

Is human culture carcinogenic for uncontrolled population growth and ecological destruction?

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BioScience Vol. 43 No. 11

December 1993

Numerous observers have described the human species as a kind of planetary disease, even comparing it to cancer (Eisley 1961, Forrester 1991, Gregg 1955). In a previous article (Hern 1990), I described the species as a “malignant epiecopathologic process” that is destroying the global ecosystem. I stated that the sum of human activities, viewed over the past tens of thousands of years, exhibits all four major characteristics of a malignant process: rapid, uncontrolled growth; invasion and destruction of adjacent tissues (ecosystems, in this case); metastasis (colonization and urbanization, in this case); and dedifferentiation (loss of distinctiveness in individual components). In this case, dedifferentiation implies that through the invention of culture, humans have developed the ability to adapt to and survive in all ecosystems. We are no longer bound, as are most other organisms, to the specific ecosystems in which we originally evolved. Human culture gives us a unique relationship with all ecosystems as well as with each other.

What are the implications of these characteristics? In an organism, a malignant process continues until the supporting organism ceases to function – it dies. In the case of human populations, parallels to cancer raise the most fundamental questions about our relationship with the planetary ecosystem.

The purpose of this article is to discuss the process by which human culture has brought about this malignant transformation in our relationship with the ecosystem, to show why it is important to examine and test the hypothesis that human activities have become malignant for the planet, and to discuss some of the implications of this hypothesis for the future.

The need for such a hypothesis arises because, in addition to the four basic characteristics of a malignant process mentioned before, we are confronted with a wide variety of apparently disparate phenomena that cannot be ignored and are directly related to human activities. One of these phenomena is the increasing relative uniformity in the appearance and structure of human communities, especially large ones, throughout the planet. Another is the regional and global environmental changes, such as severe pollution of air, water, and earth; global warming (anticipated); increased atmospheric carbon-dioxide concentrations; decreased polar ozone concentrations; universal oceanic dispersion of human trash; rapid global deforestation and desertification; and rapid decline worldwide in biodiversity with increased species extinction rates.

At present, there is no other overall theory or hypothesis that provides a satisfactory explanation for these various well-documented phenomena. Linear mathematical models such as those used in a general circulation model (Stern et al. 1992) or in systems dynamics models (Meadows et al. 1992) are inadequate to describe complex ecological relationships, particularly when they include biological and human sociocultural and political systems. A biocultural model that includes these factors is needed.

Cultural components of the ecopathologic process

An essential component of the ecopathological hypothesis is the role of culture in human survival. The principal role of culture is to provide adaptations that promote survival of the species. Over the last two million years of human evolution, cultural adaptations have varied enormously as a function of time and among societies. Cultural adaptations have contributed to and resulted from population growth (Polgar 1969, Tinker et al. 1976). The origin of agriculture in the Middle East was accompanied by large increases in population, and the elaboration of culture permitted the increasingly intensive exploitation of the environment (Hassan 1981). Similar changes have been described in other parts of the world.

Environmental changes resulting from cultural adaptations have been dramatic and frequently permanent (Angel 1975). Europe lost most of its native forests from 900 to 1900 A.D. (Darby 1956), and North America lost most of its forests from 1620 to 1920 (Williams 1989). Current rates of tropical deforestation are alarming, but they are a recent phenomenon compared with the length of human occupation of, for example, the Amazon basin (Martin 1973, Woodwell 1990).

Different societies have varying rates of population growth; these change over time and they have different relationships to the natural environment. Tribal societies have had means of regulating fertility for thousands of years, but some have regulated population more strictly than have others (Hern 1992, Nag 1962). Western culture, especially as exemplified by the European expansion into the Western Hemisphere, has shown a much more aggressive attitude toward the exploitation of natural resources than have many indigenous American societies (Crosby 1986).

Are there real differences in cultural attitudes toward population growth and environmental exploitation, or do the variations simply reflect differential access to technology? Martin (1973, 1984) has claimed that the North American megafauna were extinguished by early American hunters, and evidence abounds that rapid species extinction accompanied the human colonization of Pacific islands and other settlement points (Cassels 1984, Diamond 1984). Denevan (1992) demonstrates that the North American landscape was also highly altered by precolonial indigenous people.

