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Human Ecology: The Subversive, Conservative Science[1]

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SYNOPSIS. Paul Sears identified ecology as a subversive science; William Ophuls, referring primarily to its human applications, called it a conservative science. Both characterizations are correct. Human ecologists aim to conserve natural resources, thereby making it possible for our posterity to enjoy a quality of life at least equal to ours. Frequently this kind of conservatism is at odds with the conservation of traditional religious beliefs, political practices, and social privileges: hence the aptness of the adjective "subversive." The essence of human ecology is found in a few propositions of the sort that mathematician E. T. Whittaker called "postulates of impotence." These lead to simple but profound generalizations, of which a dozen are offered here.

Identifying a single science as both "subversive" and "conservative" may seem a perverse thing to do, but I will explain the combination before I am through. To begin with let us see how the first adjective came to be applied to ecology. Paul Sears (1964), just two years after the publication of Rachel Carson's *Silent Spring*, asked:

> Is ecology a phase of science of limited interest and utility? Or, if taken seriously as an instrument for the long-run welfare of mankind, would it endanger the assumptions and practices accepted by modern societies, whatever their doctrinal commitments?

In the discussion that followed Sears made it quite clear that he regarded ecology as being of almost unlimited interest and utility for everyday life, acknowledging that its principles threatened many assumptions and practices in the existing social order. Sears, far from a radical in ordinary political matters, was forced to conclude that ecology is a subversive science.

A short time later Paul Shepard and Dan McKinley (1969) borrowed Sears' words for the title of a useful anthology. Before a decade had passed, William Ophuls (1973), in a remarkable dissertation offered in support of a Ph.D. degree in political science, identified the subversive threat more clearly:

> Human ecology is against the conquest of nature; against growth as we think of it; against the isolation of thought and action; against individualism as an ideology; and against moral absolutes like the inalienable rights of man. "The subversive science" is thus a pitifully weak soubriquet for ecology, which demands only that our current political, social, economic, and moral order be stood on its head.

When the human ecologist fully understands the irony of Ophuls' concluding words he realizes how lonely is the path he must walk as he is belabored by both Left and Right of the political spectrum. I would not have the ecologist turn aside because of a justifiable fear of vested powers; rather would I urge that he make use of the resources of humor, stiffening his backbone by recalling a comment made by the professional humorist Art Hoppe (1970), who caused an imaginary happy-go-lucky student radical to say: "The great thing about ecology as a cause is that everybody's guilty."

Yet another burden falls on human ecologists: the science is inescapably interdisciplinary. To quote once more from Sears (1971): "It may clear matters somewhat to modify the usual definition of ecology as the science of interrelation between life and environment. Actually, it is a way of approaching this vast field of experience by drawing upon the best information available *from whatever source it may come.*" (Italics added)

Should we, then, assemble teams of scholars to carry out the needed interdisciplinary work? The proposal seems logical enough, but this approach seldom has a

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happy outcome. Great though the personal risks may be, it is the individual who must carry out the work of synthesis. Individuals must be prepared to make mistakes and be castigated by narrow specialists. Every statement made by a daring synthesizer will tread on someone's toes. Controversy is unavoidable. Obviously a field like human ecology is not everyone's cup of tea. I happen to enjoy it. Let me see if I can explain its attractions and the way in which I think human ecology should be presented to students.

The boundless multiplication of recorded facts makes it advisable that every well-developed subject be first presented by way of broad generalizations. Generalizations are always dangerous, but they are less dangerous than a refusal to make generalizations. At the very least a generalization has heuristic value, that is, it has the potential of leading to fresh discoveries. If a statement has exceptions these are more likely to be discovered if the principle is expressed in simple, dogmatic terms. (Is this a consequence of the contrariness of human nature? Whatever the explanation, the fact is useful.)

