Expanding the Scope of Science and Ethics

James D. Proctor

Department of Geography, University of California, Santa Barbara

"Balancing Scientific and Ethical Values in Environmental Science" is a wholly atypical paper for three physical geographers to produce, for which I commend Harman et al. Their argument extends far beyond the usual limits of writers in their field. Why is this so? The standard answer is that ethics intersects only tangentially, if at all, with natural science, so no big sin of omission has occurred. Harman et al. offer an alternative perspective of ethics as intimately connected with a good deal of scientific work. Given how little this connection has been discussed to date with respect to physical geography, their paper is worthy of our careful consideration, for in it we may start to build some picture of what it means to bring ethics into our own work.

I also wish to add my own thoughts on this very important issue, based in part on a slightly broader conception of ethics as intellectual reflection on the full range of values—selfish and social, silent and spoken, sanctioned and suppressed—that accompany any human endeavor, be it politics, child rearing, or—yes—science. It is true that only some geographers do research directly related to people; yet all geographers (at least those I have met—no faulty inductive logic implied here) are people! Hence, at a very general level, I would argue that ethics relates as much to physical geography as human geography; "Balancing Scientific and Ethical Values in Environmental Science" speaks to some of these important connections, though others are left unstated.

I will organize my critique and extension around four sequential arguments I find to be central to Harman et al.'s paper. In what follows, I will use the term "science" primarily to mean the approaches to physical and natural science that physical geography comprises. Describing "science" in the singular is always a questionable generalization, though at least the rhetoric, if not the reality, of its unity is beyond question (Galison and Stump 1996).

Ethics Arises in Application of Science to Policy

The authors' point of departure, their definitional premise, is that ethics arises in the application of science to policy: "In the development of public policy . . . science and ethics explicitly intersect because a wide variety of research products may be directly converted into practices that affect the human condition" (p. 278). They do agree that human geography may have more direct social application and hence ethical relevance, though the distinctions between physical and human geography "blur under closer evaluation" of how a good deal of physical geography ties to policy as well.

The relevance of ethics in the application of science to policy is unarguable, though often, as the authors suggest, downplayed or ignored. Without further clarification of how ethics and science intersect, however, this definitional premise drives a wedge between the more "pure" and "applied" areas of science, focusing on the latter in its clear ethical overtones, yet remaining silent on the former. This approach creates a clear escape hatch for scientists who wish to avoid ethics: as long as their substantive work is more on the "pure" side, then there is no connection to worry about. And, indeed, though a good deal of environmental science has policy implications, most scientists see their core professional duties as more epistemic (building knowledge) than normative (advising policy); hence many probably view the applied side of their work as secondary from a professional standpoint.

I suggest, therefore, that we reconsider the relationship between science and ethics, focusing on three key moments in the process of science. Arranged in logical order, these include (a) its premises or foundational principles, (b) core professional practices built on these premises, such as research and publication, and (c) the social (e.g., policy) implications of these professional

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practices. Of the three, professional practices are widely acknowledged to have important ethical dimensions; consider, for instance, imperatives for truth telling in claims about data reliability, or avoiding plagiarism of ideas or written work. This dimension not only constitutes the overriding focus of the National Academy of Sciences (NAS) booklet *On Being A Scientist: Responsible Conduct in Research* (NAS Committee on Science 1995, written primarily as a manual on ethics for graduate students in science), but also is explored in a number of recent books (e.g., Erwin et al. 1994; Shrader-Frechette 1994), and has been emphasized to date by geographers writing on ethics (e.g., Mitchell and Draper 1982).

