

In his arrogance toward nature, man is gambling that his superior technology will provide the essentials of food, clean water and pure air. What are the risks of such a gamble? Are these the only necessities? Drs. Iltis and Loucks are professors of botany at the University of Wisconsin, Madison. Mr. Andrews is an affiliated student in archeology and anthropology, St. John's College, Cambridge, England

Almost every current issue of the major science journals contains evidence of an overwhelming interest in one urgent question: Shall a single species of animal, man, be permitted to dominate the earth so that life, as we know it, is threatened? The uniformity of the theme is significant but if there is consensus, it is only as to the need for concern. Each discipline looks differently at the problem of what to do about man's imminent potential to modify the earth through environmental control. Proposals to study ways of directing present trends in population, space and resource relationships toward an "optimum" for man are so diverse as to bewilder both scientists and the national granting agencies.

### *ARROGANCE TOWARD NATURE*

It is no thirst for argument that compels us to add a further view. Rather it is the sad recognition of major deficiencies in policies guiding support of research on the restoration of the quality of our environment. Many of us find the present situation so desperate that even short-term treatments of the symptoms look attractive. We rapidly lose sight of man's recent origins, probably on the high African plains and the natural environment that shaped him. Part of the scientific community also accepts what Lynn White has called out Judeo-Christian arrogance toward nature, and is gambling that our superior technology will deliver the necessary food, clean water and fresh air. But are these the only necessities? Few research proposals effectively ask whether man has other than these basic needs, or whether there is a limit to the artificiality of the environment that he can tolerate.

In addition, we wish to examine which disciplines have the responsibility to initiate and carry out the research needed to reveal the limits of man's tolerance to environmental modification and control. We are especially concerned that there is, on the one hand, an unfortunate conviction that social criteria for environmental quality can have no innate biological basis - that they are only conventions. Yet, on the other hand, there is increasing evidence suggesting that mental health and the emotional stability of populations may be profoundly influenced by frustrating aspects of an urban, biologically artificial environment.

There have been numerous proposals for large-scale inter-disciplinary studies of our environment and of the future of man, but such studies must have sufficient breadth to treat conflicting views and to seek to reconcile them. We know of no proposal that would combine the research capabilities of a group studying environmental design with those of a group examining the psychological and mental health responses of man to natural landscapes. The annual mass migration of city man into natural landscapes which provide diversity is a matter of concern to the social scientist, whose research will only be fully satisfactory when joined with studies that quantify the landscape quality, the psychology of individual human response, and the evolutionary basis of man's possible genetic adaptations to nature. The following summary of recent work may provide a basis for scientists in all areas to seek and support even greater breadth in our studies of present and future environments for man.

## *“WEB OF LIFE”*

Two major theses are sufficiently well established to provide the positive foundation of our argument. First, we believe the inter-dependency of organisms, popularly known as the “web of life”, is essential to maintaining life and a natural environment as we know it. The suffocation of aquatic life in water systems, and the spread of pollutants in the air and on the land, make it clear that the “web of life” for many major ecosystems is seriously threatened. The abrupt extinction of otherwise incidental organisms, or their depletion to the point of no return, threatens permanently to impair our fresh water systems and coastlines, as well as the vegetation of urban regions.

Second, man’s recent evolution is now well enough understood for it to play a major part in elucidating the total relation of man to his natural environment. The major selection stresses operating on man’s physical evolution have also had some meaning for the development of social structures. These must be considered together with the immense potential of learned adaptations over the entire geologic period of this physical evolution. Unfortunately, scientists, like most of us moderns, are city dwellers dependent on social conventions, and so have become progressively more and more isolated from the landscape where man developed, and where the benchmarks pointing to man’s survival may now be found. They, of all men, must recognize that drastic environmental manipulations by modern man must be examined as part of a continuing evolutionary sequence.

The immediacy of problems relating to environmental control is so startling that the threat of a frightening and unwanted future is another point of departure for our views. At the present rate of advance in technology and agriculture, with an unabated expansion of population, it will be only a few years until all of life, even in the atmosphere and the oceans will be under the conscious dictates of man. While this general result must be accepted by all of us as inevitable, the methods leading to its control offer some flexibility. It is among these that we must weigh and reweigh the cost-benefit ratios, not only for the next 25 or 50 years, but for the next 25,000 years or more. The increasing scope of the threat to man’s existence within this controlled environment demands radically new criteria for judging “benefits to man” and “optimum environments.”