A common theme in the expansion of human populations around the world is that culture has permitted human beings, who are biologically almost identical, to occupy a wide variety of ecological niches. Most species are highly restricted in their distributions because of adaptations to specific ecosystems, and they usually do not drive other species to extinction in the process of becoming so adapted. By comparison, human domination of local and regional ecosystems has been accompanied by virtually instantaneous extinction of numerous species during the past 10,000 years. The elaboration or evolution of cultures has permitted humans to become undifferentiated exploiters of the entire planet.

Whereas the life span of early humans was relatively short and comparable to that of other primates, cultural adaptations such as agriculture, weapons for hunting and defense against other animals, and modern medical care have resulted in increasingly long survival times for human beings. In fact, increasing survival times have become a principal problem for industrial societies.

A primary feature of cancer cells is that the genetic regulatory mechanisms fail in several ways. One of the consequences is that cancer cells are immortal: they do not die after the normal lifespan (Prescott and Flexer 1986, Ruddon 1987). Human culture, rather than a genetic change, is the altering factor among populations that permits human survival long beyond our previous term in the ecosystem.

At the community or aggregate level, human communities have had, even before modern times, important similarities and even identities, which is what permits archeologists to make sense out of the artifacts of very different cultures. As the twentieth century has progressed, however, the easily apparent differences between the Yanomamö village, the Italian hill town, the Dogon village, and the Yoruba compound have become blurred as urbanization compels uniformity in housing. One growing village begins to look much like another, and São Paulo looks more like Chicago every day.

All large cities now essentially perform the same functions and have many of the same economic, environmental, transportation, and communication problems. The morphology of urban settlements, seen in outline, is startlingly similar everywhere and throughout time, having the ragged, aggressive, invasive appearance of a malignant process (Figures 1 and 2). There has been a loss of differentiation in human activities at the aggregate level. Notwithstanding ethnic rivalries, which are increasingly settled by the same violent means (Homer-Dixon et al. 1993), loss of differentiation has accompanied, if not signaled, the loss of important cultural differences (Reining 1991).

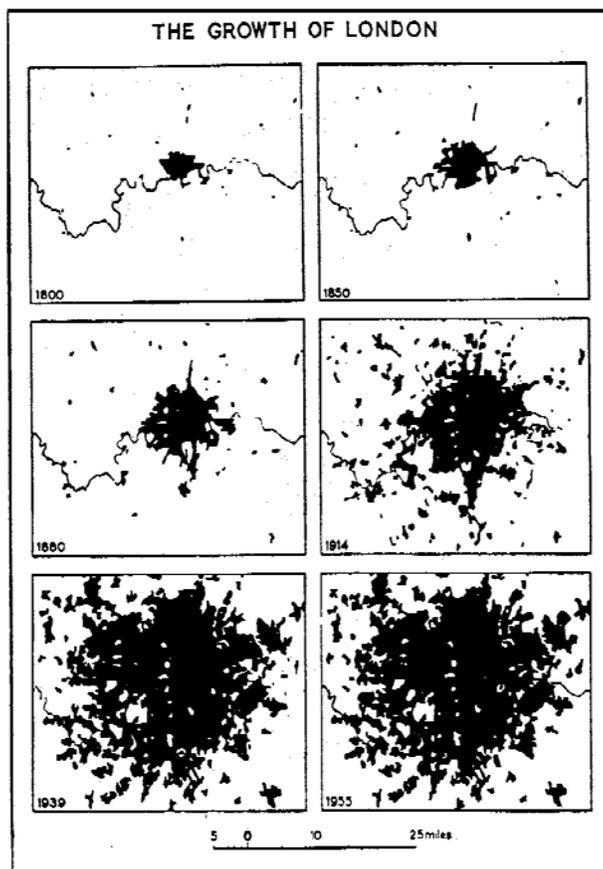
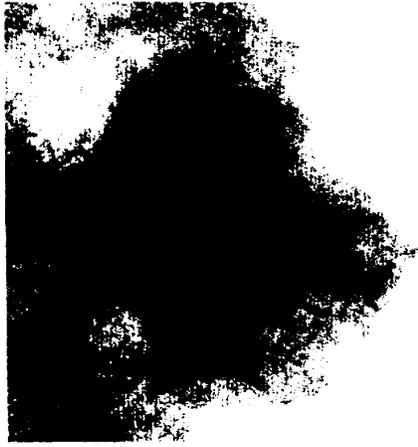


