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Perpetual Growth

The Next Dragon Facing Biology Teachers

by Garrett Hardin

I write this article within a tradition established by Theodosius Dobzhansky. In 1973 he told the National Association of Biology Teachers that, "Nothing in biology makes sense except in the light of evolution." The vast majority of biologists agree with Dobzhansky. He reminded us that evolution through natural selection was so all-encompassing a process that biologists should not, merely for the sake of momentary peace, draw back from defending Darwin's vision.

The principal opponents to evolution have been members of certain religions. The objectors have been only a small fraction of the total religious population, but they have been very vocal. Their indignant outcries have now dropped to a low level of decibels. Still, in many communities, it takes considerable courage to be a good biology teacher.

Now on the horizon is another conflict that is also, in a deep sense, a religious one. This is the conflict over growth. The idea of perpetual growth is embraced with religious fervor by mainstream economists and other worshipers of "Progress" — the material sort of progress, that is. Two decades ago Walter Heller, then chairman of the President's Council of Economic Advisers, said, "I cannot conceive a successful economy without growth." This was, and is, the majority opinion of economists. In the same category is an aphorism of one of the Rothschilds who said that, "Compound interest is the eighth wonder of the world." He implied that the exponential growth of money-at-interest creates actual physical wealth. This belief is defended with religious fervor by most economists, despite the fact that the physicist Frederick Soddy showed that money-at-interest creates only a negotiable demand on wealth, not wealth itself.

On paper, a bank account can be made to grow forever, without limit. But does this mean that material wealth also grows without limit? Not so, said Aristotle, because "Money is sterile." Two thousand years later we are the prisoners of an economic system built on the assumption that money is limitlessly fertile. Fortunately a few economists are calling for a revitalization of the Aristotelian insight, notably Kenneth E. Boulding and Herman E. Daly. Professor Boulding has remarked that, "Anyone who believes exponential growth can go on forever in a finite world is either a madman or an economist." Boulding has earned the right to be blunt: he is an eminent enough economist to have served a term as president of the American Economics Association. Most economists probably wish he had not given voice to so harsh a home truth, but his view is gaining support in the profession.

Our students are society's next generation-in-power. We owe it to them, to society at large, and to posterity to help students build their expectations on a realistic basis. Exponential growth needs to be seen as a severely time-limited process, for which costs must be paid. Growth is ultimately limited by the environment, a truth that ecologists encapsulate in the concept of "carrying capacity."

This concept is an absolute necessity for honest ecological accounting; yet several economists have, with little contradiction by their fellows, called it a "meaningless concept." To make such an assertion is as bizarre as if an accountant were to say that balancing the books is a meaningless procedure. In evaluating the annual report of a business concern one looks for "the bottom line." Carrying capacity is the bottom line of ecological accounting. Like the laws of thermodynamics, carrying capacity is part of the *conservative* structure of science. We need to uncover the reasons for the strange reluctance of economists to admit this form of conservatism into their discipline. A society that pays attention to economists needs economists who pay attention to reality.

We will gain in perspective, as well as in humility, if we keep in mind that conservation principles come down to us from classical Greece. They were first explicitly recognized by Epicurus back in 3rd century B.C. The language quoted below is a far cry from the "sound bites" of present-day television, but the ancient Greeks did not labor under our curse of an information-overload. They had time to savor the cuisine of information.

> *Nothing is created out of that which does not exist; for if it were, everything would be created out of everything with no need of seeds. And again, if that which disappears were destroyed into that which did not exist, all things would have perished, since that into which they were dissolved would not exist.*

Three unhurried readings of that passage should

convince you that it can fairly be converted to this short sound bite: "Nothing material can be either created out of nothing, or annihilated into nothing." A multitude of conversions are possible: coal and air into dry ice, for instance, or plutonium into smaller atoms plus energy. But, in our experience, there is never either true creation or true annihilation. (The problem of the one-time origin of the universe, many billions of years in the past, is really beyond science's purview.) In real time — *our* time — Epicurean conservation rules.

The Epicurean attitude implicitly guided investigators of "natural philosophy" (an antique name for science) for two millennia. It was not until the 19th century that the attitude was explicitly stipulated. In the physical sciences, the stipulations asserted the conservation of matter and the laws of thermodynamics. In biology, the most wide-ranging practical consequences followed from the denial of spontaneous generation.

Whenever a tacit understanding is converted into words it provokes a denial. The denial of conservation principles began in the 19th century. There developed an infectious belief that there are no real limits, that (as a song popular in the 20th century put the matter), "wishing will make it so." It was not science itself that created this new mythology, but the laity's understandable wonder at the apparent miracles being generated by technology. Such marvels as the telephone and the airplane, though foreseen by science-fiction writers, were viewed as impossibilities by many respected scientists until late in the 19th century. Nuclear energy was a complete surprise. The rapid development of these and many other inventions in the 20th century made it easy to accept the idea of limitless growth.