It would be perverse not to acknowledge the immense debt of modern man to technological development. In mastering his environment, man has been permitted a cultural explosion and attendant intricate civilization made possible by the very inventiveness of modern agriculture, an inventiveness which must not falter if the world is to feed even its present population. Agricultural technology of the nineteenth and twentieth centuries, from Liebig and the gasoline engine to hybrid corn, weed killers and pesticides, has broken an exploitative barrier leading to greatly increased production and prosperity in favored regions of the world. But this very success has imposed upon man an even greater responsibility for managing all of his physical and biotic environment to his best and sustained advantage.

The view also has been expressed recently that the “balance of nature”, upset by massive use of non-disintegrating detergents and pesticides, will be restored by “new engineering.” Such a view is necessarily based on the assumption that it is only an engineering problem to provide “an environment [for man] relatively free from unwanted man-produced stress.” But when the engineering is successful, the very success dissipates our abilities to see the human being as part of a complex biological balance. The more successful technology and agriculture become, the more difficult it is to ask pertinent questions and to expect sensible answers on the long-range stability of the system we build.

## *THE RIGHT QUESTIONS?*

Inspired by recent success, some chemical and agricultural authorities still hold firmly that we can feed the world by using suitable means to increase productivity, and there is a conviction that we can and must bend all of nature to our human will. But if open space were known to be as important to man as food, would we not find ways to assure both? Who among us has such confidence in modern science and technology that he is satisfied we know enough, or that we are even asking the right questions, to ensure our survival beyond the current technological assault upon our environment. The optimism of post-World War II days that man can solve his problems – the faith in science that we of Western culture learn almost as infants – appears more and more unfounded.

To answer “what does man now need?” we must ask “where has he come from?” and “what evidence is there of continuing genetic ties to surroundings similar to those of his past?”

Theodosius Dobzhansky and others have stressed that man is indeed unique, but we cannot overlook the fact that the uniqueness does not separate him from animals. Man is the product of over a hundred million years of evolution among mammals, over 45 million years among primates, and over 15 million years among apes. While his morphology has been essentially human for about two million years, the most refined neurological and physical attributes are perhaps but a few hundred thousand years old.

#### *SELECTION AND ADAPTATION*

G. G. Simpson notes that those among our primate ancestors with faulty senses, who misjudged distances when jumping for a tree branch or who didn't hear the approach of predators, died. Only those with the agility and alertness that permitted survival in ruthless nature lived to contribute to our present-day gene pool. Such selection pressure continued with little modification until the rise of effective medical treatment and social reforms during the last five generations. In the modern artificial environment it is easy to forget the implications of selection and adaptation. George Schaller points out in “The Year of the Gorilla” that the gorilla behaves in the zoo as a dangerous and erratic brute. But in his natural environment in the tropical forests of Africa, he is shy, mild, alert and well-coordinated. Neither gorilla nor man can be fully investigated without considering the environments to which he is adapted.

Unique as we may think we are, it seems likely that we are genetically programmed to a natural habitat of clean air and a varied green landscape, like any other mammal. To be relaxed and feel healthy usually means simply allowing our bodies to react as evolution has equipped them to do for 100 million years. Physically and genetically we appear best adapted to a tropical savanna, but as a civilized animal we adapt culturally to cities and towns. For scores of centuries in the temperate zones we have tried to imitate in our houses not only the climate, but the setting of our evolutionary past: warm humid air, green plants, and even animal companions. Today those of us who can afford it may even build a swimming pool next to our living room, buy a place in the country, or at least take our children vacationing at the seashore. The specific physiological reactions to natural beauty and diversity, to the shapes and color of nature, especially to green, to the motions and sounds of other animals, we do not comprehend and are reluctant to include in studies of environmental quality. Yet it is evident that nature in our daily lives must be thought of, not as a luxury to be made available if possible, but as part of our inherent indispensable biological need. It must be included in studies of resource policies for man.