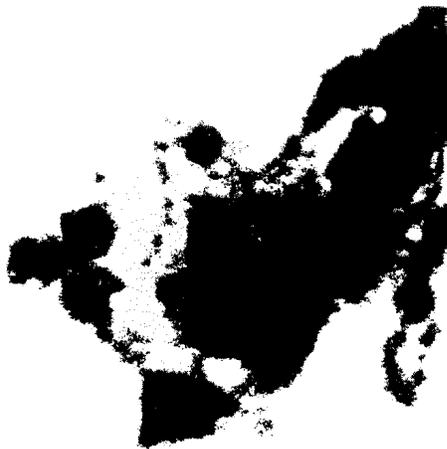
Figure 1. The growth of London, 1800 – 1955. (Frlm Johnson 1972.)



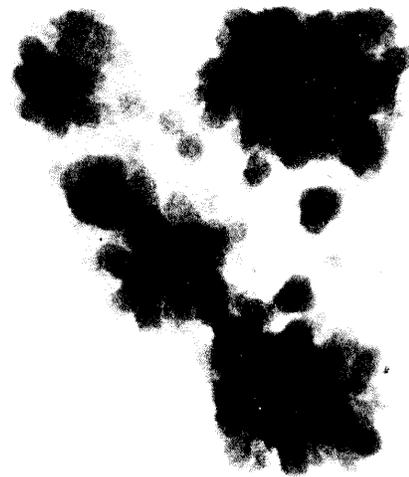
a



b



c



d

Figure 2. (a) and (c) Metastatic malignant melanoma of the human brain. (Courtesy William Robinson, Division of Medical Oncology, University of Colorado Health Sciences Center, Denver.) (b) Baltimore, 1950. (From McHarg 1969.) (d). Five Cities Cluster, North Carolina (Winston-Salem, Greensboro, High Point, Thomasville, and Lexington). (From Chapin and Weiss 1962.)

Models of population growth

Demographers have tracked, described, analyzed, and quantified human population growth beyond the capacity of most citizens to understand the results, but demographers cannot necessarily say why that growth is happening. However, it is apparent that population growth and cultural change interact in a positive feedback loop (Dumond 1975, Margalef 1968, Nag 1980).

Population growth and cultural change have been accompanied by increasingly effective technology that permits intensive exploitation of allecosystems and, indeed, the lithosphere itself. Virtually all modern societies depend on fossil fuels for survival and on extracting a wide variety of inorganic materials from the earth. Evidence is accumulating that the use of fossil fuels and the accompanying destruction of forest

ecosystems is altering Earth's atmosphere to the point of affecting all life forms (Firor 1990, Woodwell 1990).

Demographers almost universally adhere to the logistic model of human population growth, which assumes that human population growth will stabilize at some point in the future, with the projected plateau reached at 11-12 billion individuals near the end of the twenty-first century (Demeny 1991). These projections result from, according to Demeny, "the informal insertion of unspecified assumptions." One of the reasons Demeny gives for this projected stabilization is that higher projected numbers seem "implausible."

Much of the attraction of the logistic curve seems to derive from studies by Raymond Pearl, whose research on fruit flies showed this pattern in a density-dependent population (Pearl 1922, 1925, Peterson 1969). Classical demographic transition theory incorporates this idea into its formulation of human population stabilization, after modernization induces the reduction in both mortality and fertility (Notestein 1945). Unfortunately, much experience since World War II has not conformed to these expectations, because fertility has increased in many newly modernizing countries before it has begun to fall. The result has been steady growth of the global human population, notwithstanding falling rates of growth in some populations.

