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The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

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We Need Many More
SCIENTIFIC AREAS



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Vol. 24, No. 9, September 1959)

PARKS, OPEN SPACES AND WATERWAYS
Human Needs and Their Evolutionary Reasons

Hugh H. Iltis, Associate Professor
of Botany
University of Wisconsin, Madison

What sort of world do we want? A beautiful world, of course, rich, diverse, colorful and clean, with lots of wildlife, butterflies and flowers, pleasing and healthy for man. We can all agree on this. How to achieve this, how to plan for this, is another matter!

MAN NEEDS NATURE!

To plan a truly human world in a biologically (i.e. scientifically) sound way, we must be guided by the acceptance of THE BIOLOGICAL NATURE OF MAN AND THE BIOLOGICAL RELATIONSHIP OF THE HUMAN ANIMAL TO HIS ENVIRONMENT. Man, after all, is an intellectualized, clothed ape. We must therefore accept man as a part of, and the result of evolution, and as an inseparable part of the nature that produced him. This we can use as an absolute standard by which we can plan cities, states, and human lives! Man needs nature as part of his very existence, because this need is part of his adaptational inheritance, the result of his long biological evolution. Like all living things, man is a complex bundle of biological adaptations. His eyes and ears, his brain and heart, even his psyche, are the evolutionary adaptations of the human organism to nature, including other human beings. Remove these adaptations from their environment, from nature, and sick modern man is the result. Modern city man, in particular, far removed from nature in his asphalt jungles has to pay the price in neurosis, delinquency, and despair.

Many sensitive citizens, especially those who are "birdwatchers and flower-lovers", though often ridiculed by some segments of the public, are among the most dependable allies in conservation battles, for they are the very people who often instinctively understand man's inherited needs for beauty and diversity, man's inherited needs for nature.

HUMAN NEED FOR BEAUTY

I wish to stress that one of the reasons why we have to save and preserve natural areas is to save their beauty. HUMAN NEEDS FOR NATURAL BEAUTY, LIKE HUMAN NEEDS FOR LOVE, ARE VERY LIKELY INHERITED. Their overpowering force alone suggests evolutionary origins. This will be questioned, but I see no reason why we should not consider the ability to get pleasure from beautiful colors, views, and sounds, as well as from peaceful landscapes, in short, the ability to respond with pleasure to beauty, as an evolutionary adaptation, produced over hundreds of millions of years by natural selection. Thus, Tennyson's lines, "NOTHING IN NATURE IS UNBEAUTIFUL", takes on new and deep significance.

If our generalized need for natural beauty is an ancient evolutionary adaptation, don't we need natural areas -- not only for teaching, for research, or for direct economic reasons, but also to give our ears rest from the noisy cities, to give our eyes relaxation in green fields and blue skies, to give our brain a chance to function in the very environment which originally produced it, an unhurried, rather quiet, peaceful land. The needs of healthy, happy humans for natural beauty are founded in the obligatory evolutionary relationship between man and nature. Nature could well live without man, but

Conservation, Contraception and Catholicism,
A 20th Century Trinity

HUGH H. ILLIS

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PARKS OPEN SPACES AND WATERWAYS

Human Needs and Their Evolutionary Reasons

by HUGH H. ILTIS, *Associate Professor of Botany, University of Wisconsin, Madison*

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land. The needs of healthy, happy humans for natural beauty are founded in the obligatory evolutionary relationship between man and nature. Nature could well live without man, but man cannot live long without nature. While man cannot change his physical, physiological and psychological evolutionary adaptations, since evolution is a geologic process measured in millions of years, man can rather easily modify his cultural view of his environment and thus stop its destruction. Unbridled human destructiveness is part of human culture. And, human culture, as history has shown us time and again, can be modified in a lifetime.

What Guidelines for Highway "Beautification"?

It is easy to pontificate about "beauty" and the inherent dependence of man on nature. But "Beauty is in the eye of the beholder"! And what if that beholder prefers cornfields or parks to prairies or flowers? Thus, there is always the immense danger of impressing our own personal, often city-conditioned ideas of what constitutes "beauty" on a helpless landscape. How should we then, implement present efforts to beautify often despoiled roadsides? Is the removing of junk yards and the planting of trees enough?

It seems to me that there are two major alternatives, one, the construction of manicured park-like roadsides, expensive to plant, expensive to maintain; or, two, the encouragement of the local native vegetation, be it oak savanna in Central Wisconsin, hemlock-white pine forest in Northern Michigan, tall grass prairie in Illinois or Kansas, short grass prairie in Texas, or desert vegetation in Arizona. Not that parks do not have their time-honored place, especially on the outskirts of cities? But for the vast USA, native vegetation types would seem superior. As in other cases, what is cheapest is also best, and such is the case here for the following reasons:

1) Natural plant communities are diverse, integrated and beautiful in many ways, give shelter to native animals, and, since next to nothing needs to be planted, are cheap and *save the taxpayer money*. On the other hand, one artificial landscaped roadside is like any other, whether in Maryland, Wisconsin or California. Once you have seen one, you have seen them all: mowed grass, scattered conifers or shrubs, very pretty, very expensive, and very dull!

2) Certain natural communities and many of their species, especially in Wisconsin and the Middle West, are getting to be rare, and in the case of the once waving oceans of prairie grasslands, are all close to permanent extinction. Indeed, some of our last remaining prairie communities are along unsprayed railroad rights-of-way and country roadsides. There, any and every new road "improvement" program and "weed" control spraying destroys miles of hedgerows and innumerable beautiful and now rare flowers. Here again, the cheapest "beautification" would at the same time

(Continued on Page 35)

Presented at Waukesha County (Wisconsin) Beautification Conference, February 1967.