Malthus's population theory, born on the threshold of the 19th century, was an essentially Epicurean doctrine. His presumed limit, "subsistence," was essentially the sort of limit that had been taken for granted for millennia. Malthus had the profes-sional misfortune to plug the idea of limits into his theory at a time when the technological advances were increasing the *realized* carrying capacity of the environment faster than human population itself was growing. No wonder limit-accepting theorists like Malthus were soon taunted with the children's story, "Chicken Little." That chicken, remember, was the one who said, "The sky is falling! The sky is falling!" Only it didn't fall.

At the present time the public dispute between "Cornucopians" and "Doomsayers" is not resolved. (The name of each group is contributed by the opponents, of course.) Malthusian Doomsayers will admit this: "Chicken Little is wrong every time — *except the last time*." This admission comes easily to an Epicurean. On the other hand, growth-minded economists think Chicken Little is never right. They conveniently forget that civilizations before ours have perished.

The present argument is concerned with why most economists are Cornucopians, and why they are wrong. But before taking up these points we need to be sure we understand the meaning of "carrying capacity," in both human and nonhuman contexts.

As concerns domestic herds and wild game populations, the idea of carrying capacity is fairly simple: the carrying capacity of a territory is the maximum number of animals that can be supported for an extended time without degradation of the environment.

Transgression of the carrying capacity of a defined territory results in lowering its capacity in subsequent periods. For example, overgrazing a pasture causes loss of soil and replacement of sweet grass by weeds. Unless the impact of population on the environment is quickly reduced, such degradation escalates with time. Because of unpredictable secular changes and fluctuations in climate, prudence dictates that the carrying capacity figure adopted by policy should be safely below any momentary carrying capacity. This imperative is spelled out in what has been called the Eleventh Commandment of Ecology: *"Thou shalt not transgress the carrying capacity."*

When we apply this principle to human beings we encounter a new factor (which helps explain the economists'reluctance to accept the principle): this is the "quality of life" issue. Consider: Bangladesh has a population of 115 million people living in an area the size of the state of Iowa (which has a population of only 3 million). In terms of its ability to produce subsistence, Bangladesh is *not* a poor country. Its alluvial soil is as rich as Iowa's glaciated land, and it can grow three crops a year instead of only one. But Bangladesh is not rich enough to support a population 38 times as great as Iowa's in anything approaching *dignity*. Bluntly put, Bangladesh is overpopulated.

Would Americans consent to live in a population as dense as Bangladesh's if it meant living the way the Bangladeshi live? Not likely. We oppose high densities of population because we realize that carrying capacity has an inverse relationship to the quality of life: the richer the life aimed for, the lower is the carrying capacity of a territory. The material culture presumed helps determine the carrying capacity.

Rich people can afford to heat the space they live in; poor people must make do with warm clothing alone. Demanding the pleasant luxury of space heating reduces the carrying capacity of a territory. We should therefore, when dealing with human populations, specify the *cultural carrying capacity* of a territory.

Now we see why economists have such a distaste for the topic of carrying capacity. For more than a century academic economics has been trying to purge itself of "value judgments." But every commitment to a specific cultural carrying capacity inevitably presupposes a wealth of value judgments. Those who

want to live in warm houses value individual comfort above the maximum number of people. A diet rich in meat supports a smaller population than an all-vegetable diet. What shall we choose?

The thrust of most such judgments can be expressed in terms of energy. An adult, living a moderately active life, requires about 2300 kilocalories of food per day. The calories required for all the other "goods" of life — clothing, shelter, artificial lighting, vacation trips, education, movies, television, horse racing and other forms of recreation — amount to a great deal more. The average American consumes one hundred times as much energy in nonfood uses as he consumes in the form of food. Obviously the cultural carrying capacity of our land, assuming our sort of life, is much less than it would be for people living the life of the average Bangladeshi. At times, some of us become a bit ashamed of our "wasteful" way of life; but when push comes to shove, few Americans would be willing to settle for Bangladeshi standards.

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One's reaction to the ethical problem of the distribution of wealth and income is affected by one's view of the phenomena of growth. Many economists think we can sidestep the problem of devising an acceptable theory of the distribution of wealth by simply allowing perpetual economic growth to take place. "A rising tide floats all ships," they say, conveniently forgetting that the ebb of tides is as certain as the rising of them. (The public rewards optimists; it punishes *and ignores* pessimists.) Economists gain additional "Brownie points" with their "trickle-down theory" for dealing with poverty. Make the rich richer, they say, and the poor will have more crumbs to pick up.

Biologists, better than most academics, know that the exponential increase of any material measure is only a momentary fact. Without presuming to solve all the problems of economics and sociology, biologists must insist that perpetual growth is impossible. In a finite world — and that is the only world that is practically available to *Homo sapiens* — no material element of a system can increase exponentially forever. In any subsystem the trickling finally stops as the tide of growth reverses. Then, if not before, the problem of the optimum distribution must be faced. After 3,000 years of trying, professional ethicists have yet to describe a satisfactory solution to the highly emotional problem of the distribution of wealth and income. Economists should be able to make significant contributions to this problem, but they cannot do so as long as they shrink from making value judgments.

