# How do we know we have global environmental problems? Undifferentiated science-politics and its potential reconstruction[1]

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## INTRODUCTION

More than a generation ago scientists detected radioactive strontium from atomic tests in reindeer meat and linked DDT to the non-viability of bird eggs. Ever since then, if not before, science has had a central role in shaping what count as environmental problems. During the 1980s environmental scientists and environmentalists called attention, in particular, to analyses of carbon dioxide concentrations in polar ice, measurements of upper atmospheric ozone depletion, remote sensing assessments of tropical deforestation, and, most notably, projections of future temperature and precipitation changes drawn from computation-intensive atmospheric circulation models. This coalition of environmental activism and "planetary science" stimulated a rapid rise in awareness and discussion of global environmental problems.[2] A wave of natural and social scientific studies have followed on the effects of global environmental change on vegetation and wildlife, agriculture, world trade and national economic viability, and international security. This science centered environmentalism thus provides the first answer to the title question: We know we have global environmental problems because, in short, science documents the existing situation and ever tightens its predictions (or fills in its scenarios) of future changes. Accordingly, science supplies knowledge needed to stimulate and guide social-political action.

Science-centered environmentalism is, however, vulnerable to challenges and "deconstruction." Environmental problems, almost by definition, involve multiple, interacting causes. This allows one group of scientists to question the definitions and procedures of others, promote alternative explanations, cast doubt on the reliability of predictions, and emphasize the levels of uncertainty. In turn, people trying to make or influence policy often find the lack of scientific closure and the uncertainty potent weapons.[3] After an initial honeymoon period, global climate modeling, estimates of biodiversity loss, and other studies of the implications of environmental change have become subject since the early 1990s to scientific and consequent political dispute.[4]

The purpose of this essay is not to add my own assessment of the reliability of global environmental science, the severity of the problems, or the appropriate framework for responding to the uncertainty of this science. Instead, building on the social studies of science, I propose a different interpretation of the special relationship between environmental science and politics, and then reflect on how such an interpretation could contribute to the potential reconstruction of environmental science-politics.[5]

The social studies of science has, over the last twenty years, illuminated the social influences that shape what counts as scientific knowledge.[6] Truth or falsity of the science is rarely sufficient to account for its acceptance, either within science or, as will be an equally important concern here, within the political realm. Instead, to support their theories scientists employ heterogeneous resources--equipment, experimental protocols, data, conventions of statistical analysis, citations, colleagues, the reputation of laboratories, metaphors, rhetorical devices, funding, publicity, and so on. Moreover, in this process of heterogeneous construction,[7] establishing theory becomes just one aspect of scientific work. Such a social studies of science perspective leads me to make three propositions, each confounding the answer given above to how we know we have global environmental problems:

(1) In science certain courses of action are facilitated over others, not just in the use or misuse of scientific results, but in how science is formulated in the first place--the problems chosen, categories used, relationships investigated, and confirming evidence required.[8] Politics--in the broad sense of courses of social action pursued or promoted--is not merely stimulated by scientific findings; politics is woven into the very fabric of science. In the case of environmental problems, we know they are global in part because scientists and political actors jointly construct them in global terms.[9]

(2) In global environmental discourse, two allied views of politics--the moral and the technocratic--have been privileged. Both views of social action emphasize people's common interests in remedial environmental efforts, while at the same time steering attention away from the difficult politics that result from differentiated social groups and nations having different interests in causing and alleviating environmental problems.[10] We know we have global environmental problems, in part because the "we" referred to acts as if it were unitary and not a component of some highly differentiated population.[11]

(3) Global environmentalism, whether as a framework for science or for political mobilization, is particularly vulnerable to deconstruction. Inattention to the national and localized political and economic dynamics of socio-environmental change will ensure that scientists, both natural and social, and the environmentalists who invoke their findings will be

continually surprised by unpredicted outcomes, unintended conflicts and unlikely coalitions. When environmental scientists (or some other group) attempt to focus on global environmental problems, to stand above the formation of such coalitions and conduct of such conflicts and to discount their responsibility for the undesired outcomes of their policy proposals, they are more likely to reinforce the constraints on, rather than enhancing the possibilities of, engaged participants shaping interrelated, yet not common nor global, futures. In short, they know there are global environmental problems because they do not know most people do not have problems of a global nature.

