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COMMENT

Environmental scientists: advocates as well?

What should be the response of environmental scientists when the world and the Earth appear to be heading toward exceptional crisis? Some scientists have signed up to public assertions that there indeed could be environmental Armageddon ahead (e.g. Union of Concerned Scientists 1992; US National Academy of Sciences and Royal Society of London 1992). Other scientists proclaim that our most valuable resource is not environmental well-being but professional credibility; the 'cry wolf' risk is the key determinant. Others appear to prefer to be scientists pure and simple, eschewing the policy arena, let alone the political scrum. Still others seem to think that warning of prospective crisis, even warning amongst themselves, is out of protocol's court.

To illustrate the last point first: as we have known for several decades, we are conducting a planet-wide experiment, disrupting the biosphere on many a side. It is eliminating tropical forests, it is creating deserts, it is dislocating climate itself, *et* lengthy *cetera*. One prominent consequence is that humankind is depleting certain basic processes of evolution, with depauperizing impact for several million years (Myers 1996). The recovery period could well extend for twenty times longer than humans have been humans, and the number of people to be affected, or rather impoverished, could eventually total thousands of times more than all people who have existed to date. On scientific and social grounds, then, this is surely an issue to be addressed with due despatch and emphasis. Yet a perusal of the half dozen journals most concerned with evolution shows that hardly a single paper has ever addressed this question head on, or broached it much at all.

Something similar applies to other leading journals. I fully agree with the purpose of journals *per se*. They offer fora for research reports, data-based analyses, and lots of other scientific writings where strict objectivity is at a premium. But given the unprecedented problems and risks of our times, should there not be an unprecedented departure in the scope of certain (many?) journals, by allowing space for discursive articles that may be more in the form of editorials, essays, commentaries, think pieces, or whatever else supplies a platform for discussion of what could eventually prove to be the biggest scientific issue of our times?

'Eventually': what if, in another decade's time, the forces of environmental destruction have worked up so much momentum that it will be impossible to slow and stem them, let alone halt or even reverse them? Society may well look back and ask whether scientists were not aware of the portents of danger at a time (such as the 1990s) when there was still room for manoeuvre, and if so, what did the scientists do to raise the alarm? Did they ensure that political leaders and the public alike were left in no doubt about the crisis underway and the grossly impoverishing repercussions it would visit on people for generations to come? I, for one, worry that I may not have a sufficient answer for those who will be enduring the consequences of my efforts, or lack thereof.

This is not to say that journal articles should simply be a case of turning up the rhetorical volume on what other articles have already said. Nor should any journal ever run the risk of becoming a mouthpiece for advocacy or activism. But there is plenty of scope for articles that reflect the urgency of the environmental crisis, and do it while saying something new. For instance:

(1) A piece headed something like 'How much time do we have left?' might look at when humankind might cross some environmental threshold of major irreversible harm.

(2) Many articles assert that in this and such a way we are doing better than before; such positive assertions are welcome in order to allay a trend toward doom and gloom. But the only valid question in the long run, and not raised often enough, is 'Are we doing enough?' An article could ask if we are steadily getting on top of Problem X, or is it still getting on top of us?

(3) Amongst likely environmental surprises ahead are discontinuities, often triggered by synergistic interactions. Environmental textbooks confirm that this is one of the most significant phenomena in nature, yet it is little studied. An article could identify and define some discontinuities, especially those with potentially powerfully adverse repercussions, e.g. a synergistic linkage between global warming and ozone-layer depletion.

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(4) Another article could examine the scope for 'constructive discontinuities'. What corrective responses can we devise with exceptional policy leverage and multiplier effects? How to tear down the Berlin Walls of ignorance, or ignore-ance, that block environmental advancement?

Scientific rigour

The above is not to discount the imperative of unprecedented scientific rigour to reflect unprecedented challenges. Any article with policy implications must be based on the best scientific information and analyses, presented as carefully and cogently as possible in order that the statement enjoy a full hearing (*cf.* Ehrlich & Ehrlich 1996; Lubchenco 1998).