(Continued from Page 31)

be the best. In many roadsides, which now are covered with acres upon acres of neatly mowed and sterile lawn grass, one could artificially re-establish prairies, needing only an occasional spring fire for maintenance. It should always be remembered that prairies contain no agricultural weeds.

3) Natural plant communities are preferable to parks since no two of them are ever alike. Thus one of the main attributes of natural beauty (and indeed of a healthy landscape) is its immense diversity. And, this diversity we need to maintain wherever we can. Thus it is important to remember that the beauty of Kansas or the Dakotas or parts of Southern Wisconsin lies in its prairies and vast open skies, and thus in the absence of trees! Our vacation-minded visitors from the big city would much prefer that our "beautification" offer to them something different from the parks of Chicago or the New York Thruway. In the prairie regions of the Midwest, at least, widespread re-prairiefication would be cheap, beautiful and sensible.

We need, then, to be highly suspicious and critical of even the best intentioned traditional roadside beautification programs, for they may turn all our highway roadsides into strips of neatly mowed blue-grass lawns interspersed with artistic clumps of lilacs, dogwoods, pinoaks, or junipers, boringly homogeneous from New York to California. *Not only will this imminent landscaping orgy cost immense sums of tax money, but it will destroy what could be biological valuable, esthetically stimulating environmental corridors of native plants.* And in a state like Texas, where preservation of its truly magnificent flora and fauna barely exists, this chance must not be missed.

If we must spend money, let us buy small or large roadside parks of native vegetation, fifty or one hundred acres where we and our children can learn while we rest, and where wildlife will find a haven. It will take a wise highway beautification program indeed, free from vested interests and leaning heavily on advice from modern biological science, to choose for America the ever-varying diversity of our now vanishing native plant communities.

The New Land Ethic

The current conservation revolution is based on the knowledge that man can master his cultural destiny, but not his evolutionary heritage. The *land ethic*, the result of this revolution, considers man not only as an integral part of nature, but nature as an integral and necessary part of man.

One immediate and very urgent aspect of the new land ethic is the preservation of remnants of undisturbed nature, of man's evolutionary environment. Wisconsin, in one way, is a very appropriate place to discuss conservation. It was here that University of Wisconsin presidents Van Hise and Chamberlain worked, two of the earliest and most influential conservationists in the United States.

John Muir, who spent his boyhood near the lily-filled

meadows of Ennis Lake in Marquette County, came to the campus of the University of Wisconsin, where a part of Bascom Woods was recently dedicated to him (unfortunately a smokescreen to delude the public and destroy a large portion of the woods!). Aldo Leopold worked, wrote, and died here, and his noble spirit is yet with us. Norman Fassett, inspired by the enthusiasm of his teacher Fernald at Harvard University, came here in 1925, and jointly these men, close personal friends, including John Curtis and Albert Fuller, worked toward the establishment of nature preserves, through a "State Board for the Preservation of Scientific Areas" (the first of its kind in the nation) and the creation of the University of Wisconsin Arboretum. Much more important, however, they instituted a new tradition in conservation thinking and feeling, and trained a generation of students in the philosophy of the "land ethic" and "conservation conscience," in which the saving of natural and wilderness areas is of prime importance.

Let us find them, human solutions to the three monumental problems that today make biotic preservation all but impossible and meaningless—let us urge *birth control* to halt the *population explosion*, peaceful settlement of conflict to *stop war*, and training of more ecologists and biologists to *decrease our ecological ignorance*.

Let all in Waukesha County read and study "Natural History," and walk in what is yet left of nature. Let us locate all the larger tracts of land that are yet wild, and make it our own business to safeguard them forever. Let us become biologically educated, so that as voting citizens we can help the ecologically sound decisions which our times demand. Let us, as parents, teach our children by example a deep respect for nature and a reverence for life.

Let us become not only personally committed to an ecologically sensible use of our living world, but financially committed to the preservation of undisturbed natural vegetation, for time is indeed running out.

Let us again reaffirm the proposition here today that in agriculture, in forestry and in any other land use, only by a new biologically responsible "Land Ethic," by an ecologically sound philosophy can man preserve and maintain an environment in which a continuing, full and rewarding life is possible for his species, not only in a material sense, but in a physiological, emotional and spiritual sense as well.

Let our voices be loud and clear—"the world need not and must not be turned into a biotic desert"! And since conservation is now fundamentally a political problem, let us carry our voices to city councils, to the state legislatures, and to Congress and the United Nations, so that we, the concerned citizens, and not only the despoilers and exploiters, will have our say; so that, even if we are successful only in a limited way, our children will inherit a world well-prepared for the conservation revolution. Let us, who are just "passing through", leave our grandchildren a human world that will remain rich in diversity of life and in harmony with nature.

ILLINOIS PARKS

OFFICIAL PUBLICATION OF
THE ILLINOIS ASSOCIATION
OF PARK DISTRICTS

2

THE
MEANING
OF
HUMAN EVOLUTION
TO
CONSERVATION

by
Hugh H. Iltis

In an age when it is fashionable to glorify technology, when machines, we are told, will liberate man from all the limitations of his animal nature, when atomic physics promises to produce for us all we shall ever need, to discuss the meaning of human evolution to conservation may seem out of place. Yet evolution, that most wonderful of all phenomena, not only produced the lilies of the fields and the lowly earthworm amongst their roots, but also that king of all beasts, the human animal. It is obvious, therefore, that the study of evolution is a passport, the only passport, to the understanding of man and man's place on earth.