I advance the following thesis: the heart of human ecology can be presented as a set of rather dogmatic generalizations, most of which are in the form of negative statements. Let me take as my first example a well accepted dogma from the subdivision of ecology known as "economics." (Card-carrying economists may not like to hear their specialty identified as a subdivision, but I call your attention to the fact that the names of both sciences are derived from the Greek *oikos,* house or home. Economists tend to focus only on the people in Household Earth, thus making their subject only a fraction of the total science of ecology, which deals with all of earth's inhabitants and their environment.)

Popularly expressed, the central dogma of economics is this: "There's no such thing as a free lunch." Asked if this is always true the economist replies, "You'd better believe it!" He can't prove there are no exceptions, but neither does he believe that an understandable, reliable science of economics can be created without this generalization (whether explicitly expressed or not). This dogma, which natural scientists would call a conservation principle, leads to the assumption of business practice that accounts must balance. It is intolerable to suppose, or hope, that actual income might exceed the sum of intake minus outgo. (When a set of books seems to indicate that such a miracle has occurred the cause is sarcastically referred to as "creative bookkeeping.")

Why should a major dogma be best presented in a negative form? We could have expressed the major assumption of economics in a positive way: "Every lunch has its price." I doubt very much if many people would make the idea part of themselves if the positive form had been used. There is something about a negative formulation that captures the human attention. Perhaps this fact is related to the observation of Sigmund Freud (1925) that, at the subconscious level, the human mind cannot deal with negation. Since the subconscious mind cannot deal with negation, even to refute it, the conscious mind must: so the negative form captures our attention. Whether or not this speculation uncovers the truth, the fact remains: negative statements make us think.

The greatest dogmas of the natural sciences are given in negative form: they tell us what we cannot do. Take the facetious (but profoundly true) forms of the laws of thermodynamics:

You can't win.
You are sure to lose.
And you can't get out of the game.

Here is negativity in earnest—but it gets our attention. The mathematician E. T. Whittaker (1942) has called the foundation stones of science its *Postulates of Impotence,* saying that each one

> asserts the impossibility of achieving something, even though there may be an infinite number of ways of trying to achieve it. A postulate of impotence is not the direct result of an experiment, or of any finite number of experiments; it does not mention any measurement, or any numerical relation or analytical equation; it is the assertion of a conviction of the mind, that all attempts to do a certain thing, however made, are bound to fail.

This is a remarkable, perhaps even

shocking, view of science. That science might, at the bottom, be based on *a conviction of the mind,* rather than experiments, brutally contradicts a common textbook view of science as an aggregation of empirical statements. In a sense, perhaps both contradictories are true. We will not tolerate a dogmatic statement that always contradicts empirical findings; on the other hand, in the practice of science we put a great deal of trust in a very few dogmatic statements that have proved so useful in the past that a contradictory new empirical finding will itself be doubted for a long time before we are willing to throw out a dogma that has become "a conviction of the mind." It is, for instance, difficult to imagine an empirical finding that would lead us to scrap any of the laws of thermodynamics. Without impotence principles, without conservation laws—without *closure* of the analytical system—intellectual anarchy threatens to take over.

What, then, are the central dogmas of ecology? To begin with, ecology must admit all the conservation laws of the physical sciences. Those accepted, ecologists go on to generate additional postulates of impotence. Let me lay out what I regard as the foundation stones of human ecology.

1. *We can never do merely one thing.* Implicit in Darwin's *Origin of Species* is the image of a complex web of life, with every species having strong or weak ties with every other species. Darwin was not the first person to be aware of widespread connections in the world. In the words of Ophuls (1977): "With their vision of total interdependence and connectedness the mystics were in effect the first ecologists." To John Muir is attributed the saying that "Everything is connected with everything else." These are less the words of a scientist than of a mystic, though they are often identified as the "First Law of Ecology."

Muir's mystical sentence is criticizable on two grounds. First, it is a positive statement and so is not well suited to be a prime principle. Second, by dispersing our attention over literally everything, it interferes with our seeing particular things. To achieve practical control of natural forces we need to focus on singularities, even though we thereby risk not seeing the forest for the trees. Pursuing the opposite course puts us in danger of becoming the mystical Hamlets our opponents accuse us of being.

