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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.

edited by: J. David Allan, University of Chicago
Arthur J. Hanson, University of Michigan

Wadsworth Publishing Company, Inc.
Belmont, California, 1972, pp. 98-102.

Pollution: Can Man Adapt?

Hugh H. Illis

Why is pollution so important a question today? Why is it so crucial to human survival? Bad odors, noise, a few dead birds, and many dirty beaches are indeed unpleasant, but most of us can live with them, or have learned to ignore them. For these reasons, perhaps, the beginnings of the pollution crisis were not much noticed and were no more obvious than milk turning sour. In fact, by the time you can taste the sourness in milk, it's too late. Similarly with pollution most people barely noticed what was happening, and here we are today—faced with a thoroughly polluted and disrupted biosphere.

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 know 30 years ago. At best, pollution kills an individual or maims the people of a city. At worst, pollution disrupts the biosphere, selectively exterminates species and, if man is not careful, most life forms on this planet—an ecological suicide lurking around the corner.

Leaving discussions of eco-catastrophes to others, let us here focus on the effects of pollution on city man. Emphysema, lung cancer, and chronic bronchitis affect tens of millions of people, and each year additional unsuspecting millions, mostly children, are initiated gradually 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 4000 people, or by predictions of future and far greater disasters for Chicago or Los Angeles.

Less well known by far are the less spectacular, but probably more important *subclinical effects*, the subtle effects of chronic exposure to air, water,

and food pollution found in the larger cities. The problem was well phrased by Harold Cassidy who cites Randolph's 1956 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 asocial 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 a quarrel. If irritability is increased, asocial attitudes enhanced, and judgment impaired, the effects [of pollution] can become amplified to enormous proportions. We have here a factor that is not commonly mentioned in listing the causative reasons for riots, crime and the less spectacular idiocies we see practiced in our cities.¹

Now, for the sake of argument, consider a president and his cabinet sitting in the White House, Constitution Avenue on one side, Pennsylvania Avenue on the other, both crowded with trucks and cars. They are discussing the possible bombing of Red China or our invasion of Cambodia, when a series of trucks sends huge clouds of exhaust gases into the conference room. Remember some of the subclinical effects of such pollution: "... asocial attitudes, ... hostile and paranoid behavior, dopeyness ..."

Fantasy? Perhaps. But who can say it isn't so?

Similar concerns have been voiced by René Dubos, relating to the truly devastating subclinical effects of pollution on children:

All environmental influences have their deepest and most lasting effects when they act on the organism during the early ... formative development. ... It is not an overstatement to say that in human beings the first four years of life—and for that matter, prenatal life—are of such critical importance that if the environment at that time is not *just right* the organism suffers some kind of handicap from which it will *never recover*. In the light of this fact, the worst effects of environmental pollution are probably yet to come, since it is only during recent decades that certain chemical pollutants have reached high levels, and that children have been exposed to these pollutants almost from birth [emphasis added].

Clearly these children are not going to die. What will happen is that in 20 or 30 years, as a result of that slow, chronic response to environmental insult, these children will certainly suffer from some form of chronic disorder ...²

As Dubos points out, despite our high levels of technological knowledge, these man-made poisons, of which in car exhaust alone there are hundreds, are all but unknown:

Most important, and generally overlooked, is the disturbing fact that some 70 percent of the particulate contaminants in urban air are still unidentified. Their

Shepherds Leading Sheep to Slaughter

The Extinction of Species And the Destruction of Ecosystems

By HUGH H. ILTIS

• Second part of a two-part article. The first part (with biographic footnote) appeared in the March issue.