Evolution, like history, does not repeat itself. Nevertheless, in both, the series of changes or revolutions, one on a geologic, the other on a cultural timescale, do have value for man. By understanding his past history and biologic evolution, man can hope to adapt to change and thus control his fate. Failure to adapt on the other hand will mean extinction! The more rapid the changes, and the more violent the revolutions, the greater the danger of evolutionary or historical disaster. Since modern scientific man, who generally dies in bed and of old age, is the only animal that has to adapt through will rather than through fate (since for him natural selection has all but ceased to operate),* it is important that he understand the rules by which to play the game. Thus, whether man shall remain the "darling of the gods" or become extinct is strictly up to him. He may wish to remain happy without being good, but evolution will never let him. For evolution and history are littered with the fossils of extinct species and the ruins of vanished cultures. Conservation, whether of species, biotic communities, or of man, thus becomes highly meaningful only with evolutionary understanding.

Now we, in the 1960's, are living in a period of unprecedented revolutions, rapid, violent revolutions in the relationship of man to his environment. Of these, there is, first of all, the revolution of rising expectations that is sweeping the underdeveloped countries of the world, and even parts of the United States, a revolution dependent on increased productivity through increased technology. Thus, there is, secondly, the allied revolution in the methodology of exploitation, in the tremendously increased and often blind efficiency in the use and destruction of resources, living or dead.

Revolution in American Conservation

Third and last, important for all of us in its healthy if rather late beginnings, there is the Revolution in Conservation, which, forced upon us by the alarming destruction of our wildlife resources, we finally have to face. In this revolution, the "shot that was heard around the world" was fired by a quiet studious lady biologist, Rachel Carson. In exposing man's deliberate pollution of his environment through pesticides, her brilliant book Silent Spring, published in 1962, drastically and probably for ever changed our optimistic faith in Science, and, as Garrett Hardin recently pointed out, forced scientists and technicians alike, for the first time in history, to recognize and accept their awesome and inescapable social responsibilities.

*The geneticist Sewall Wright, now emeritus professor at the University of Wisconsin, commented on this in a letter: "I doubt whether natural selection has all but ceased to operate in man, but I am afraid that it is operating to produce a type that flourishes in a slum environment that will hurry man's progress to destruction or at least to a tolerance of overpopulation under which human life would seem to lose most of its value."



Northwest Conifer

Pacific Northwest Chapter of the Sierra Club

VOLUME 17, NUMBER 4

The Optimum Human Environment and its
Relation to Modern Agricultural
Preoccupations¹

HUGH H. ILTIS²

Department of Botany, University of Wisconsin, Madison, Wisconsin

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Letters

ted as man's silent ancient companion in evolution. Only by defending a biological equilibrium, and not by manipulations of our genotypes or technological constructions of "better" environments, can a self-enlightened humanity give valid evolutionary directions to the changing of man.

HUGH H. ILTIS

Department of Botany,
University of Wisconsin, Madison 53706

A Plea for Man and Nature

While Dobzhansky's humanism is to be admired ("Changing man," 27 Jan., p. 411), his "evolutionary optimism" is incongruous, not because man cannot change, but because of long life-span and genetic limitations he cannot change fast enough! Today, technological effects are so enormous and rapid that man soon will live in a radically changed environment where his heredity will be out of phase with the natural forces that shaped it. Thus, evolutionary optimism is ill-founded. Anyone driving from New York to Washington or from Palo Alto to San Francisco can see, not a better world, but a natureless ecological nightmare. Can man function here as a well-adapted human? Will selection to "higher" evolutionary levels really occur? Dobzhansky seems blind to the technological impact on a highly vulnerable nature, especially in the tropics. As highly evolved as we are, our core of biological adaptations are still programed to the natural environment and not to the big cities. Is it sensible to suggest that natural or even rural environments are of no value to man, that "we must certainly prefer an adaptedness to the present environments, not to those long defunct?" In effect, has there been, or will there soon be sufficient selection by polluted metropolitan environments to erase man's unspoken needs for open spaces, wild mountains, clean lakes, or small towns? Does Dobzhansky mean it is desirable to permit (let alone encourage) adaptation to New York-type cities, their bleak lifeless canyons of stone crawling with humanity, their noisy sunless streets and overcrowded subways? He sounds like so many of our big city students who brag of dislike for nature; who glory in technological sophistication, but are blind to flowers or songbirds in the spring. Yet without nature they, as members of the human species, are unadapted and meaningless. Dobzhansky decries

the prophets of doom. Yet their emphasis on the interrelatedness within the web of life, of man's dependence on living nature, is quite realistic! That "evolution may some day be directed by man" independent of nature, which presumably by then will have gone the way of all Dodo's, seems more absurd.

Recently, in San Francisco, I heard two symphonies, Roger Sessions' cacophonics followed by Beethoven's melodies. And why did I prefer Beethoven? Because it is like a sunny day on Cape Cod compared with downtown New York. I don't know whether Dobzhansky has forgotten what it was like to walk the dunes in solitude or to swim in the ocean, but to most humans, as products of natural selection, it is pleasanter than basking in 5 p.m. traffic on Fifth Avenue. Man will never become genetically adapted to technological society and remain human. Even if he could adjust genetically to this disbiological change, a biological and cultural absurdity would result.

Blind faith in the ecological good sense of man has dug graves for many human societies. Long before the problems which geneticists fear become realities, the population explosion will have destroyed those very qualities of nature to which we, as vertebrates, mammals, and finally as humans, have become adapted through 200 million years of natural selection. The most precious values of man, the enjoyment of life and of living, will then cease to have meaning for *Homo post-sapiens*. He will end as a species which has devoured its evolutionary mother, with a culture which has lost its biologic roots. Beethoven and Shakespeare, like flowers and hummingbirds, wild geese, and the free human spirit, will be incomprehensible curiosities.

Let us realize that future human evolution can develop only within contexts of diverse environments which are at least partly untamed in a nature pro-

Shepherds Leading Sheep to Slaughter

The Biology Teacher and Man's Mad and Final War on Nature

By HUGH H. ILTIS

• First part of a two-part article. The extensive references, including those cited here, will appear with the remaining text, in April. At that time, too, the significance of the italic line in the title will be more strongly apparent.