In contrast to Muir's statement, the assertion that "We can never do merely one thing" (Hardin, 1963), though it does not tell us exactly what to look for, does tell us to look very hard at every proposed intervention in an existing system to make sure we are not about to carry out actions we may later regret. Muir's statement encourages passivity and fatalism; the revised version encourages study and prudent action.

2. *No effects are truly "side effects."* Strictly speaking, all effects are effects, *period.* He who wishes to control the perceptions, and hence the actions of others, labels as "side effects" those consequences he does not wish people to become aware of or to act upon. A variant of this rhetorical ploy is pinning the label "external costs" or "externalities" on the costs a businessman *wants to keep external* to the account books of his company (Hardin, 1972).

3. *No system can long survive the effects of unopposed positive feedback.* This, of course, is the heart of the Malthusian insight, an insight that has been vigorously attacked by many in the academic community—particularly by sociologists—for more than a century. I know of no better way to sweep away the mental miasma of the dream of perpetual growth than by exposing the student to an essay by A. A. Bartlett (1978), "Forgotten fundamentals of the energy crisis," the printed version of a lecture Professor Bartlett has delivered more than seven hundred times to general audiences.

Perhaps the simplest way to bring home to the average citizen the magnitude of the threat of unopposed positive feedback is to point out the logical consequences of putting out money at interest. Suppose that the thirty pieces of silver Judas received for betraying Christ had been worth $30; and suppose that he had put this into a bank account bearing 5 percent compound interest, payable in gold. Presuming the present price of gold, the initial capital would amount to about 2.5 grams of gold. How long would it take for the Judas

Account to be worth a weight of gold equal to the weight of the entire earth (5.983×10^{27} grams)? Just 1,292 years. This means that at about the time of Dante's death the heirs of Judas could have presented themselves at the bank and demanded the world's weight in gold. Such is the power of exponential growth (or "geometric growth," as Malthus called it).

4. *Negative feedback can be a positive boon.* Banks sell their services with the implied promise of absolute safety for savings accounts—forever. So long as such accounts bear a positive rate of compound interest, no matter how small, such a promise is ridiculous. Interest is tolerable only because the exponential growth it promises is opposed by bank failures, theft, fraud, government expropriation, revolution, conquest and repudiation. We regard all these negative feedbacks with distaste, but one or more of them must be included in every workable system in a finite world, if no limit is put on time.

More relevant to our interests, the positive feedback of biological growth must be opposed by the negative feedbacks of predation, parasitism, socially induced sterility and many other factors that interfere with reproduction and favor death—in Malthus' terms, by "misery and vice." Biologists are in a particularly favorable position to oppose the Pollyanna attitude that has been nurtured by the remarkable technological progress of the past two hundred years. Death is still a necessity and a boon.

5. *"Thou shalt not transgress the carrying capacity."* If ever agreement is reached on a Decalogue of Ecology, this surely will be one of the commandments. If the language seems too theological, reword the advice to your taste, but do not lose the imperative flavor. To disarm the defences of Growthmanship, it may be well to bring forward the implications of carrying capacity by first analysing a non-human situation, say the history of the reindeer herd on St. Matthew's Island (Klein, 1968; Hardin, 1982). Two evils follow from transgression. First, per capita well-being falls as overpopulation takes over. (This phenomenon, in fact, gives us an operational definition of the controversial word "overpopulation.") Second, once transgression has occurred, the carrying capacity in successive years spirals downward to very low levels. Uncorrected transgression can ultimately extinguish a population.