Harman et al. move beyond this commonly admitted connection between professional scientific practice and ethics in emphasizing its social and policy implications, but left relatively untouched is the much broader, more abstract realm of premises or assumptions (what Longino [1990] calls constitutive values) that underlie, and are in many ways reproduced by, science. These premises are many and complex, and I cannot do justice to them here, but a few examples may provide some of their flavor. One such premise is that of skepticism, the refusal to take truth-claims on faith. "Prove it to me" (or at least, in Popperian terms, "Let me try to disprove it") is a key operative principle of science, indeed the basis upon which science and religion are commonly (if not correctly) distinguished. As the authors demonstrate (see below), valuing skepticism leads to very concrete implications for how scientists generally behave in cases of statistical uncertainty. A premise of a different sort, one championed especially in positivist approaches, is that scientific knowledge is built on empirically testable hypotheses, hence assertions related to nonempirical realms of reality (such as critical realists' focus on social structure—see Bhaskar 1975; Sayer 1992) are meaningless to positivists, as are relatively nontestable assertions such as concern senses of place (e.g., Duncan and Ley 1993). Still other basic premises relate to a justification of science; these have arisen quite strongly in recent defenses of science against its supposed detractors and impostors, such as the notoriously vindictive book *Higher Superstition: The Academic Left and Its Quarrels with Science* (Gross and Levitt 1994; cf. Ross 1996) and its multiauthored sequel, *The Flight from Science and Reason* (Gross et al. 1996). The bottom line is that, though scientists have long been uneasy about values intruding into their practice for a number of reasons (Proctor 1991)—and, of course, value-freedom is itself a value (Ley 1994)—values permeate or derive from the premises that undergird and shape science.

The connections between science and ethics thus include, yet go far beyond, the professional practices of scientists, and even the social implications of scientific research. Depending on how far one is willing to go down this path, the notion of doing "ethical science" (i.e., ethically informed science) may vary considerably. As limited to professional practices, an ethical scientist simply does her/his research, publication, and so forth in an ethical manner. If expanded to include social and policy implications, as emphasized by Harman et al., an ethical scientist would carefully consider, and publicly seek to positively influence, the social implications of one's work. If further expanded to consider the premises that undergird science, the notion of doing "ethical science" gets more complex. Minimally, an ethical scientist at this level would adopt a critical perspective throughout one's work, being on guard for, and carefully reexamining, the full range of values that support and are reproduced by it. If taken to the extreme, one could argue that ethical science is oxymoronic—that the ethical thing to do is get out of science! This range of ethical demands placed on scientists is clearly broad, and though virtually all scientists would probably agree with its point of departure, they would also equally oppose its extreme endpoint—otherwise, they would not be scientists. I would situate my own position somewhere between that of the authors and the extreme view: though I do believe that Harman et al. could have gone further in their exploration of the ethical dimensions of environmental science, it would be scary to imagine living in our technoworld without the benefit of good science.

Uncertainties in Science Lead to Ethically Difficult Policy Decisions

Given the authors' definitional premise that ethics enters into science via its applications to policy, the second step in the authors' argument is to point out that uncertainties in science lead to ethically difficult policy decisions. They begin the paper by noting, "many environmental problems present us with very difficult choices today. . . . much of this difficulty stems from the combination of scientific, economic, and ethical uncertainty entangled in the details" (p. 277). Following their introductory section, they discuss complexities in behavior of the global climate system and related projections of the likely rate and magnitude of anthropogenically stressed climate change, as a prime example of uncertainty in applying environmental science to policy. Should scientists advocate waiting until more is known about climate-system behavior? Should they urge policymakers to take corrective actions immediately, given the future possibility—if not probability—of rapid short-term climate change? The ethical dilemma is clear, as scientists often play a crucial role in advising policymakers in these contexts.