Walking the crowded streets of Chicago on the first morning of the NABT convention, I picked one of Mayor Daley's plastic flowers and wished for a few real ones. I also wished for fewer people and cars. After all, the topic of my address to the convention, and one of the main concerns of NABT, as it ought to be for all men, was the people-environment equation. And there is no better place in the world to perceive the staggering imbalance so typical of modern civilization than downtown Chicago.

I was reminded of a comment by Marston Bates (1955), to this effect: Human population growth is like cancer. The yearly annual increase is now about

70 million, or 6 million a month—the equivalent of the population of Chicago. And whatever one may think of Chicago, a new one every month seems a little excessive.

Excessive, too, is the general unawareness of the significance of all the environmental turmoil: the popular view that, on the one hand, man can somehow adapt to pollution and crowding and, on the other hand, that he can solve his environmental problems solely by relying on technologic advances.

In a cartoon in *Look* magazine (Flagler, 1971) two businessmen are walking down Fifth Avenue with their attaché cases; one is saying to the other: "The way I look at it, there's a price tag on everything. You want a high standard of living, you settle for a low quality of life." The irony here may not be lost on you, but it seems to have been missed by many economists and sociologists. Indeed, even Philip Hauser, the eminent demographer at the University of Chicago, seems to see nothing particularly incongruous about giving up a biologically rich and humanly decent environment for one with increased urbanization and all that that implies—and using almost the identical language of that cartoon to do so! He said, in an interview:

The romantic nostalgia that some town and country planners have espoused is utter nonsense. Ferdinand the Bull sitting under the trees and smelling the pretty flowers just won't work in the modern world of the present or the future. This could be accomplished only at the expense of lower productivity and lower levels of living. (Hess, 1971)

But the problem of man and nature cannot be so cavalierly and sarcastically dismissed. Like so many



This paper is adapted from the keynote address to the annual convention of the National Association of Biology Teachers, 14 October 1971, in Chicago. Hugh H. Ilitis is professor of botany and director of the herbarium, University of Wisconsin, Madison 53706. A 1948 graduate of the University of Tennessee, he did graduate work at Washington University and the Missouri Botanical Garden (M.A. 1950, Ph.D. 1952). He has taught at Wisconsin since 1955. Ilitis's field work has taken him to Costa Rica, Mexico (maize studies), Hawaii, and Peru (potato studies). His special interests are biogeography, evolution, and the preservation of biotic communities. A devotee of backpacking and camping, with a deep concern for the "optimum human environment and human adaptations, especially as they relate to children and the family," he has been active in Nature Conservancy, the Sierra Club, the Wilderness Society, and other preservation groups.

FIRST NATIONAL CONGRESS ON OPTIMUM POPULATION AND ENVIRONMENT



CHICAGO/JUNE 7-11, 1970

CORN AND COWS ARE NOT ENOUGH! The Uses of Diversity

by

Hugh H. Iltis¹

Butterfly and wild flower, mountain lion and
caribou, blue whale and pelican, coral reef and prairie
land--who shall speak for you? My grandchild may need
to know you, to see and smell you, to hear and feel you
to be alive, bright and happy!

The prime concern of mankind, from now until the
end of time, will be the conservation of the diversity
of the natural environment.

¹ Dr. Iltis holds degrees from the University of Tennessee and Washington University, St. Louis, and is now Professor of Botany and Director of the Herbarium at the University of Wisconsin. He has made botanical explorations in Latin America; his scientific interests center on taxonomy and biogeography and man's adaptive needs for natural beauty and diversity. This article is based on an editorial from the 75th Anniversary Issue of "Field and Stream" magazine, June, 1970.

Criteria for an Optimum Human Environment

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 our 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

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. Illtis 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.

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 mat-

ter 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 manip-

PILOT PROJECT IN ENVIRONMENTAL SCIENCES

Ecology Subcommittee

University of Wisconsin, Madison (April 1967)

Discussion No. 5: The Optimum Human Environment and Its Relation
to Modern Agricultural Preoccupations

Discussion Led by: Hugh H. Iltis, Professor, Department of Botany

We are meeting here to discuss the biological bases for human existence. In so doing, we are trying to reformulate our cultural concepts of man's ancient relationships to his natural environment. That similar dialogues are going on all over this campus and in many parts of the world is evidence for the overriding urgency of the problem. The problem is one of a single species of animal who is making the earth unfit for habitation by conquering it.

The city-dwelling American, in particular, has been so removed from an intimate relationship with nature through the spectacular advances of science, industry and agriculture that he tends to lose sight of his very real dependence on nature (a dependence brought forcefully home by last summer's water shortage in New York, by the famines in India, by the pollution of air in Los Angeles, etc.). The more complex science and technology become, and the more extensive their use, the more far-reaching will be their destructive effects on nature, and the more difficult it will be to assess those effects, to stop them, or reverse them. The more successful science becomes the more difficult also will it be to ask the pertinent questions and expect any sensible answers. Technological success corrupts the ability to see the human animal in proper biological perspective. Technological success has become a technological plague.

It would be blind not to acknowledge the immense debts of modern man to this technological destruction. In mastering the environment, the fabulous inventiveness of modern agriculture has allowed a cultural explosion that continues to this day. In fact, it has made our civilization possible. Agricultural technology of the 19th and 20th centuries, from Liebig and the gasoline engine to hybrid corn, weed killers and pesticides, has crashed an exploitative sound barrier of increased production and prosperity in favored regions of the world whose long-term effect for good (and for evil) we must now try to assess.