6. *The "sanctity of life" must give way before the "sanctity of the carrying capacity."* This statement presumes that "sanctity" is an admissible concept in rational thought, and that a cardinal aim of policy is to minimize the loss of life (over an extended period of time). In discussing problems of game management biologists should be able to convince students that maximizing the number of healthy lives is the proper aim of game management. The herd on an overcrowded range is peremptorily thinned, by killing if necessary, so as to reduce the size of the herd to the carrying capacity; and it is kept at or below that level so as to maximize the amount of life over a long period of time. *This* year is only a moment in time, and the present population is only a fraction of the total. The rational game manager kills in order to maximize the number of lives over time. It is carrying capacity, not the individual life, that needs to be invested with "sanctity" (Hardin, 1976). This should be obvious, but the teacher who discusses game management problems will discover that some students bridle at the thought of killing an animal today even if this is the only way to save more animal lives tomorrow.

Application of the principles acquired in game management to human situations will be strongly resisted. In controversial areas it is not the function of the teacher to demand agreement; his role is to expose assumptions and arguments. It may come as a surprise to biologists to learn that some professional philosophers (for instance, Taurek, 1977) have ranked "fairness" above life itself in discussing human analogs of the game management problem. Triage aimed at maximizing the number of lives saved (Hardin, 1980) is viewed by Taurek as "unfair," and he would rather be fair than save lives.

One cannot but wonder how such a philosopher would react if he were *in fact* made responsible for the well-being of a herd of

animals in an overpopulated range. Out of "fairness," would he passively allow almost an entire herd to die of starvation, as the reindeer on St. Matthew's Island did, rather than "unfairly" eliminate a considerable number so that the environment could be saved for the reindeers' posterity?

I find it difficult to believe that our philosopher would stick to the principles he evolved in the quiet of his study. (I find it even more difficult to believe that anyone would knowingly hire such a philosopher for the management of herds on an estate he hopes to pass on to his posterity.) I have made numerous public recommendations for dealing with the problems of regional hunger now surfacing with increasing frequency throughout the human world (Hardin, 1974, 1976, 1980, 1982, 1985). For more than a decade ecologists have pointed out that the population of Ethiopia is beyond the prudent carrying capacity of the land. Now that the crash has come well-intentioned people, upholding the sanctity of life rather than the sanctity of the carrying capacity, are eagerly sending in food from the outside thus ensuring that the Ethiopian population will remain above the carrying capacity. The consequences of good intentions that are uninformed by ecological principles will be the transformation of a presumed temporary crisis into a veritable permanent crunch (Hardin, 1974).

It is time to recall the prescient words of William Ophuls (1973): "Human ecology is against . . . the isolation of thought and action; against individualism as an ideology; and against moral absolutes like the inalienable rights of man." Ophuls' insight may be too strong a medicine for the student to take; the good teacher, like the good psychoanalyst, must carefully choose the time for reevaluation.

7. *Not all elements of the human carrying capacity are expansible.* We are rightfully proud of the technological advances humanity has made in the past two centuries. These advances have significantly enlarged the usable carrying capacity of the earth, but only with respect to *some* of the elements that we include in the aggregative term, "carrying capacity."

To the extent that capital investment is an important element of production costs, population growth brings the benefits of economies of scale. Food production and energy extraction have increased greatly, but the fundamental absorptive capacity of the earth for harmful waste products has not increased. Time moves no faster now than it did a thousand years ago, so high quality goods that require much time in their production, *e.g.*, cabinet-quality hardwoods, have become increasingly scarce. Amenities that cannot possibly be increased in quantity—lonely beaches and wilderness are examples in point—continually decrease on a per capita basis.