There are several basic problems with the belief that human population growth will eventually stabilize. First, there is no convincing evidence that the global human population as a whole will stop growing in the foreseeable future. Although there are examples of modern societies, such as China, that have made decisions to stop population growth, these decisions have not proven to be highly effective. A few tribal societies have successfully limited population growth, and pre-colonial Japan showed zero growth for more than a century (Peterson 1969), but these phenomena were modified when the societies became less isolated. And although some European nations have recently exhibited a negative intrinsic population growth rate, also losing population from emigration, others have gained from immigration. The US population is growing at the rate of approximately 1% per year (PRB 1992).

A second problem with the proposed population stabilization is that the Pearl-Reed logistic curve, still applied to project population stabilization even though it has been discredited as a predictor of population change, assumes a density-dependent population (Peterson 1969). But the human population has often shown itself historically to be density independent owing to new cultural adaptations. An example is the European population explosion that followed the introduction of New World cultigens and colonial expansion (Crosby 1972).

Third, the belief that population must stabilize in the imaginable range of 11-12 billion because other larger projections seem improbable or incredible is similar to beliefs earlier in the century that the population would stabilize at levels much lower than the current count. Fourth, this belief assumes free access to safe and effective fertility control – including contraception, abortion, and sterilization – for everyone on the planet, whereas this access has not been realized and will not be in the foreseeable future. Fifth, it assumes effective use of all fertility control methods, and this assumption is similarly unwarranted.

The belief that population numbers will stabilize seems warranted only if, as in animal populations, the death rate goes up to exceed the birth rate, or if birth rates plummet due to

croding, social disruption, or other kinds of social pathology (Calhoun 1962, Homer-Dixon et al. 1993). But human population growth is not necessarily diminished by greater density. Growth rates increase with sedentism, aggregation, and modernization (Binford and Chasko 1976, Nag 1980). The response to density is increasingly intense exploitation of the ecosystem (Boserup 1965, Geertz 1963). Humans communicate through culture and form coalitions that defeat limitations posed by ecosystems (Harms 1987). In this respect, humans and their systems are behaving similarly to the cells described by von Foerster in his mathematical analysis leading to the equations for density-independent growth (von Foerster et al. 1960).

Von Foerster's equations, originally describing the behavior of cell coalitions, have proved to be stunningly accurate, if perhaps conservative, in their estimates of human population growth over the last 30 years (Umpleby 1990). This correlation should at least cast doubt on the logistic curve/density-dependent school of thought that predicts stabilization of the human population numbers with the next century. Von Foerster has also shown that the growth rates of the human population that appear to be declining overall are more likely to be targets to a hyperbolic curve on a semilog scale that describes not a declining growth rate of the human population but one that is actually increasing (Umpleby 1990, von Foerster 1966). This increase is caused by the steady decline in length of doubling times of the human population since A.D. 0 (von Foerster et al. 1960).

There is a choice of perspectives in viewing the ecological changes and species extinctions that have accompanied human population expansion. One may adopt a neo-Darwinian perspective that this progression of events is natural, but that perspective has the potential hazard of being both teleological and anthropocentric. If human activities cause collapse of the global ecosystem, the neo-Darwinian perspective could also prove to be maladaptive. Wilson (1992) estimates that most mammalian species survive up to 5 million years. Humans have been wandering the planet for approximately 2 million years starting with our *Homo erectus* ancestors. But *Homo sapiens sapiens* has only been around for 100,000 years or so; current trends indicate the likelihood of population overshoot, collapse, and extinction within the next four centuries. We appear to be accelerating the process somewhat and inventing a new evolutionary experience: auto-extinction.

There is no evidence that other species have caused as many species extinctions as has ours, so the current extinction rate is not merely a reflection of Darwinian competition. Something more relentless is at work. Human beings, almost without exception (and there are some), have tended to simplify ecosystems and exclude other species from their territories. As global biodiversity declines, it is apparent that a principal effect of human activity and population growth, accompanied by increasing cultural sophistication, is a reduction in the total number of species, ecosystem complexity, and the introduction of serious if not irreversible instability into all ecosystems (Allen and Flecker 1993, Skole and Tucker 1993, Stanley and Warne 1993). If we posit a healthy ecosystem that is as complex as possible, relatively stable, with high species diversity and competition, the effect of human activity is almost universally to make ecosystems less healthy.