This emphasis on uncertainty is important; indeed, as one recent commentator observes, there can be a "misplaced certainty" in policy-relevant environmental science that is perhaps more problematic than a frank initial admission of uncertainties (Caldwell 1996). The authors' invocation of Lorenz does not so much reduce uncertainty about climate as suggest that we cannot really tell whether and under what conditions climate may behave intransitively (i.e., chaotically), transitively (i.e., nonchaotically, reaching similar equilibrium values without respect to initial conditions), or semitransitively (an unpredictable combination of the two). One review of scientific research on climate change, prepared by the chair of the committee that wrote the landmark 1983 report, *Changing Climate* (National Research Council 1983), suggests that much progress in understanding climate change over the last decade has come through new empirical evidence such as Greenland ice-core analysis (e.g., Johnsen et al. 1992), yet this evidence has raised as many questions as have been answered (Nierenberg 1995). The author notes, for instance, that evidence from Greenland and elsewhere demonstrates that our current (i.e., Holocene) climate is much more stable than it has generally been during the Quaternary, and suggests that it is hard to tell whether we ought to worry more about risks caused by anthropogenic stresses on the climate system or those arising due to natural variance. Indeed, the author's review casts at least a shade of doubt on more confident reports of levels of certainty surrounding current scientific knowledge about climate change (e.g., Schneider 1993; Houghton 1996).

One possible interpretation of trends in epistemic certainty about climate change, then, is that the more we know, the more we realize we do not know. Things are probably more complex than were admitted in the well-known Intergovernmental Panel on Climate Change (IPCC) science report, *Climate Change*, initially released at the turn of the decade (Houghton et al. 1990), which most reviewers lauded as, for example, "the most authoritative assessment to date" (Bates 1991:279), one that "provides a solid scientific foundation for future negotiations on a global response to climate change" (Bongaarts 1992:191). Harman et al. are correct in suggesting that, at some level, uncertainty is here to stay with scientific knowledge regarding global climate change.

I am a bit concerned, however, with this emphasis on uncertainty as key to ethical complexity. One problem is analogous to the "pure/applied" distinction implicit in their limited definition of ethics raised above: what of the case of policy addressing environmental issues of relatively more certain epistemic status? An example is ozone depletion. I would agree with early commentators (e.g., Maddox 1990; Morrisette 1991) that the success of the Montreal Protocol controlling chlorofluorocarbon (CFC) production may never be matched in global warming policy due in large part to the complexity of the climate system. Yet does this suggest that ethics does not enter into these more epistemically clear cases—that ethics enters into policy applications of science only as a function of uncertainty? I suspect we are ignoring the famous "is-ought" distinction much touted by moral philosophers ranging from Hume to G. E. Moore and beyond, that one cannot derive an "ought" (e.g., a climate-change policy directive) solely from an "is" (scientific knowledge about climate change). This distinction suggests to me that science is a necessary, yet insufficient condition for policy, that even when scientific knowledge is certain, policy will not necessarily be unambiguous and uncontested.

The problem is not just philosophical; it also comes down to the political question of what role scientific knowledge should play in environmental policy. As the IPCC reviews quoted above suggest, much of the rhetoric surrounding climate-change policy prioritizes "sound science," which is problematic not so much in what it emphasizes as what it neglects. As Brian Wynne has commented:

> It is ironic to note that as the geopolitical reach of environmental science has become more and more expansive, its intellectual temper has become more reductionist. . . . Whereas [the 1987 Brundtland Commission] articulated a basic political, moral and social framework from which to define policies for environmentally sustainable global development . . . IPCC began from a scientific origin—defining and managing a sustainable climate—from which should be derived the necessary social, economic, and other policies for survival (1994:171).

We should be careful, therefore, when we emphasize the ethical importance of scientific uncertainty not to overemphasize the role of scientific knowledge in environmental policy formation. Scientific uncertainty regarding future climate conditions need not necessarily lead to policy paralysis; greater scientific certainty related to climate change is not the only necessary factor in sound environmental-policy development. Indeed, the future will always be to some extent unknown, and no climate model can undo that inevitability. One recent review of climate-change science concluded:

> Global [climate] models are a promising new type of scientific tool, but they are not a panacea. They need to be assessed alongside other ways of studying the changing environment. Regional problems of environmental degradation, population and poverty are not recognised or analysed best in a global setting, or by modeling, and are tractable without full understanding. The great global experiment is a beguiling and thought-provoking metaphor; the need for models with which to understand it is real. But it should not be the over-riding focus of attention. Understanding the world is one thing; living in it is another ("A Problem as Big as a Planet" 1995:85).