The widespread and catastrophic extinction of species and ecosystems occurring on all continents but especially in regions previously untouched by technology—the tropics and the oceans—is the second concern I wish to discuss. To stop this immense calamity has acquired an urgency absolutely beyond belief. If you pick up Vincenz Ziswiler's *Extinct and Vanishing Animals* (1967), Fisher, Simon, and Vincent's *The Red Book: Wildlife in Danger* (1969), or any of the many similar studies you will find pages and pages with nothing but lists of animal species and subspecies close to extinction. Here are some figures for surviving individuals: blue whale (including the pygmy blue whale) about 6,400 in the Antarctic, 1,000 to 2,500 in the North Pacific (Gambell and Brown, 1971); mountain gorilla, 1,000 to perhaps 5,000; tamarau (a water buffalo of the Philippines) 200; Florida Key deer 235; giant sable antelope 500; Sumatran rhinoceros 150; Indian rhinoceros 600; Indian tiger 1,700; and on and on into the night of everlasting extinction. Plants are equally vulnerable, and, as a forthcoming book edited by R. Melville of the International Union for the Conservation of Nature and Natural Resources shows, there is no time to lose. Not only are species by the thousands threatened with a fate as irrevocable as that of the marvellous dodo, but whole ecosystems of

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great ecologic and economic value are being "developed"—a euphemism for exploitation with hardly a thought to the future.

The Forests of the Amazon

One can only shudder at the devastation of tens of millions of acres in western Australia, heavily subsidized by a major American bank; at the destruction of parts of Africa by the ill-conceived British peanut-sunflower scheme; of Russia's disastrous plowing of the virgin prairies; and especially of the devastation of the vast Amazonian rain forests, recently described in *Time* and *Newsweek* magazines (1971). Amazonia may be Brazil's last frontier, but it is as well the world's richest ecosystem: it contains fully 30,000 species of flowering plants, of which over 5,000 are trees (!), and about 200,000 insects—a diversity that staggers the imagination. It is estimated that a very large number of species (in some animal groups 80%) are yet to be described. Yet Peru, Venezuela, Colombia, and Brazil, with urging from the United States, the U.N. Food and Agriculture Organization (FAO), and private exploiters are all at work, blindly and rapaciously obliterating the Amazonian rain forest from the face of God's good earth.

Said a Brazilian minister: "We have to conquer Brazil completely and [building roads and cutting the forest] will do it" (*Time*, 1971, p. 36). With U.S. support, and no doubt much industrial interest from U.S. Steel—the world's largest deposit of iron ore is here—Amazonia may cease to exist (*Time*, 1971). Unbelievable? Read what William Denevan, a University of Wisconsin geographer, recently wrote in a paper (in press) entitled "Development and the Imminent Demise of the Amazon Rain Forest":

I. The Realities of Pollution

Pollution and

Adaptation:

What Hope for Man?

HUGH H. ILLIS

Department of Botany,
University of Wisconsin

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 'exclusive, and sometimes hostile and paranoid behavior,' 'dopeyness, indifference to surroundings sometimes approaching lethargy, etc.'"

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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

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. Iltis 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. Iltis'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.



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

Sierra Club Bulletin

VOLUME 52

OCTOBER 1967

NUMBER 9

Whose Fight Is the Fight for Nature?

→ HUGH H. ILTIS

The Optimum Human Environment and its
Relation to Modern Agricultural
Preoccupations¹

HUGH H. ILTIS²

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Reprinted from
THE BIOLOGIST
JUNE 1968 Vol. L No. 3-4
pp. 114-125.

can one love a plastic tree?

Hugh H. Illitt
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Every planner, landscape architect or human ecologist should read Martin Krieger's "What's wrong with plastic trees?" (*Science*, 179: 446-455, Feb. 2, 1973) if he wishes to catch a glimpse of the nightmare future that technology is preparing for man and nature. His article discusses the litanic 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 Andersen'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 corasges 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 devote 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" (p. 447). But if biologists and ecologists or, for that matter, planners, won't concern themselves about the fate of Nature, who is there that will? And since most ecologists and planners are in the 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 Rozshak's apt expression); of Spilhaus, Doxidias and Weinberg, and of Handler, Buckminster Fuller and Seaborg. And now, as a final insult, a biologically innocent planner sanctified, as it were, by publication in *Science*.

One wonders why *Science* publishes this 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 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 complementary 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 become obsolete? Will mail-order plastic women filled with warm water and greased with vaseline satisfy sufficiently our human needs? Will the false harmony of false trees or of surrogate sex be able to produce feelings of affection? Will all these makeshift substitutes send us screaming into the night for the satisfying totality of the emotions that evolution has led us to expect? Has our innocent apologist never heard of Charles Darwin?