Because of this success, some of our chemical or agricultural leaders now firmly hold that we can feed the world, that we can do anything we wish. Because of the population explosion, we must bend

Letters

ted as man's silent ancient companion in evolution. Only by defending a biological equilibrium, and not by manipulations of our genotypes or technological constructions of "better" environments, can a self-enlightened humanity give valid evolutionary directions to the changing of man.

HUGH H. ILTIS

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A Plea for Man and Nature

While Dobzhansky's humanism is to be admired ("Changing man," 27 Jan., p. 411), his "evolutionary optimism" is incongruous, not because man cannot change, but because of long life-span and genetic limitations he cannot change fast enough! Today, technological effects are so enormous and rapid that man soon will live in a radically changed environment where his heredity will be out of phase with the natural forces that shaped it. Thus, evolutionary optimism is ill-founded. Anyone driving from New York to Washington or from Palo Alto to San Francisco can see, not a better world, but a natureless ecological nightmare. Can man function here as a well-adapted human? Will selection to "higher" evolutionary levels really occur? Dobzhansky seems blind to the technological impact on a highly vulnerable nature, especially in the tropics. As highly evolved as we are, our core of biological adaptations are still programed to the natural environment and not to the big cities. Is it sensible to suggest that natural or even rural environments are of no value to man, that "we must certainly prefer an adaptedness to the present environments, not to those long defunct?" In effect, has there been, or will there soon be sufficient selection by polluted metropolitan environments to erase man's unspoken needs for open spaces, wild mountains, clean lakes, or small towns? Does Dobzhansky mean it is desirable to permit (let alone encourage) adaptation to New York-type cities, their bleak lifeless canyons of stone crawling with humanity, their noisy sunless streets and overcrowded subways? He sounds like so many of our big city students who brag of dislike for nature; who glory in technological sophistication, but are blind to flowers or songbirds in the spring. Yet without nature they, as members of the human species, are unadapted and meaningless. Dobzhansky decries

the prophets of doom. Yet their emphasis on the interrelatedness within the web of life, of man's dependence on living nature, is quite realistic! That "evolution may some day be directed by man" independent of nature, which presumably by then will have gone the way of all Dodo's, seems more absurd.

Recently, in San Francisco, I heard two symphonies, Roger Sessions' cacophonics followed by Beethoven's melodies. And why did I prefer Beethoven? Because it is like a sunny day on Cape Cod compared with downtown New York. I don't know whether Dobzhansky has forgotten what it was like to walk the dunes in solitude or to swim in the ocean, but to most humans, as products of natural selection, it is pleasanter than basking in 5 p.m. traffic on Fifth Avenue. Man will never become genetically adapted to technological society and remain human. Even if he could adjust genetically to this disbiological change, a biological and cultural absurdity would result.

Blind faith in the ecological good sense of man has dug graves for many human societies. Long before the problems which geneticists fear become realities, the population explosion will have destroyed those very qualities of nature to which we, as vertebrates, mammals, and finally as humans, have become adapted through 200 million years of natural selection. The most precious values of man, the enjoyment of life and of living, will then cease to have meaning for *Homo sapiens*. He will end as a species which has devoured its evolutionary mother, with a culture which has lost its biologic roots. Beethoven and Shakespeare, like flowers and hummingbirds, wild geese, and the free human spirit, will be incomprehensible curiosities.

Let us realize that future human evolution can develop only within contexts of diverse environments which are at least partly untamed in a nature pro-

Clipping from
The New York Times

JUN 14 1970

Date _____

Plea for Primacy of Nature in Ecology Effort

To the Editor:

The ubiquitous conservation speeches of today stress mainly the urgent problems of population, pollution and crowding. That priorities are given to these big-city, strictly human, homocentric syndromes is obvious — and understandable. People die of pollution, people go crazy with crowding, people starve and lay waste the lands through overpopulation.

It is to be hoped that we may solve this pollution crisis; we can, I think, clean up our polluted nests. But what if in cleaning up the cities, we forsake the rest of life? If we, in human preoccupation, let all but corn and cow slide into the abysmal finality of irreversible extinction, our species indeed will commit ecological suicide.

With the specters of ecosystem collapse, of catastrophic extinctions of most animal and vast numbers of plant species on the horizon, there is little cause for optimism in the broader environmental crisis.

Have our genes ceased to need the environment that shaped them? If we destroy ecosystems and species with abandon, ecosystems to which we

are adapted, species whose values we do not know and cannot predict—we surely do it at our own peril.

Butterfly and wild flower, mountain lion and antelope, blue whale and pelican, coral reef and prairie land—my grandchild may need to know them, to see and smell them, to hear and feel them, to be alive, bright and happy! Yet, hardly anyone speaks for wild nature—for Morpho butterflies in a Peruvian valley, for timber wolves chasing caribou in Alaska.

The ultimate question is: Shall man come always first, at the expense of other life? And is this really first? This may be expedient but in the long run impossible.

Not until man places man second, or, more precisely, not until man accepts his dependency on nature and puts himself in place as part of it, only then does man put himself first. This is the great paradox of human ecology.

Not until man sees the light and submits gracefully, moderating his homocentricity; not until man accepts the primacy of beauty, diversity, and in-

tegrity of nature, and limits his domination and numbers, placing equally great value on the preservation of natural environments as on his own life, is there hope that he will survive.

HUGH H. ILTIS

Department of Botany
University of Wisconsin
Madison, Wis., May 25, 1970

Revised: June 2, 1970

Low Flights

The first flight, recorded on the bank of the river, was made on 24 July 1968. It was a single male, which flew over the river and landed on the opposite bank. It was seen to fly over the river and land on the opposite bank. It was seen to fly over the river and land on the opposite bank.

July 2, 1970

July 2, 1970

THE FLIGHTS OF THE MALE SARRACENIA ALATA

INTRODUCTION

A female *Sarracenia alata* was seen to fly over the river on 24 July 1968. It was a single male, which flew over the river and landed on the opposite bank. It was seen to fly over the river and land on the opposite bank.