In Uncertain Cases, It Is Best to Adopt a Position of Ethical Versus Scientific Rationality

The first two points given above are preliminary to the major thesis Harman et al. advance: that, in uncertain cases such as climate change, it is best to adopt a position of "ethical rationality" (borrowing from Shrader-Frechette and McCoy [1993]) based primarily on moral theory, versus the standard "scientific rationality." One operational difference between the two is that ethical rationality would seek to minimize type II statistical error (accepting a null hypothesis—e.g., one that posits no climate change risk—that is actually false), whereas scientific rationality seeks to minimize type I statistical error (rejecting a null hypothesis that is actually true). In a nutshell, these differing emphases on statistical error amount to an "innocent until proven guilty" position of scientific rationality as regards potential environmental damage and/or social risk, whereas ethical rationality adopts more of a "guilty until proven innocent" position.

The main problem I see with this terminology is that it implies that there is no ethical component of scientific rationality. It would seem better to consider the various ethical approaches one could follow in scientific practice than to frame these approaches as a necessary choice between scientific and ethical rationality. Indeed, the authors of the term "ethical rationality" argued not that it should replace scientific rationality, but that both ought to be ingredients of "ecological rationality." Their justification resonates with the first point of Harman et al.'s argument noted above: "We argue . . . that ecological rationality, because of the predominantly practical and applied nature of the science, must be both ethical and scientific" (Shrader-Frechette and McCoy 1993:151). Shrader-Frechette and McCoy argue for the need to err on the side of reducing public risk (i.e., minimizing type II statistical error) in the application of ecology to policy. They do, however, acknowledge that there is a variety of opinion among ecologists, some of whom are concerned that the goal of minimizing type II errors, and the inevitable effects of "crying wolf" in cases that turn out to be otherwise, may injure ecology's reputation, weakening its potential contribution to conservation in the long run (e.g., Simberloff 1987).

The critical question when one is presented with a choice between scientific rationality and a "minimize type I error" priority, and ethical rationality and a "minimize type II error" priority, is how we should go about deciding when to choose one and when to choose the other. This is where I have the greatest difficulty with Shrader-Frechette's argument. In another publication, Shrader-Frechette argues, "In a situation of statistical uncertainty in which we cannot adequately assess effects, we should place the burden of proof on the persons who create these potentially adverse effects—that is, on polluters and developers" (1996:20). But how much statistical uncertainty ought there to be before one moves to the "minimize type-II error" domain? Neither Shrader-Frechette nor Harman et al. provide a handy rule of thumb, much less a decision algorithm. There is always some level of uncertainty in any scientific conclusion; there will always therefore be some basis for an argument that we should place the burden of proof on polluters and developers. Yet they would howl at abuse of uncertainty in this manner as grossly hypocritical, and they may be right. Uncertainty is always vanishingly small when it surrounds a conclusion we would tend to support (e.g., evidence of clear environmental harm), and alarmingly big when it surrounds a conclusion we find less palatable. Here again we may have gotten ourselves into the predicament of vaulting scientific knowledge to such a high position that epistemic certainty becomes the final judge in cases of disputed environmental policy.

There is another problem I have with the argument Harman, Harrington, and Cerveny have adopted. The authors propose that their paper will present a "fresh answer" to the problem of uncertainty. Yet their thesis, itself drawn from an already-published source, does not to me sound a great deal different than the good old precautionary principle, which argues in brief that policy should not wait for scientific certainty in cases of serious potential risk. The precautionary principle has been endorsed in many climate-change discussions, as well as other global change issues such as biodiversity conservation (Myers 1993). Yet critics argue that the precautionary principle may be a good idea in general, but it lacks sufficient clarity to inform actual decisions (Bodansky 1991; Malnes 1995:xi–xiv). Or, taken a slightly different way, the type I versus type II statistical-error issue is analogous to the long-standing legal discussion over who ought to assume the burden of proof in disputed cases, which is not so much a scientific choice as a value-based decision (Lemons 1996:228). These discussions over the precautionary principle and the burden-of-proof issue suggest that the problem of uncertainty has been addressed in many ways; Harman, Harrington, and Cerveny would be better off if they tied into these existing discussions explicitly. For instance, much debate around climate-change policy involves the metaphor of "buying insurance" for the future, which some commentators (e.g., Schneider 1993) wholeheartedly endorse, and others (e.g., Rubin and Landy 1993) scorn. Would ethical rationality always support the former position? Perhaps, but it is important to note that uncertainty is just that: to some extent, we can never know whether a more future-conservative approach will turn out to be the best choice until the future arrives. And then it will be the task of future historians to inform us of the wisdom of our present decisions.