To develop these propositions, I focus on one kind of environmental science, computer modeling of global environmental, resource and climatic systems. I begin with a reconstruction and overview of the interwoven science and politics of The Limits to Growth (LTG) study of the 1970s.12 This case, which should be familiar to most readers, is convenient because it illustrates the interweaving of science and politics clearly and allows me to introduce, in a somewhat exaggerated form, the moral and technocratic tendencies. From this beginning I make extensions to current studies of climate change and its human/social impacts, contrasting modeling work to analyses of environmental dynamics as socio-environmental. This contrast is intended to speak also to other aspects of globalized, and more generally, undifferentiated environmental discourse. Although I do not spell out the details of such extensions, it is in this spirit that I discuss examples indicating the vulnerability to deconstruction of such discourse. I conclude the essay by reflecting on my critique as a contribution to cultural politics.

## GLOBAL MODELING, 1970S STYLE

The Limits to Growth study was initiated by the Club of Rome, an elite group of Western businessmen, government leaders, and scientists, and conducted by system dynamics (SD) computer modelers at MIT. The predictions from World 3, a SD model of the world's population, industry, and resources, were for population and economic collapse unless universal (coordinated, global-level) no-growth or steady-state policies were immediately established.

A major debate developed over the LTG study.13 Environmentalists applauded the attention the LTG drew to the finiteness of the earth's resources, and many of them took up the steady-state economy as their major economic-environmental goal. Economists, however, strongly criticized the LTG's pessimism. Scarcity, signalled in price changes, they contended, would stimulate technological advance and thus push back the limits of available resources. From a different vantage point, many leftists and social-justice-oriented progressives saw the LTG worldview as being insensitive to the needs of the poor and innocent of the realities of the penetration of multinational capital across the world.14 Others, particularly those skilled in the methodology of systems analysis, pointed to weaknesses in the model's empirical basis, structure, and validation.15

Some of the technical objections were addressed in a subsequent Club of Rome-sponsored modeling effort, Mankind at the Turning Point.16 This study disaggregated the world into ten regions and increased the detail of the model 1,000-fold. Collapse was still predicted, but its timing and character would differ from region to region. By the time of this second report, however, the debate had cooled, a state of affairs that has been given divergent interpretations: the result of the unproductive polarization of pro-growth and anti-growth positions17 or of incommensurable cultures/world views,18 a decline in public environmental concern,19 a shift toward greater specificity of discussion of environmental issues,20 a quick rejection because the LTG's proposal for a steady state economy threatened interests that were tied to economic growth and precipitated a "corporate veto."21

Despite the initial firestorm of criticism, the system dynamicists never conceded that their modeling was in error.22 (Similarly for many environmentalists the earth's finiteness became increasingly self evident.) After the heated reaction to the LTG, the system dynamics group at M.I.T. adopted a lower profile, but continued to use SD in a wide variety of modeling and educational projects,23 most notably the explanation of broad modes of economic behavior--business cycles, inflation, and long waves (Kondratiev cycles). We can understand their continued belief in the validity of SD if we take another look at the construction of the LTG model of the world. While the system dynamicists were "doing science" they were also constructing interventions in their world. Both the representation of how the world works and the interventions proposed for improving it made each other seem more real/izable. Moreover, we will see that the character of these representation-interventions was simultaneously moral and technocratic.