That being the case, what are we to make of a species that makes ecosystems unhealthy or even destroys them? One strategy is to look at the effects in terms of a disease model (Hern 1990). Although that model has been applied until now only to individual

organisms, it can be useful in larger systems. The model, however, must take into account the intangible and perhaps unmeasurable capacity of culture to modify both ecosystems and survival probabilities for human beings.

The previous analysis shows how cultural adaptations, as distinguished from biological adaptations, provide the means by which humans have not only survived, but by which they have become the dominant species on the planet. Cultural adaptations are key components of population growth, colonization of distant sites as original resources are exhausted, and destruction of adjacent ecosystems, which are always replaced by human communities or corporate activities. The fourth component of malignant process, dedifferentiation, is shown by the examples given previously of loss of biological and cultural differentiation at the individual level and loss of aggregate differentiation at the community level.

In making a diagnosis of malignant neoplasm at the organismic level, the pathologist requires only two of the four characteristics of malignancy. Cultural adaptations permit the human species to have all four characteristics of a malignant process. Stopping population growth, even if it were possible to do so tomorrow, does not, by itself, change the diagnosis.

Value of the ecopathology hypothesis

It is apparent that, in general, human culture plays the principal role in the transformation of human activities from noninvasive subsistence of skinny primate in the late Pleistocene to a truly malignant process disrupting the planetary ecosystem. This hypothesis does explain the widespread phenomena that concern us. It can be studied and tested in these ways:

- By examining the many examples of deliberate control of human fertility already cited, including the fact that human governments can change their policies concerning fertility limitation, as President Bill Clinton began doing on 21 January 1993 by lifting the Reagan-Bush administration restrictions on abortion.
- By exploring how various organizations, activities, and official governmental actions are working to save environments and species, reversing the effects of pollution, and slowing the pace of ecological destruction.
- By comparing what the human species has wrought on the planet in the last few thousand years, particularly since the beginning of the Industrial Revolution, with what it may be possible for us to do if we were to decide to stop being a cancer on the planet.
- By examining how humans around the globe convert as much plant, animal, organic, and inorganic matter as possible to human biomass or its adaptive adjuncts.

The testing of epidemiologic hypotheses must often be performed as observational experiments by comparing historical with currently evolving data or in a natural experiment. In this case, the planetary experiment may proceed to its conclusion without a control, as we are doing; we may choose two or more areas for study, leaving control areas with no regulation of fertility or ecological destruction, and highly regulating other areas

with respect to intrinsic population growth and environmental modification; or we may use the past as an uncontrolled control and make decisions now that stop the malignant process everywhere.

The first option may bring extinction not only to us but to many other species. The second option, although theoretically possible, is unworkable and unacceptable for both ethical and political reasons, just as it is unacceptable to let a cancer patient die when you know of a remedy that has a strong likelihood of cure. Another problem is that the forces we address are global, not local, and no locality may escape their consequences. The third option is both ethically acceptable and politically feasible (Ludwig et al. 1993). Whether it is possible remains a question that is not technical but political. We know what to do. Can we do it? Can we do it in ways that are acceptable to enough of us to permit it to happen?

The principal difference between the human species and organismic cancer is that we can think, and we can decide not to *be a cancer*. *Without such a collective decision, taken and expressed globally through our cultural and political institutions*, we face the implications of this hypothesis, or diagnosis: the characteristic of a malignant process is to continue until the supportive organisms has ceased to function. For us, this lack of a decision could result in the terminal derangement of the global ecosystem to such an extent that it would no longer support human life or activity. It is the ultimate bad news, at least as far as human beings are concerned.

Scientists may honestly debate whether it is useful to consider such a dreadful hypothesis. The hypothesis at least has the value of helping us to understand not only what is happening to us and to the planet but why it is happening. If we conclude that there is more to support the hypothesis than to refute it, but that we can counter it by our decisions and actions, the conclusion gives a compelling new urgency to our task.

Acknowledgments

This article is based on a presentation at a symposium entitled “Demography and the Environment” at the annual meeting of the Population Association of Americas, 1 May 1992, in Denver, Colorado.

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