8. *Population growth ultimately makes democracy impossible.* Easy communication is the *sine qua non* for an enduring democracy. All communication functions are inherently afflicted with *dis*economies of scale, since (for every well defined communication network) the burden created by the communication of n people increases as the *square of n.* This burden expresses itself in information-overload, which leads to misunderstandings, social pathologies, and (ultimately) the acceptance of a totalitarian regime as the least of the evils available to an overpopulated political unit. In the face of unlimited population growth the *word* "democracy" can be retained, *but not the fact.*

Biology teachers usually avoid dealing with political matters, but I recommend that in this case they depart from custom to emphasize this scale effect. Ever since Malthus, apologists for perpetual population growth have shown great ingenuity in the selection of data to bolster their position. (For recent instances see Simon, 1981, and Simon and Kahn, 1984.) Always implicit, and often explicit, is their repugnance at the thought of the loss of individual freedom through population control measures. It needs to be brought home to the Growthmanship crowd that the fundamental diseconomies of scale inherent in communication mean that the freedom they cherish cannot be retained if the growth they advocate comes to pass.

When Pasteur and others brought about a revolution in public health they intended

only to conquer disease. We, the beneficiaries of this great revolution, now face the bitter truth that "We can never do merely one thing." Now that the providential negative feedback of density-dependent crowd-diseases has been eliminated, the question that people in all societies must ask is this: In which way would you prefer to lose your freedom? Through the community's regulation of the number of children, or through Nature's cruel elimination of the excess population?

9. *Selection dictates the direction of evolution.* This is so obvious to biologists that the point need not be debated. Let us go on to see some of the practical applications of the principle.

10. *Every biocide selects for its own failure.* Until *Silent Spring,* technological optimists seldom had to face this principle. When first introduced, DDT did indeed seem a miracle stuff; but it selected for insects that had genetic resistance to its action. Similarly, antibiotics select for microbes that are genetically resistant to their toxic qualities. Control of pests and disease germs is not impossible, but neither is it simple. No single control agent can be expected to be effective for very long; combinations and alternations must be used. The price of liberty, it has been said, is eternal vigilance; this is also the price of freedom from disease.

11. *Every human law selects for its own evasion.* Discussion of pesticides sets the stage for discussion of phenomena of human ecology customarily relegated to political science. I recommend that such matters be brought into a course in human ecology, not as an act of academic piracy, but to emphasize the artificiality of academic boundaries and the unity of knowledge. Obviously the word "selects" is here used in a sense different from the biological meaning. Genetic selection is not involved; the selection invoked is of the most general sort. Behavior is socially selected for and rewarded; and as bystanders observe the way an unintended reward system works they may be tempted to imitate the rewarded behavior. A few examples should clarify the idea of social selection.

Every new tax law creates new "loopholes": people who discover them are rewarded with lower taxes. An unmanaged commons (Hardin and Baden, 1977) selects for the selfish behavior that will, under conditions of scarcity, tragically exhaust the resource (Hardin, 1968). A managed commons, usually called "socialism," selects for managerial behavior that primarily protects the interests of the manager. This gives rise to the ancient question, *Quis custodiet ipsos custodes?*—"Who will watch over the watchers themselves?" On the other hand a privatistic politico-economic system favors a positive feedback of social power that threatens to create unbearable economic and social inequalities (Hardin, 1963).

12. *No inning is the last inning.* There is no easy answer to the problem of creating an acceptable and stable social order. In biology, the "climax community" is recognized as a fiction fostered by the short time span of human attention. In principle, every species is part of the selective environment for every other species, so change in the numbers of one species tends to set off a prolonged domino process of selection and change in other species. In human sociology, analogous processes (even in the absence of genetic differences and genetic changes) lead to similar domino-processes.

The environmentalist who focuses on strictly scientific facts is likely to become disillusioned as he observes the multitude of ways in which people can evade sensible environmental laws and regulations. In the biological realm, selection determines evolution; in the social realm, rewards (intended or not) determine behavior. A strict law governing water quality may be evaded by shifting pollutants to the atmosphere. Control the air as well, and polluters may bury their by-products in the ground. As for the regulators themselves, in their desire to survive and prosper they may find it to their personal advantage to be "captured" by the powers they are supposed to regulate. Once captured, they are in a good position to be offered much higher paying jobs in the regulated industries.

