

ESSAYS ON SCIENCE AND SOCIETY: Extensions of "The Tragedy of the Commons"

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It is easy to call for interdisciplinary syntheses, but will anyone respond? Scientists know how to train the young in narrowly focused work; but how do you teach people to stitch together established specialties that perhaps should not have been separated in the first place? Early in this century the specialties of biology and chemistry were joined to form biochemistry; similarly, economics and ecology are now in the process of being combined into ecological economics.

My first attempt at interdisciplinary analysis led to an essay, "The Tragedy of the Commons." Since it first appeared in *Science* 25 years ago, it has been included in anthologies on ecology, environmentalism, health care, economics, population studies, law, political science, philosophy, ethics, geography, psychology, and sociology. It became required reading for a generation of students and teachers seeking to meld multiple disciplines in order to come up with better ways to live in balance with the environment.

I did not start out intending to forge an interdisciplinary link, but rather to present a retiring president's address to the Pacific division of the American Association for the Advancement of Science. But even after six revisions, each quite different from the one before, my summary of an ecologist's view of the human overpopulation problem would not crystallize. Repeatedly, I found fault with my own conclusions.

With Adam Smith's work as a model, I had assumed that the sum of separate ego-serving decisions would be the best possible one for the population as a whole. But presently I discovered that I agreed much more with William Forster Lloyd's conclusions, as given in his Oxford lectures of 1833. Citing what happened to pasturelands left open to many herds of cattle, Lloyd pointed out that, with a resource available to all, the greediest herdsmen would gain--for a while. But mutual ruin was just around the corner. As demand grew in step with population (while supply remained fixed), a time would come when the herdsmen, acting as Smithian individuals, would be trapped by their own competitive impulses. The unmanaged commons would be ruined by overgrazing; competitive individualism would be helpless to prevent the social disaster.

So must it also be, I realized, with growing human populations when there is a limit to available resources. The direct psychic gains of parenthood are offset by economic losses channeled through the whole population. It was so in Lloyd's day; it is even more so today. I rewrote the essay for what I thought would be the last time.

But in a final reading to my family and friends at a stopover on our way to the meeting in Utah, I was encouraged to modify it again. I scribbled in the changes, most notably the suggestion that the way to avoid disaster in our global world is through a frank policy of "mutual coercion, mutually agreed upon." Under conditions of scarcity, ego-centered impulses naturally impose costs on the group, and hence on all its members.

A crude example makes the point: I might like to rob banks, but I am unwilling to allow other citizens to do so. So most of us, acting together, pass laws that infringe on the individual's freedom to rob banks. For an example closer to home, think of what is happening to the freedom to make withdrawals from the oceanic bank of fishes. In 1625, the Dutch scholar Hugo Grotius said, "The extent of the ocean is in fact so great that it suffices for any possible use on the part of all peoples for drawing water, for fishing, for sailing." Now the once unlimited resources of marine fishes have become scarce and nations are coming to limit the freedom of their fishers in the commons. From here onward, complete freedom leads to tragedy. (And still the shibboleth, "the freedom of the seas," interferes with rational judgment.)

My address was a success, and the essay was printed 6 months later, trimmed by half and, presumably, more appealing in its brevity to a wider audience. The 600 reprints were exhausted in a matter of weeks.

Its message is, I think, still true today. Individualism is cherished because it produces freedom, but the gift is conditional: The more the population exceeds the carrying capacity of the environment, the more freedoms must be given up. As cities grow, the freedom to park is restricted by the number of parking meters or fee-charging garages. Traffic is rigidly controlled. On the global scale, nations are abandoning not only the freedom of the seas, but the freedom of the atmosphere, which acts as a common sink for aerial garbage. Yet to come are many other restrictions as the world's population continues to grow.

The reality that underlies all the necessary curtailments is always the same--population growth. Yet the slightest attempt to limit this freedom is promptly denounced with cries of Elitism! Big-Brotherism! Despotism! Fascism! and the like. We are slow to mend our ways because ethicists and philosophers of the past generally did not see that numbers matter. In the language of 20th-century commentators, traditional thinking was magnificently verbal and deplorably nonnumerate.

One of today's cardinal tasks is to marry the philosopher's literate ethics with the scientist's commitment to numerate analysis. Words are important, but they often require

a numerate cast. What I have realized from reading numerous criticisms of the theory of the commons is that both Lloyd and I were analyzing a subset of commons--those where "help yourself" or "feel free" attitudes prevail. This was the message European pioneers in North America thought they had been given by the land they chose to perceive as unpeopled. Even today, laws encouraging private access to public lands for mining, pasturing, and forestry perpetuate subsidies that support malfunctioning commons.

Numeracy demands that we take account of the exponential growth of living systems, while acknowledging that resources, when thoroughly understood, will prove to be definable by numbers that are relatively constant. Of course, under the impact of new science, the apparent limits of resources may be pushed back for a while; but finally what E. T. Whittaker called "impotence principles"*--for example, the laws of thermodynamics--will exert their influence on policy.

To judge from the critical literature, the weightiest mistake in my synthesizing paper was the omission of the modifying adjective "unmanaged." In correcting this omission, one can generalize the practical conclusion in this way: "A 'managed commons' describes either socialism or the privatism of free enterprise. Either one may work; either one may fail: 'The devil is in the details.' But with an unmanaged commons, you can forget about the devil: As overuse of resources reduces carrying capacity, ruin is inevitable." With this modification firmly in place, "The Tragedy of the Commons" is well tailored for further interdisciplinary syntheses.

A final word about interdisciplinary work--do not underestimate its difficulties. The more specialties we try to stitch together, the greater are our opportunities to make mistakes--and the more numerous are our willing critics. Science has been defined as a self-correcting system. In this struggle, our primary adversary should be "the nature of things." As a matter of policy, we must not reply in kind to those critics who love to indulge in name-calling. (They are all too numerous in interdisciplinary undertakings.) But critics who, ignoring personalities, focus on the underlying nature of things are the true friends of science.

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