Fortunately we now have a large-scale instance of how the scientific community can interact with the policy community, and to the marked benefit of both sides. The question of global warming has been addressed through the Intergovernmental Panel on Climate Change, being a group of eminent climatologists and meteorologists from all parts of the world, working with experts in economics, human settlements, agriculture, public health and other relevant sectors. The Panel's reports have set a standard for an international group of scientists going public with their analyses of a singularly complex issue beset with myriad uncertainties. They have presented their consensus statements with an emphasis on transparency and critical review. It has all made for scientists' involvement with policymakers in the best manner to date.

This démarche is paralleled in spirit by a recent initiative in the USA, where the Ecological Society of America has launched a fellowship programme to train its membership in the techniques of reaching out to non-scientific audiences. This sort of training might well be considered for a specific niche in graduate courses for environmental students, although when I proposed something such as this at a prominent university on this side of the Atlantic, the idea was viewed as part way to a corruption of the pure scientific mind.

In sum, it is appropriate to appraise environmental problems with as much (or as little) information as is available. This is the more pertinent when dealing with problems of exceptional import and urgency. Scientists should present a realistic statement of problems as they understand them, less than complete though their knowledge may be in many respects. Or: they should present them with as much 'precise imprecision' as they can muster.

Uncertainty

Now for the key factor of uncertainty. This factor prompts many scientists to adopt a cautious stance, if not to keep quiet. After all, they object, scientists will lose public support if they prognose this or that crisis and then are found to have been off target. This is a legitimate concern, for super sure (Lemons 1996). But beware the asymmetry of evaluation. This is so vital to all manner of environmental questions that I have set out the case on several past occasions, and it is worth repeating here.

What is 'legitimate scientific caution' in the face of uncertainty, especially when uncertainty can cut both ways? Some observers may consider that in the absence of conclusive evidence and assessment about an environmental problem such as soil erosion (how widespread and severe, what costs of action or of inaction?), it is better to stick with low estimates of the problem on the grounds that they are more 'responsible.' But there is an asymmetry of evaluation at work. A low estimate, ostensibly 'safe' because it takes a conservative view of such limited evidence as is to hand in documented detail, may fail to reflect the real situation just as much as does an 'unduly' high estimate that is more of a best-judgement affair based on all available evidence with varying degrees of demonstrable validity. A minimalist calculation with apparently greater precision may in fact amount to spurious accuracy. In a situation of uncertainty where not all factors can be quantified to conventional satisfaction, let us not become preoccupied with what can be precisely counted if that is to the detriment of what ultimately counts. Crying wolf?

This applies to environmental problems with policy implications of exceptional scope, as in the case of soil erosion, mass extinction, or global warming. Suppose a policymaker hears scientists stating they cannot legitimately offer final guidance about a problem because they have not yet completed their research with conventionally conclusive analysis in all respects. Or suppose the scientists simply refrain from speaking out in public (or even in journals) about the problem because they believe, in accord with certain traditional canons of science, that they cannot validly say anything much before they can say all. In these circumstances, the policymaker (or journal reader)

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may well assume there is therefore little to worry about for the time being: absence of evidence about a problem implies evidence of absence of a problem. By consequence, the policymaker (or journal reader) may decide to do nothing, and to do nothing in a world of unprecedentedly rapid change can be to do a great deal. In these circumstances, undue caution from scientists can become undue recklessness in terms of the consequences; their silence can send a resounding message, however unintended.

As in other situations beset with uncertainty, it will be better for us to find we have been roughly right than precisely wrong. There is nothing new about all this, especially as concerns the costs and benefits of action, or inaction. After all, policymakers deal with the dilemma every day. What, for instance, could be the ultimate and overall economic returns on today's investments in health, education and defence, these being sectors where the returns will not become apparent for some time into the future, and be generalized at best?

I hope this Comment will stimulate discussion on an issue that is surely at the heart of environmental science today. Is it not, moreover, an issue to be tackled with as much professional discipline as any other?

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