System dynamics, pioneered by Jay Forrester at MIT in the 1950s, was used first to model individual firms, then to explain urban decay and, by the end of the 1960s, to uncover the dynamics of the whole world. The origin of SD in the modeling of firms has significance for the subsequent applications. Managers with whom Forrester had talked--recall that the LTG model and its predecessor models were developed at the Sloan School of Management at MIT--had observed repeated cycles of running up inventories, then laying off workers, and then once again accumulating a backlog of orders, adding labor, and increasing production, only to find

themselves overcompensating and running up inventories again. Instead of attributing this cycle to the business cycle, Forrester concluded that the causes were endogenous to the firm. Each decision of management was rational, but, when they were coupled together and incorporated the unavoidable time delays between setting a goal and fulfilling it, the overshoot-undershoot cycle resulted. Given that the undesirable behavior was caused by the interactions among different sectors of the firm, the firm's overall management could overcome the cycling only if there were a superintending manager in a position to override the decisions of managers in the separate sectors of the firm. For example, the sector managers could be instructed to keep larger inventories and respond more slowly to changes in the backlog of orders than they would otherwise prefer to do.

SD for firms set the pattern for the construction and validation of the subsequent urban, global and other SD models. In general, the SD modeler does not rely primarily on series of recorded data, but instead invokes common-sense knowledge of how individuals work when they face a task with the usual information available. Computer games are often employed to convince players that they would not behave any differently from the people or other entities in the models.24 Building on this common-sense validation of the separate decisions or rules in the model, SD then demonstrates that these locally-rational decisions, when worked through time-delayed feedbacks in the system model, generate unanticipated, and undesired or pathological, outcomes.25

Using decision rules that look plausible to an individual, not only the LTG, but almost all SD models exhibit undesirable cycles or positive-feedback-based exponential growth and collapse. These cycles are difficult to overcome by adjusting the parameter values, even if set as high as economic or technological optimists would like. SD modelers infer that this behavior is intrinsic to the structure of the system modeled, to the arrangement of feedbacks, not their detailed specifications. The actions of some individuals within the system cannot override the structure, even if those individuals understand the system as a whole. Instead a change in the structure is needed. In the case of the LTG "world system," however, unlike in firms, there is no superintending manager to enforce the required interrelated changes in or at this world level. Catastrophe is thus inevitable unless "everyone"--all people, all decision-makers, all nations--can be convinced to act in concert to change the basic structure of population and production growth. In this fashion SD models support either a moral response--everyone must change to avert catastrophe--or a technocratic response--only a superintending agency able to analyze the system as a whole can direct the changes needed. There is no paradox in my linking moral responses with technocratic rones; they are alike in attempting to bypass the political terrain in which different groups experience problems differently and act accordingly.

Does the nature of the politics indicated by some scientific results matter? Under a standard interpretation of science it is no grounds for doubting the science. Forrester has argued that in order to address global questions, such as the "feasibility" of continued growth of the world's population, capital stock, and resource usage, global models are required.26 One could, therefore, focus on the LTG's global models as science--do they provide an adequate account of the past and predictions of the future? However, following the interpretation that social actions are woven into the very formulation of science, I want to develop a stronger critique, one that addresses the LTG's science and politics simultaneously. If we consider how events would develop if population growth proved not, in Forrester's words, to be"feasible," a more politicized alternative to the LTG's analysis will become apparent.

Consider two hypothetical countries. Country A has a relatively equal land distribution; Country B has a typical 1970s Central American land distribution: 2% of the people own 60% of the land; 70% own 2%. In other respects these countries are similar: they have the same amount of arable land, the same population, the same level of capital availability and scientific capacity, and the same population growth rate, say, 3%. If we follow through the calculations of rates of population growth, food production increase, levels of poverty, and the like, we find that five generations before anyone is malnourished in country A, all of the poorest 70% in Country B already are.27 Food shortages linked to inequity in land distribution would be the likely level at which these poor people, and by implication most of the world's population, would first experience what others call "population pressure." In the LTG model global aggregation of the world's population and resources obscured the fact that crises will not emerge according to a strictly global logic, much less in any global form as such. The spatial disaggregation in Mankind at the Turning Point does not resolve this issue. Land-starved peasants share nations, regions, and villages with their creditors, landlords and employers. The socio-political responses of the peasants and, by extension, the ramifications of such local responses through national, regional, and international political and economic linkages, will be (and already have been) qualitatively different from those highlighted by the LTG.28

This simple counter example to global modeling does not tell us how to analyze the politics within localities, nations, regions, or the world, politics in which people contribute differentially to environmental problems. My point here is simply to highlight the politics of inequality excluded by the science of SD in its analysis of global limits to growth. The moral and technocratic emphasis is by no means a unique characteristic of

the LTG study. My critique of the LTG's science-politics can be extended to the current globalization of environmental discourse.29 Before doing so, let me first say a little more about the moral-technocratic alliance that such discourse generally presupposes.