The flight was recorded on the bank of the river, and was seen to fly over the river and land on the opposite bank. It was seen to fly over the river and land on the opposite bank.

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XX. Hugh H. Iltis to Pierre Dansereau

Madison, June 1, 1969

Dear Pierre:

I am sending you herewith the text of an address which I was invited to deliver at St. Louis University last year. I hope you will find it relevant to the "Conversations on Ecology" since it concerns an important institution that could play a leading role in conservation.

Yours sincerely,

Hugh H. Iltis

THE POPULATION EXPLOSION, THE CONSERVATION CRISIS,
AND THE CATHOLIC CHURCH¹

A recent essay "Knowledge and the Future of Man," published by the Catholic St. Louis University of St. Louis, Missouri, sets forth an optimistic theme common to much of modern technological thinking:

"Man's perennial war of survival against the destructive forces of nature is coming to an end in our day. And we are justifiably proud that man is the victor...Famine and ignorance can now be safely controlled by man's prudent use of his knowledge."

Though man's victory over nature is indeed nearly complete, there is some doubt that it deserves much celebration. With much of nature vanquished, I am not very optimistic whether man himself has much of a future. For man's victory over nature, so absolute, so unconditional, is in many ways a bitter defeat for himself: the defeat of his own environment. It is the only one man can ever have or use, the only one, in fact, to which he is adapted. In destroying the very thing he loves, the very environment he must have, man's victories over nature are hollow, and in the long run may be lethal.

In all honesty, I should not have accepted this invitation, old-fashioned taxonomist and plant geographer that I am, for no field in biology is more ancient and in some ways more archaic. Much like Linnaeus some 200 years ago, we still go out on collecting expeditions, be it to the Ozarks or to Peru, to gather specimens and moss. We become excited when we find an unplowed prairie, or a flower that is beautiful, or one that is rare. It is in our blood, this love affair with nature. Even the most incredible achievement of mid-20th Century biology, the unraveling of the genetic code, "The

¹ Based on an invited lecture presented at the symposium "Frontiers of Modern Biology," during the Sesquicentennial Celebration of St. Louis University, St. Louis, Missouri, on December 12, 1968.

Man First? Man Last? The Paradox of Human Ecology

Hugh H. Iltis

The ubiquitous conservation speeches and environmental panels of today are dealing mainly with urgent problems of population, pollution, and crowding. That the priorities are given to these big-city, strictly human, homocentric syndromes is obvious—and understandable. People die of pollution, people go crazy with crowding, people starve and lay waste the lands through overpopulation.

Hopefully, we may yet solve the *pollution crisis*; we can, I think, clean up our polluted nests. But if, in cleaning up the cities, we forsake the rest of life, if we, in our human preoccupation, let all but corn and cow slide into the abyssal finality of irreversible extinction, our species indeed will have committed ecological suicide.

However, there is no cause for optimism in the broader *environmental crisis*, for the specters of ecosystem collapse, of catastrophic extinctions of most living animal species and of a vast number of plant species, are on the horizon.

According to Talbot (*BioScience*, 15 March 1970), 3% of the world's mammals became extinct in historic times, not counting such prehistoric wonders as the Irish Elk or the Mammoth, and most of them during the past 50 years! Today, 10% to 12% can be considered endangered, extrapolating from the conservative 8% of species and subspecies listed as periled in the Red Data Book for Mammals of the International Union for the Conservation of Nature, and perhaps 130 of the 400 United States mammal taxa are believed to be threatened with extinction. Birds are faring no better! S. Dillon Ripley of the Smithsonian Institution recently estimated that a majority of animal species will be extinct by the year 2000! And Kenneth Boulding suggests that, with the present rate of human reproduction, in another generation it may be economically impossible to maintain any animals, except domesticated ones, outside of zoos.

Butterfly and wild flower, mountain lion and caribou, blue whale and pelican,

coral reef and prairie land—who shall speak for you? My grandchild may need to know you, to see and smell you, to hear and feel you, to be alive—bright and happy!

Yet among all the many programs of the recent "Teach-ins" at the University of Michigan and at Northwestern University and 1000 other campuses, few spoke for the wild environment, for nature, for a *Morpho* butterfly in a Peruvian valley, for a timber wolf chasing caribou in Alaska.

This lack of concern is understandable, because man now occupies every bit of the earth and like a dictator, controls, or thinks he could control, if he wished, every living thing. As some see it, except for a few primitive tribes, "Man has . . . broken contact almost entirely with the ecological universe that existed before his culture developed. He no longer occupies ecological niches; he makes them."¹

But have our genes ceased to need the environment that shaped them? If we destroy ecosystems and species with abandon—ecosystems to which we are adapted, species whose values we do not yet know, and cannot predict—we surely do it at our own peril.

Thus, the lack of focus on the natural environment, on the wild animals and plants, on the woods and streams, is frightening.

Who defends wilderness, the natural, unspoiled environment? Who defends the environment in which we evolved, and which we still need in all its purity? Who, except for a vociferous but ineffective minority?

The ultimate question one has to ask is this: Shall man come first, always first, at the expense of other life? And is this really first? In the short run, this may be expedient; in the long run, impossible.

Not until man places man second, or, to be more precise, not until man accepts his dependency on nature and puts himself in place as part of it, not until then does man put man first! *This is the great paradox of human ecology.* Not until man sees the light and submits gracefully

and moderates the homocentric part of himself; not until man accepts the primacy of the beauty, diversity, and integrity of nature and limits his domination and his numbers, placing equally great value on the preservation of the environment and on his own life, is there hope that man will survive.