The command "Grow or die!" is a popular bit of folk-economics. Consider what would face a human being at age 18 if nature followed this command. Either the young person would have to die at that point, or he or she would have to continue growing for another 50 or more years. If a man or a woman grew at the rate that characterizes the adolescent years, what a mountain of flesh the undertaker would have to deal with when death finally entered the scene! The worshipers of perpetual growth seldom spell out its ultimate consequences, being satisfied with its proximate effects, which are sometimes aesthetically attractive.

"To persuade people to give up perpetual growth we must show them that nongrowth can also be beautiful."

It is often casually assumed that science and aesthetics are completely separable disciplines. Darwin knew better. His *Origin of Species* focuses primarily on the facts, but he recognized that these were not enough to persuade the skeptical. The last three paragraphs of his book are particularly revealing. He admits that there is a "war of nature," and yet, he says, "from famine and death" the "most exalted forms of life" have evolved. He argues that the evolutionary view of life is at least as beautiful as the special creation view.

Perpetual growth, like special creation, is an aesthetically seductive notion. To persuade people to give up perpetual growth we must show them that nongrowth can also be beautiful. *Nongrowth is not synonymous with stagnation*. In the life of an individual, the vigorous bodily growth of the first two decades of life gives way to a steady-state metabolism. What we ordinarily judge to be the "productive" years of human life occur *after* the growth in mass has stopped. Growth in skills, in intelligence, and in civilization are possible to individuals, *and to societies*, after growth in mass is at an end. Even at the purely physiological level there are beauties in the steady state, as the exquisite writings of Sir Charles Sherrington demonstrate. Unfortunately, steady-state economics has yet to find its Sherrington.

Well, biologists are not responsible for reforming economics. But the subject matter of ecology overlaps the subject matter of economics. The names of both are derived from the Greek root, *oikos*, meaning house or home. Ecology deals with the interactions of *all* the animals and plants with their environment — the Earth — our home. Economics concentrates on the interactions of the members of one species only, man. Economic processes take place within an ecological

nexus, of which too many economists are unaware. We biologists can argue that economics is but a small branch of ecology; but we should not wait around for economists to agree with us! However, it is worth noting that in 1989 a new professional journal was established under the name of *Ecological Economics*. It is staffed mostly by economists. This is a most hopeful sign.

More and more high schools are adding an economics course to the curriculum. Inertia in the educational system insures that the training of high school economics teachers will, for some time to come, be mostly of the older, non-ecological sort. Textbooks will also lag. Faced with this unfortunate situation, conscientious biology teachers have two courses to choose from. They can complain about the backwardness of high school economics; or they can engage in dialogues with their economics colleagues, either directly or through the students they share.

Without demanding that students commit themselves to one view or another, biologists can ask them to list the different consequences that follow from the contrasting views that unlimited growth is (a) possible, or (b) impossible. Those who believe in the possibility of perpetual growth see no need for the concept of carrying capacity. To them, the conservation of resources may seem rather silly, because tomorrow (it is thought) we will discover acceptable substitutes and new sources of energy — *forever*.

Biologists can point to situations in which resources are clearly limiting. A culture of yeast in grape juice produces the waste product, alcohol, which eventually kills most of the yeast cells. Is the production of smog by automobiles, the number of which is proportionate to the human population, so very different? It is true, of course, that improve-ments in technology can postpone the evil day when smog might put an end to the system; but what happens if the human population grows without limit? Can improvements in technology also take place without limit? Can you prove it? Interesting questions, these!

Some of society's most endearing traits are connected with the belief in perpetual growth. Because sharing gives pleasure, a poem was placed in the Statue of Liberty inviting the tired, the poor and the homeless to come to us from foreign shores. At the time those lines were written, America's frontier still seemed boundless; but where is the unoccupied space now? Can America — can any country — absorb an unlimited number of immigrants? And now that our own homeless are increasing in numbers, are we being kind to our own people — and to our grandchildren — when we invite more homeless to come in?

Or if we reject that option, should we send food to the starving in other countries? We can certainly feed 50,000 starving people with our surplus: what about 50 million? Or a billion? The number of the world's needy seems to be growing without limit: can the productivity of our farms also grow without limit? Is the amount of our topsoil now increasing or decreasing?

To some people questions like these may seem far from the proper subject of biology; but since human beings are members of the animal kingdom, biologists have something to say about such questions (even if more than biology is required for complete answers). Such questions are interdisciplinary, and biology is one of the disciplines needed to work out the answers. Admittedly, asking interdisciplinary questions starts controversies, but if the controversies are handled tactfully they can greatly augment the impact of the subject of biology on the mind of the student.

It seems very probable that we are moving into a period of history when limits of many sorts will affect society more and more. Biology teachers have a rare opportunity to prepare students for the trials of character that will soon confront everyone in our society. We must convince students that unlimited exponential growth of any material thing is not possible. We must reject the mythology of perpetual growth that grew out of the fantastic technological developments of the past two centuries. We must commit ourselves once more to the Epicurean common sense of conservation principles. If we are truly competent as teachers we should be able to persuade the next generation that the secret of living a good life is learning to live within limits. ■