#### *DEPENDENCE ON NATURE*

Studies in anthropology, psychology, ethology and environmental design have obvious

implications for our attempts to structure a biologically sound human environment. Unfortunately, these results frequently are masked by the specifics of the studies themselves. Except for some pioneer work by Konrad Lorenz followed up at several symposia in Europe, nothing has been done to systematize these studies or extend their implications to modern social and economic planning. For example, Robert Ardrey's popular work, "The Territorial Imperative," explores territoriality as a basic animal attribute, and tries to extend it to man. But his evidence is somewhat limited, and we have no clear conception of what the thwarting of this instinct does to decrease human happiness. The more extensive studies on the nature of aggression explore the genetic roots of animal conflicts, roots that were slowly developed by natural selection over millions of generations. These studies suggest that the sources of drive, achievement, and even of conflict within the family and war among men are likely to be related to primitive animal responses as well as to culture.

Evidence exists that man is genetically adapted to a nomadic hunting life, living in small family groups and having only rare contact with larger groups. As such he led a precarious day-to-day existence, with strong selective removal due to competition with other animals, including other groups of humans. Such was the population structure to which man was ecologically restricted and adapted until as recently as 500 generations ago. Unless there has since been a shift in the major causes of human mortality before the breeding age (and except for resistance to specific diseases there is no such evidence), this period is far too short for any significant changes to have occurred in man's genetic makeup.

Studies of neuro-physiological responses to many characteristics of the environment are also an essential part of investigating genetic dependence on natural as opposed to artificial environment. The rapidly expanding work on electroencephalography in relation to stimuli is providing evidence of a need for frequent change in the environment for at least short periods, or, more specifically, for qualities of diversity in it. There is reason to believe that the electrical rhythms in the brain are highly responsive to changes in surroundings when these take the full attention of the subject. The rise of mechanisms for maintaining constant attention to the surroundings can be seen clearly as a product of long-term selection pressures in a "hunter and hunted" environment. Conversely, a monotonous environment produces wave patterns contributing to fatigue. One wonders what the stimuli of brick and asphalt jungles, or the monotony of corn fields, do to the nervous system. Biotic as well as cultural diversity, from the neurological point of view, may well be fundamental to the general health that figures prominently in the discussions of environmental quality.

#### *RESULTS WITH PATIENTS*

The interesting results of Maxwell Weismann in taking chronically hospitalized mental patients camping are also worth noting. Hiking through the woods was the most cherished activity. Some 35 of the 90 patients were returned to their communities within three months after the two-week camping experience. Other studies have shown similar results. Many considerations are involved, but it seems possible that in a person whose cultural load has twisted normal functioning into bizarre reactions, his innate genetic drives still continue to function. Responses attuned to natural adaptations would require no conscious effort. An equally plausible interpretation of Weismann's results is that the direct stimuli of the out-of-doors, of nature alone, produces a response toward the more normal. A definitive investigation of the bases for these responses is needed as guidance to urban planners and public health specialists.

These examples are concerned with the negative effects which many see as resulting from the unnatural qualities of man's present, mostly urban, environment. Aldous Huxley ventures a further opinion as he considers the abnormal adaption of those hopeless victims of mental illness who appear

most normal : “These millions of abnormally normal people, living without fuss in a society to which, if they were fully human beings, they ought not to be adjusted, still cherish 'the illusion of individuality,' but in fact they have been to a great extent de-individualized. Their conformity is developing into something like uniformity. But uniformity and freedom are incompatible. Uniformity and mental health are incompatible as well . . . . Man is not made to be an automaton, and if he becomes one, the basis for mental health is lost.”

Clearly, a program of research could tell us more about man's subtle genetic dependence on the environment of his evolution. But of one thing we can be sure: only from study of human behavior in its evolutionary context can we investigate the influence of the environment on the life and fate of modern man. Even now we can see the bases by which to judge quality in our environment, if we are to maintain some semblance of one which is biologically optimum for humans.