If we are to usher in an Age of Ecologic Reason, we must accept the certainty of a radical economic and political restructuring as well as ethical and cultural restructuring of society. No more expanding economics. No more expanding agricultures. No more expanding populations. No new unnecessary dams. No new superfluous industries. No new destructive subdivisions. We must stop and limit ourselves, now.

Let the archaic power structures of the technologically intoxicated cultures of the USA, USSR, Japan, and others, listen and listen well to the winds of change:

The earth and the web of life come first,
man comes second;
profits and "progress" come last.

Man now is responsible for every wolf,
as well as for every child, for prairie and
ocean as well as for every field.

Henceforth the laws to govern man must be the laws of ecology, not the laws of a self-destructive laissez-faire economics. And what the laws of ecology say is that we, we fancy apes, are forever related to, forever responsible for this clean air, for this green, flower-decked, and fragile earth.

Indeed, what ecology teaches us, what it implores us to learn, is that all things, living and dead, including man, are inter-related within the web of life. This must be the foundation of our new ethics.

If you love your children, if you wish them to be happy, love your earth with tender care and pass it on to them diverse and beautiful, so that they, 10,000 years hence, may live in a universe still diverse and beautiful, and find joy and wonder in being alive.

¹The author is with the botany department of the University of Wisconsin, Madison.

²G. L. Stebbins, *Saturday Review*, March 1970.

PLEASE NOTE: This paper, originally entitled, "Can One Love a Plastic Tree?" (changed unbeknownst to the author by the editor of Landscape Architecture to "Down the Technological Fix"), was written in response to M.H. Krieger's "What's Wrong with Plastic Trees?" (Science 179(4072): 446-455, Febr. 2, 1973). The latter appeared in an edited version immediately preceding this paper (pp. 349-360, 411) under the title "Up the Plastic Tree". The photographs are from Dr. Harry Harlow, Primate Laboratory, University of Wisconsin, Madison, to whom I wish to express my sincere thanks.

DOWN THE TECHNOLOGICAL FIX

By Hugh H. Iltis

Every planner, landscape architect, or human ecologist should read Martin Krieger's "Up the Plastic Tree" in this issue of LAQ (reprinted from Science) if he wishes to catch a glimpse of the nightmare future that technology is preparing for man and nature. His article discusses the titanic events of the environmental crisis, of Man vs. Nature, totally outside of the framework of biological reference; hence, one of his conclusions — that plastic trees and all sorts of nature substitutes have a valid place in planning — reads like a bad fairy tale. If he had only contemplated Hans Christian Anderson's "The Emperor's Nightingale" in which a mechanical nightingale is given the emperor to substitute for the real one whose song the emperor had loved. Eventually, of course, the clockwork breaks. Death comes and sits on the emperor's bed. But the real nightingale reappears and sings so sweetly that the emperor recovers. It is an old moral — you can't make a real nightingale out of wheels and diamonds, an idea quite lost on our author.

If there is nothing wrong with plastic trees, if plastic trees can "give most people the feeling that they are experiencing nature," why not invent plastic dogs instead of live ones? Why not plastic corsages with synthetic perfumes, instead of orchids or gardenias? Why not substitute plastic dolls which need no diapers instead of babies? Why not 3,000 giant Disneylands, one in each county, and then develop the rest of the country to grow more food and build more cities?

Why worry about the extinction of the African giant sable antelope or the Indian tiger? Or the preservation of the weedy Mexican grasses ancestral to corn or Peruvian wild potatoes? Why protect the Amazonian rain forest, or preserve the arctic tundras? According to Krieger, such proposals are "imperialistic at worst, unrealistic at best." But if biologists and ecologists or, for that matter, planners, won't concern themselves about the fate of nature, who is there who will? And since most ecologists and planners are in the "developed" countries should they

remain uninvolved to satisfy misguided notions of what it is to be "imperialistic"? Of course, we are all against "imperialism" and for "social justice"! But we are also against stupidity and misinformation.

What then is a socially concerned teacher and biologist to do when he reads such misconceptions? What are we to think of Science, that editorially confused journal which proclaims its adherence to social justice and the scientific comprehension of the environmental crisis, yet publishes, regularly now for years, the unenlightened "optimism" of the technological bamboozlers (to use Theodore Roszak's apt expression): of Spilhaus, Doxiadis and Weinberg, and of Handler, Buckminster Fuller and Seaborg? And now, as a final insult, these gratuitous environmental opinions of a biologically innocent planner sanctified, as it were, by publication in two noted professional journals.

Why should it be desirable to publish such an author who values flowers by cost/benefit ratios, and argues preservation of nature only in the framework of rarity and the free market in apparent ignorance of the vast and complex ecological arguments as to why nature and its diversity must be protected?

Why, indeed, must nature be preserved? This question has been answered in detail so many times by others — biological diversity as a basis of long-range ecological stability; genetic diversity as the necessary concomitant of continuing evolution (including gene preservation for future crop-breeding options); and that vast uncharted New World of esthetic diversity: of human genetic needs for natural pattern, for natural beauty, for natural harmony, all the results of natural selection over the illimitable vistas of evolutionary time — of the complimentary co-adaptations of man to nature, of man and woman, of mother and child?

Do plastic trees have mycorrhizae? produce oxygen? transpire and cool the air? have fragrant flowers visited by bees and produce fruits that feed the birds? Do they have leaves that decompose into a rich humus? But further, in contemplating plastic trees as economically inexpensive nature substitutes, one may well ask the question, can one love a plastic tree? Or the sound of wind in a plastic pine? Is indeed "the demand for a rare [read natural] environment . . . a learned one"? Is the love of a living tree or flower truly taught only by culture, or is it due to the interaction of culture and evolution? With such wonderful plastic surrogates, will this love eventually be-

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I. The Realities of Pollution

Pollution and

Adaptation:

What Hope for Man?