And what of the special needs of children? Suppose that they have biological imperatives for wilderness, for natural beauty, for natural harmony? If these are not satisfied, what will happen to their orderly and adapted ontogeny? Supposing that, for the sake of social justice, all children, not only those of the rich, should have a chance to experience the feeling of untouched wilderness (in order to grow up to be happy, healthy and wise)? What if, long after all of nature has finally been ground up in the garbage disposal of the "technologic sink (with bamboozlers like the author at the switch), it becomes suddenly clear that there are indispensable genetic needs for many of these components of nature? But by then it would be way too

All planners should be human ecologists. They enunciate and illuminate what an alive, evolved and evolving man *must* have to remain human, with human biological needs foremost on their minds, with the needs of the technological consensus in proper perspective. And what does it mean to put human needs first? "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 not until then does man put man first! This is the greatest paradox of human ecology." (H.H. Illitt, *BioScience* 20: 820, 1970)

But what in fact does our present school of planners think its duty is? Is it to offer frivolity of choice to a human population uniformly programmed to genetically de-

termined and culturally influenced needs? Thus Krieger offers genuine, unspoiled nature only to those rich enough to rent a plane to visit it, and small city parks for the poor masses who can afford only to ride a street car. What brand of social justice gives the poor a tiny city park, the rich a giant wilderness? "A summum bonum of preserving trees has no place in an ethic of social justice" (p. 453)—indeed! It should of course be obvious that there can never be any meaningful social justice without "preserving trees".

The counter-culture is bad enough in its simplistic insistence on the *Greening of America*. On having its car and driving it too. On living simply, in affluence. Are we now to be blessed with a counter-counter-culture, which will hasten the destruction of most of what is biologically sacred, a destruction, white begun by a mindless technocratic profit-oriented capitalism, is now to be completed in the guise of social justice and relevancy by a pack of technological optimistic liberal planners?

No matter what Harry Harlow's experiments might suggest, to the affection-starved baby monkey a terry-cloth, wire female with only a light bulb hearl does not much of a loving mother make! And, likewise, plastic trees or tiny city parks do not a healthy landscape make. We cannot condition humans to be happy and human with the surrogates of technology—we can only make them happy and human with what they, biologically, have been selected to experience.

The planner who maneuvers himself into becoming an apologist for our cultural derelictions, including the virtues of plastic trees; the planner who encourages the faked and denatured environment, no matter how good his intentions may be, becomes himself an addict of the "technological fix", a technological junkie, hooked on growth, hooked on profit and hooked on the propagation of that one, grand, and damnable lie (the lie which makes the abhorred destructive extremes of the technological revolution possible); that man can adapt to anything, even plastic trees;

A.M. Weinberg argues persuasively (*BioScience* 23(1): 41-45, 1972) that for every "technological fix" there is a "technological fix", ironically forgetting that the latter phrase was coined by environmentalists to designate a cure of an ill analogous to the "fix" of a drug user hooked on heroin, i.e., it is precisely because so many "technological fixes" are bad that they do not represent a valid solution (e.g. the Green Revolution and unlimited food, atomic energy and unlimited power, etc.).

This paper reprinted with minor corrections from *Landscape Architecture Quarterly*, Vol. 62(4): 361-363, July 1973, where it appeared under the title "Down the Technological Fix". The author is Director of the Herbarium, and Professor of Botany at the University of Wisconsin, Madison.

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 abysmal 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.

MAN AND HIS VANISHING ENVIRONMENT -- The Contemporary Catastrophy

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

- A. ORIGIN OF THE EARTH over 5 billion years ago.
Origin of life over 4 billion years ago.
Earliest algae (plants) 2.8 billion years ago.
Earliest invertebrates 1.5 billion years ago.
First land plants 400 million years ago.
First aquatic vertebrates 400 million years ago.
Coal age & terrestrial vertebrates 250 million years ago.
Dinosaurs and early flowering seed plants 150 million years ago.
Extinction of Dinosaurs, rise of mammals 100 million years ago.
First anthropoids (monkeys) 40 million years ago?
First man-like animals ca. 3 million years ago, in Africa.
Evolution of man & glaciations of Pleistocene period last 2 million years.
Extinction of larger mammals last 30,000 years.
Rise of civilization last 10,000 years.
Neolithic (agricultural) revolution.
Urban revolution.
Industrial revolution.
Scientific (medical) revolution.
Darwinian revolution, 1859.
Technological revolution.
Conservation revolution (i.e. in man's relation to his environment -- a neo-Darwinian revolution).