We do not plead for a return to nature, but for re-examination of how to use science and technology to create environments for human living. While sociological betterment of the environment can do much to relieve poverty and misery, the argument that an expanding economy and increased material wealth alone would produce a Utopia is now substantially discounted. Instead, a natural concern for the quality of life in our affluent society is evident. But few economists have tried to identify the major elements of the quality we seek, and no one at all has attempted to use evolutionary principles in the search for quality. Solutions to the problems raised by attempts to evaluate quality will not be found before there is tentative agreement on the bases for judging an optimum human environment. A large body of evidence from studies in evolution, medicine, psychology, sociology, and anthropology suggests clearly that such an environment will be a compromise between one in which humans have maximum contact with the properties of the environment to which they are innately adapted, and a more urban environment in which learned adaptations and social conventions are relied upon to overcome primitive needs.

Our option to choose a balance between these two extremes runs out very soon. Awareness of the urgency to do something is national, and initial responses may be noted in several well-established but relatively narrow scientific disciplines. There has been the recent revival of eugenics. A balanced view has been proposed by Leonard Ornstein (Bulletin, June 1967) who agrees with others that positive improvements in man's genetic make-up must wait until we are vastly more knowledgeable. He recommends control of degenerating effects from uncontrolled mutation (in the absence of high selection) until more positive measures can be taken.

#### *AN “IMPOSSIBLE” CHALLENGE*

More extreme views have been expressed that man could be changed genetically to fit any future, but the means to do this and the moral justification of the aims sought are still far from being resolved. Many support the so-called evolutionary and technological optimists who, unlike their forefathers of little more than a generation ago, believe man can be changed radically when the time comes. They show a faith that science has proved its ability to draw on an expanding technology to do the impossible. The technologically impossible seems to have been accomplished time and time again during the past two or three generations, and may happen again. But some important scientific objectives have not been achieved, and we are likely to become more aware of the failures of science, of the truly impossible, as the irreversible disruptions of highly complex biological systems become more evident.

We suggest that the alternative to genetic modification of man is to select a course where the objectives only verge on the impossible. Let us regard the study and documentation of criteria for an

environmental optimum as the “impossible” challenge for science and technology in the next two decades! Although considerable research in biology, sociology, and environmental design is already directed to this objective, there are several other types of study required that we outline briefly, simply to indicate the scope of the challenge.

First, a thorough examination must be undertaken of the extent to which man's evolutionary heritage dominates his activity both as an individual and in groups. The survival advantage of certain group activities has clearly figured in his evolutionary success and adaptive culture. Although cultural adaptation now dominates the biological in the evolution of man, his basic animal nature has not changed. Research leading to adequate understanding of the need to meet innate genetic demands lies in the field of biology, and more specifically in a combination of genetics, physical anthropology and ethology.

Second, we need to understand more of how cultural adaptations and social conventions of man permit him to succeed in an artificial environment. Cultural adaptation is the basis of his success as a gregarious social animal, and it will continue to be the basis by which he modifies evolutionarily imposed adaptations. Medical studies suggest there may be a limit to the magnitude of cultural adaptations, and that for some people this is nearly reached. Studies in sociology, cultural anthropology and psychology are all necessary to such research, in combination with environmental design and quantitative analysis of diversity in the native landscape.

Third, relationships between the health of individuals, both mental and physical, and the properties of the environment in which they live should be a fundamental area of research. It is easy to forget that we should expect as much genetic variability in the capacity of individuals to adjust to artificial environments as we find in the physical characteristics of man. Some portions of the population should be expected to have a greater inherent commitment to the natural environment, and will react strongly if deprived of it. Others may be much more neutral. Studies of the population as a whole must take into account the variability in reaction, and must therefore consider population genetics as well as psychiatry and environmental design.

Fourth, environmental qualities should be programmed so as to optimize for the maximal expression of evolutionary (i. e. human) the capabilities at the weakest link in the ontogenic development of human needs. While there are many critical periods during our life, we believe the ties to natural environments to be most vital during youth. We have abundant evidence on our campuses and in our cities that the dislodgement of youth presents one – if not the most- serious obstacle to successful adoption of more complex social structures. The dislodgement of man in an artificial environment will vary throughout his ontogeny. Even the small child or infant cannot be expected to be indifferent to changes in the gross characteristics of his community, as he cannot within his own family.