Ethical Rationality Is Particularly Compelling for Its Symbolic Utility

The authors recognize that ethical rationality is a major departure from how most scientists understand their work. They therefore buttress their thesis with an additional argument: that it is particularly compelling to adopt a perspective of ethical rationality when understood for its "symbolic," versus merely instrumental, utility (the term is derived from Nozick [1993]). They argue:

> We defend intervention [by scientists] in some environmental crises through an entirely different route than the usual instrumental/prudential (such intervention may save lives, for example), and invoke the symbolic value of setting a good example. . . . Publicly deferring to concerns about human health and safety in the face of uncertain but potentially grave environmental threats carries the potential to contribute to the ethical fabric of society (p. 284).

This is a very interesting twist to their argument. Up until now they have implicitly argued, from a fairly standard consequentialist perspective, that we ought to adopt ethical rationality due to the potentially grave future impacts of not doing so. Now they are saying that, apart from the practical consequences of adopting ethical rationality, there is a very important symbolic impact as well. Harman et al. are saying nothing less than that the role of scientists in society ought to be recast as symbolic as well as material actors, as people whose knowledge provides meaning as well as instrumental utility. Their claim, to be precise, is that scientific knowledge already conveys symbolic import; the decision is up to scientists to choose which kind of import they wish to convey.

The authors' argument is not entirely novel. For instance, in summarizing Nozick's thesis, they state, "In addition to their value in maximizing individual utility, actions have independent value as symbols" (p. 283), virtually a founding principle of contemporary cultural theory. Even if it is not exactly news that science has cultural connotations (witness the journal *Science as Culture*), nonetheless this expanded sense of the role of science in society is, to me, a very important consideration that scientists should include in their decisions as to policy recommendations emanating from their work.

This understanding of science is particularly compelling in that it moves away from the reductionist, instrumental worldview criticized in the passage from Wynne quoted above. As I argued earlier, ethics enters into science most fundamentally in terms of its basic premises. Scientists are, in part, cultural actors whose work builds on culturally based assumptions as to what good science is; their work thus carries cultural/moral weight as well as practical weight. The consequences for rethinking the relationship between environmental science and policy are profound. Indeed, Wynne similarly concludes his examination of the relationship between scientific knowledge, uncertainty, and global environmental change by calling for an expanded cultural sense of science, without minimizing the special voice scientists have to add to policy discussions:

> This focus on the implicit cultural framing of scientific knowledge does not mean that such knowledge would be debunked or denied authority. Rather the conditions for validity would be critically explored, and the tacit social and moral commitments of knowledge exposed for debate and deliberation. . . . In this kind of process scientific uncertainties would not be an embarrassment, but—seen more properly as authentic human indeterminacies—the meat and drink of a more mature social learning process (1994:188).

The most important contribution Harman et al. thus make, in my mind, is to demonstrate that science, and its application to environmental policy, have important cultural and moral dimensions through and through. To admit this is not to diminish the epistemic voice of scientists nor to add to the burden of uncertainty; it is to emphasize that theirs is not just the domain of "facts," but of values as well, and as such, ethics is not so much something that should be added on to science as discovered within it. This, to me, constitutes a suitably broad framework for thinking about science and ethics.

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Correspondence: Department of Geography, University of California, Santa Barbara, CA 93106-4060, email jproctor@geog.ucsb.edu.