		<u>Homonoid Population of world.</u>	
		Pleistocene	ca. 1-10 million???
		Classical	ca. 50 million
		Time of Christ	ca. 200 million
1650 A.D.	1650 A.D.	ca. 500 million	
	1950 A.D.	ca. 2.4 billion	
	1964 A.D.	ca. 3.3 billion	
	1984 A.D.	ca. 6 billion???	
	2884 A.D.	ca. 50 billion ?????	(if any?)

B. THE ROLE OF NATURE IN PRODUCING MAN.

Homo sapiens L. is a highly evolved animal, a clothed, intellectualized, toilet-trained transformed ape, the result of evolution by natural selection (see above). All organisms, including man, are closely adapted, physically & mentally, to earth's natural environment, because this very environment produced all organisms (to quote G. G. Simpson "any monkey without a realistic perception of the tree branch he jumped for was soon a dead monkey and therefore not one of our ancestors"). Selection & evolution is very slow! Mammalian attributes of man are at least 100 million years old, primate ones 40 million, human ones less than 2 million and those of civilization less than ca. 20,000 years old. Mans adaptations are the very core of his being. To understand man, we have to understand his adaptations, to understand these, we have to know nature. Man is just one of many animals in nature, even if a dominant and important one. He cannot be divorced from it, or placed above it except to his own detriment.

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. Illis 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-

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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 POPULATION EXPLOSION, THE CONSERVATION CRISIS,
AND THE CATHOLIC CHURCH¹

Hugh H. Iltis²

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 well 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 pressed specimens

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

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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.

Letters

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-

tected 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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CORNFIELDS and cows inherited the tamed earth, the curse of concrete spread upon a denatured land, and woe became the soul of forsaken man.

This is a world no reader of *FIELD & STREAM* would wish to live in! Yet in *less* than seventy five years if current technology, production-orientated economics, and exploding populations continue, one can safely predict utter destruction of wild

Man's Forgotten Necessity... Eco-Variety

By HUGH H. ILTIS



Dr. Ilitis, born in Czechoslovakia, holds degrees from the University of Tennessee and Washington University, St. Louis. He is now Professor of Botany and Director of the Herbarium at the University of Wisconsin. He has made extensive explorations in Latin America; his scientific interests center on taxonomy and biogeography, and, as the reader can tell, on biotic diversity.

animal and plant life from Alaska to the Amazon, from Africa to Australia, a simplification of biotic communities serving but one end—the feeding and housing of the billions of Man.

To any man whose heart belongs to the out-of-doors, the main lesson of the 20th century should be clear: the earth is well on the road to becoming a crowded cesspool, an ultracivilized wasteland with thousands of factories for wingless, featherless chickens and mutated blobs of “cow” perpetually milked, with synthetic bacon for breakfast and algae steak for lunch, with controlled climates without season, a world of plastic flowers, endless television and frantic tedium, an inhuman inferno, a “Human Zoo.”

Though you hunters, who read this, can still dream today about stalking bear, mountain lion, tiger, or rhinoceros, these and a thousand others are considered by some to be endangered species. In seventy five years, most mammals, birds, reptiles, even fish, clams, and insects, might well be stuffed curiosities in museums or pretty pictures in books, as irreversibly extinct as the magnificent Dodo.

(Turn back to page 44)

TO THE TAXONOMIST AND ECOLOGIST:

WHOSE FIGHT IS THE PRESERVATION OF NATURE ?

Hugh H. Iltis
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REPRINTED FROM BioScience vol. 17 No. 12, pp. 886-890.
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