In human affairs there is no such thing as a last inning, and the ways in which com-

peting forces can more or less adjust to one another are beyond numbering. The complexity of a politico-economic system is comparable to the complexity of the ecological systems biologists study. Put the two together into a system of systems and we have *real* complexity. The most carefully thought out intervention in this system of systems will not always produce the results we want. Interventions are often counterproductive.

Having begun with Sears' perception that ecology is a subversive science, let us end with a balancing contention by Ophuls: "Ecology is a profoundly conservative doctrine in its social implications" (Pirages, 1977). The truth of the statement depends on the meaning imputed to the word "conservative."

In a century and a half the word has accumulated many meanings, some of them contradictory. No definition can be said to be *the* correct one. Whenever we hear the word "conservative" we should automatically ask, *conservative of what?* Which of the many known kinds of conserving actions can the human ecologist, *qua* ecologist, support?

Conservative of ancient beliefs? Science is ineluctably married to doubt, and the antiquity of a belief is no warrant of its truth—though it may be a reason for seriously examining it. Many non-scientists would, if they could, enforce public belief in unexamined ancient dogmas for the sake of social stability. As a scientist, no ecologist can support such an action. In this sense, ecology is clearly not conservative.

Conservative of existing political and social institutions? Conditioned by his First Law, "We can never do merely one thing," the ecologist has to be somewhat sympathetic with this policy. This hesitancy to embrace institutional change is, for the ecologist, less a matter of principle than a matter of prudence. The undeniable bad effects of institutional arrangements that worked well under conditions of lower population densities makes the ecologist more willing than non-scientific conservatives to seek improvements in human institutions.

Conservative of existing social privileges? An ecologist sees no compelling reason for supporting the existing power structure. Because of the positive feedback of social power those who possess it will do quite well enough supporting their own interests. In fact, in the absence of deliberately engineered negative feedbacks in the social realm, the powerful will do too well. The eternal need for limitations on the runaway feedback of social power is a point that escapes the understanding of doctrinaire "libertarians."

Conservative of environmental resources and amenities? Yes: this is a primary interest of human ecologists, who wish to preserve as much as possible of our real wealth for subsequent generations. With some political and economic conservatives human ecologists can make common cause. On the other hand there are many people who now call themselves "conservatives" who have absolutely no interest in this sort of conservation. To this type of conservative the proposals of human ecologists seem subversive. In turn, ecologists say that those who refuse to regard themselves as posterity's trustees of nature's riches do not deserve the name "conservative." In the game of survival, the conservation of any particular social system is ultimately futile in the absence of the truly essential conservation of natural resources.

The greatest commonality between ecological conservatives and political conservatives is in their attitudes. Two common attitudes deserve notice. First, committed conservatives of all kinds hold that the social value of actions is determined more by their consequences than by the intentions of those who performed them. "The road to Hell is paved with good intentions." Good intentions, though they may explain poor results, do not excuse them.

Secondly, true conservatives take a long view of time. Not as long as the geologists, whose unit may be a million years, but certainly much longer than that used in business-as-usual and politics-as-usual, where the horizon is no more than five years off. Such short-sightedness grows logically out of the economic practice of "discounting the future" in terms of the going rate of interest (Hardin, 1975). The higher the rate of interest, the more heavily the future

is discounted, which means that short-sightedness "pays." Times of trouble—inflation, social disorder, revolution—raise the interest rate and thus make provision for the future more difficult. In consequence, it becomes ever harder to escape the trouble. Positive feedback generates a vicious circle.

The economic theory of discounting the future makes a certain amount of sense, but the permanent features of an enduring civilization are built on actions that ignore this sort of economic theory. There are times in the life of every community when even the investment that must be made in bearing and rearing children cannot be justified by "hard-nosed" economics. It would be going too far to claim that the future belongs to those who reject the economic theory of discounting; but the future does belong to the *descendants* of those who reject the simple implications of this theory. Such rejectors are the true conservators of civilization. Subversive ecologists can take pride in the fact that they are true conservatives.

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