Young men and women accept many of the modern social conventions, but retain the highly questioning mind that once led to new and better ways to hunt and forage. By early middle age, man's physical and mental agility has changed and he becomes a stronger adherent to the social conventions that make his own society possible. During the rise of modern man on the high African plains, and continuing into modern primitive societies, each community was very much dependent on its young men. They contributed to hunting and community protection through their strength and agility, commodities for which there is declining demand in modern society. Survival in the primitive groups was to some degree dependent on the willingness of youth to innovate and take risks, and this has become a fixed adaptation, requiring outlets of expression.

Over 30 years ago, sociologist W.F. Ogburn suggested that society in the future would require

“prolonging infancy to , say, thirty or forty years or even longer.” Is not our 20-year educational sequence a poorly-veiled attempt to do just that ? From an evolutionary point of view will not this dislodgement of youth present the most serious obstacle to successful adoption of more complex social structures? We are compelled to acknowledge that our over-all technological environment for youth has not compensated for the loss of the challenges of the hunt and the freedom of the Veldt. The disruptions on our campuses and in the cities indicates the need to plan environmental optima for this weakest link in the human need for expression of evolutionary capabilities.

Finally, systems ecology is developing the capacity for considering all of the relationships and their interactions simultaneously. The notion of fully describing the optimum for any organism may seem presumptuous. It requires measurement of every type of response, particularly behavioral responses, and their statement as a series of component equations. Synthesis in the form of a complex model permits mathematical examination of an optimum for the system as a whole. Until recently it seemed more reasonable to study such optimization for important resources such as fisheries, but the capability is available and relevant to the study of the environmental optimum of man, and its application must now be pursued vigorously.

These five approaches to the study of human environment provide an objective base for investigating the environmental optimum for man. We cannot close this discussion, however, without pointing out that the final decision, both as to the choice of the optimum and its implementation, is an ethical one. There is an optimum for the sick, and another for the well; there is an optimum for the maladjusted, and another for the well-adjusted. But in treating the problems of the poor and minority groups, in our preoccupation with their immediate relief, we may continue to overlook the ways in which cultural demands of the modern, sub-optimum environment go far beyond the capacity of learned adaptations.

#### *A COMPROMISE?*

Considering our scientific effort to learn the functions and structure of the human body, and of the physical environment around us, the limited knowledge of man's relationships to his environment is appalling. Because of the very success of our scientific establishment we are faced with population densities and environmental contaminants that have left us no alternative but to undertake control of the environment itself. In this undertaking let us understand the need to choose a humane compromise – a balance between the evolutionary demands we cannot deny except with great emotional and physical misery, and the fruits of an unbelievably varied civilization we are loath to give up.

Yet are we even considering such a compromise? With rare exceptions are we not continuing to destroy much that remains of man's natural environment with little thought for the profit of the remote future? In the conflict between preservationists and industrialists (or agriculturalists) the latter have had it their way, standing as they do for “progress” and “modern living.” While the balance between these conflicts is slowly changing, preservationists continue to be regarded as sentimentalists rather than realists.

Theodosius Dobzhansky says that 'the preponderance of cultural over biological evolution will continue to increase in the foreseeable future.’ We could not wish this to be otherwise; adaptation to the environment by culture is more rapid and efficient than biological adaptation. But social structures cannot continue indefinitely to become more complex and further removed from evolutionary forces. At some stage a compromise must be reached with man's innate evolutionary adaptability.

#### *NEED FOR CONTINUING STUDY*

We believe that the evidence of man's need for nature, particularly its diversity, is sufficient to justify a determined effort by the scientific community to obtain definitive answers to the questions we have posed. The techniques for studying the problems are to be found in separate disciplines, and there is a sufficient measure of willingness among scientists to undertake the new approaches. But the first steps will be faltering and financial support will be slow in coming.

Now that buttercups are rare, at least symbolically, and springs often silent, why study them? Have there not already been several generations for whom the fields and woods are nearly a closed book? We could encourage the book to close forever, and we might succeed, but in doing so we might fail disastrously. The desire to see and smell and know has not yet been suppressed and enthusiasm for natural history continues to bring vitality to millions. Let us recognize that we are a product of evolution, without apology for the close affinities with our primate forebears. We need only prepare consciously to make a compromise between our cultural and our genetic heritage by striking a balance of social structures with maintenance of natural environments. Most important, we must discover the mechanisms of environmental influence on man. There is no other satisfactory approach to an optimum environment.