HUGH H. ILLIS

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Based in part on an address given at the University of Michigan "Teach-in on the Environment" (En-Act), at Ann Arbor, March 13, 1970.

*Man cannot adapt to culture;
culture must adapt to man.*

Why has pollution become such an important question today? Bad odors, noise, a few dead birds, and the many dirty beaches are indeed unpleasant, but most of us seem to have successfully deluded ourselves as to their importance, or have merely learned to ignore them. It is perhaps for these reasons that the insidious beginning of the burgeoning pollution crisis went unnoticed, for the change has been continuous but largely imperceptible, like milk turning sour. Thus today we suddenly find ourselves faced with a problem of global dimensions, the solution and amelioration of which we must perform in all haste, encumbered as we are with a stultifying conglomerate of antique ideologies and sociological complexities.

We often hear about the obvious manifestations of pollution, but do we really comprehend the seriousness and urgency of our situation? Today we ought to understand what we did not understand 30 years ago. Pollution affects the physiological processes of the exposed individual and may even bring them to a lethal halt. This individual phenomenon, seen in aggregate, may work to maim the entire people of a

city, rich and poor alike. The unabated addition of a multitude of chemical compounds, generated as a direct response to increasing population and technology, virtually insures the further degradation of the environment and evermore frequent instances of potentially lethal levels of pollution. More serious is the realization that pollution recognizes no political boundaries. It pervades the entire world and disrupts the totality of life in some degree, whether palpably at its point of greatest concentration, or half the world away at a lower but insidious level, leading to chronic, long-range effects. These may include outright extinction of selected species or may be masked in some way by the organism and thus become insensible to science. Consider penguin eggs and DDT in Antarctica, where the compound was, of course, never used. If man is not very careful, most complex life forms on this planet may well become extinct—an ecological suicide lurking around the corner.

Pollution: Clinical Versus Subclinical Effects

Leaving discussions of eco-catastrophes to others, let us focus on the effects of pollution on city people. Emphysema, lung cancer, and chronic bronchitis affect tens of millions, and each year additional unsuspecting millions, mostly children, are gradually initiated into their own physiological hells. The clinical effects of these diseases, of course, make grim statistics of which the general public is now well aware. In addition, one may be impressed by well-publicized disasters such as the London smog of December 1952, which killed 4,000 people, or by far greater disasters for Chicago, Los Angeles, Tokyo, or Calcutta, predicted for the near future.

Not as well known are the less spectacular, but far more prevalent and significant *subclinical effects*, the subtle consequences of chronic exposure to air, water and food pollution found in the larger cities. The problem is well phrased by Cassidy (1) who cites the allergist Theron Randolph's study of pollution effects in Chicago:

"... in one third of his chronically ill patients, the leading causative factor was susceptibility to pollutants in air, water, food and drugs; in another third, it appeared to be a contributing factor. Now consider the effects of chronic exposure. These are manifested in social attitudes, moroseness, sullenness 'seclusive, and sometimes hostile and paranoid behavior,' 'dopeyness, indifference to surroundings sometimes approaching lethargy, etc.'"

"Put all these discoveries together and realize that the people affected are continually making decisions—sometimes major ones, like determining community policy; sometimes minor ones like initiating

The Maize Mystique - A Reappraisal of the Origin of Corn.

Hugh H. Iltis¹

Abstract

Corn is domesticated Teosinte (Euchlaena mexicana, *sensu lato*), differing not at all in any of its basic vegetative, floral, or genetic attributes. All the unique peculiarities of corn are concentrated in the structure of the female inflorescence, the corncob, and all can be easily interpreted as the result of human selection for human needs for more food: for greater quantity, and for greater, more efficient harvestability. Thus, compared with wild Teosinte, the increase in the volume of harvest sub-units, namely in grain size, in grain number through activation of aborted spikelets and aborted florets, in row number and in cob length were all selected for by primitive man to produce more food. The decrease in the number of primary harvest units (the female inflorescences) to one or two giant, apically dominant, terminal inflorescences per plant, the coordinated protection of these inflorescences by many husks, these liberated from their old function of protecting the many, now suppressed, lateral cobs, and the change from a fragmenting, disarticulating rachis (cob axis) and rachilla to one that is shatterproof, were all selected for by primitive man to increase the ease and efficiency of harvesting. In addition, the reinforcement in the corn plant of Teosinte's annual habit and of a single, gigantic stem are likewise due to human selection. The resulting cultigen is easily grown, easily harvestable and abundantly yielding.

The domestication steps of corn outlined above are analogous to what has happened in the evolution of other crops. Thus, the reactivation of the sterile pedicellate spikelet of a pistillate pair (and even the occasional reactivation of the sterile, aborted floret of each spikelet) are analogous to the reactivation again by human selection, of the two lateral sterile spikelets of a "triplet" in barley (Hordeum vulgare). The giant monocephalic terminal corn cob derived by suppression of the many tiny lateral female inflorescences found in a fertile Teosinte branch and the stout strong single stem of corn are analogous to the monocephalic head and stout single stem of the cultivated sunflower, Helianthus annuus var. macrocarpus, which makes one think of corn as a graminoid "sunflower".² In these two crops, and in most cultivated grains, increase in both size and number of harvest sub-units (Heiser 1951), as well as in the complexity and size of the primary harvest unit itself, are both very prominent, trends that are replicated in the series from Teosinte through popcorn to modern maize. All these three crops are cultivar analogues, artifacts of man's selection, triumphs of the human ability to turn weedy annuals into high-yielding crops.

¹ Department of Botany, University of Wisconsin, Madison. Lecture presented at Iowa State University, Ames, December 18, 1970, and at the University of Illinois, Urbana, September 12, 1969.

² The common name of the sunflower in N. Mexico is "Maiz de Tejas", i.e. flat corn! (Bukasov, in Mangelsdorf and Reeves, 1939).