In technocratic formulations, objective, scientific, and (typically) quantitative analyses are employed to identify the policies that society (or, in the case of the LTG, humanity) needs in order to restore order or ensure its sustainability or survival--policies to which individuals, citizens, and countries would then submit. In the LTG these policies are deduced from the model structure, which is held to reveal a dynamic that the ordinary citizen, politician, or businessperson would not have recognized or specified. Moral formulations, in contrast, try to avoid coercion and rely on each individual making the change needed to maintain valued social or natural qualities of life. Yet, in many senses the moral and technocratic are allied. Both invoke the severity of the crisis and threat to our social order to command our attention. The solutions appeal to common, undifferentiated interests as a corrective to scientifically-ignorant or corrupt, self-serving or naive governance. Moreover, appearances notwithstanding, special places in the proposed social transformations are reserved for their exponents--the technocrat as analyst/policy advisor; the moralist as guide, educator or leader.30

Revealingly, the LTG report combined at numerous junctures managerial language and moral recruitment (emphases mine): "Until the underlying structures of our socio-economic systems are thoroughly analyzed, they cannot be managed effectively";31 "The economic preferences of society are [to be] shifted more toward services";32 "We cannot say with certainty how much longer mankind can postpone initiating deliberate control of his growth";33 "The two missing ingredients are a realistic, long-term goal that can guide mankind... and the human will to achieve that goal."34 In short, according to the LTG team, the global society needs management to achieve control; mankind as a whole, like an individual man, needs a goal and a will to change.

## GLOBAL MODELING AND ENVIRONMENTAL SCIENCE TODAY

> We are moving into a period of chronic, global, and extremely complex syndromes of ecological and economic interdependence. These emerging syndromes threaten to constrain and even reverse progress in human development. They will be manageable--if at all--only with a commitment of resources and consistency of purpose that transcends normal cycles and boundaries of scientific research and political action (Clark and Holling35).

Global climate models--or, more precisely, general circulation models (GCMs) of the atmosphere--have, especially since the hot dry summer of 1988 in the United States, provided a new scientific basis for projections of imminent global environmental crisis. The actual modeling technique bears no similarity to system dynamics, but, as the diagnosis of environmental scientists Clark and Holling illustrates, the language of the LTG lives on. More importantly for my argument, the science of global environmental change continues to reflect, and in turn reinforce, a tendency illustrated in extreme form by the LTG, namely, that towards moral-technocratic formulations of global environmental problems.36 Two observations about contemporary research will serve to illustrate this point and to remind us of alternative formulations that, as in the LTG case, tend to be obscured by undifferentiated and globalized discourse.

First, consider the high premium that is placed on reducing uncertainty about physical processes in GCMs. To date, GCMs concur in predicting an average global warming, but the projected magnitude of the increase varies among the models. Moreover, at the level of regional predictions, larger uncertainties and inconsistencies among the GCMs are evident and need to be reduced. Indirect climatic feedbacks, creating new uncertainty, have been added to the research agenda.37

Tightening long-term projections or highlighting their severity is not, however, the only means by which policy responses to climate change could be catalyzed. As Glantz has observed, extreme climate-related events, such as droughts, storms, and floods, already elicit socio-political responses that can be relatively easily studied.38 Recent and historical cases of climatic-related "natural hazards" shed light on the impact of different emergency plans, investment in infrastructure and its maintenance, and reconstruction schemes. Policymakers, from the local level up, can learn "by analogy" from experience and prepare for future crises. Glantz' approach is valuable whether or not these crises increase in frequency (or are already increasing in frequency) as a result of global climate change. Instead of emphasizing the investigation of physical processes and waiting for uncertainty to be eliminated before action is taken from the top, this approach calls for systematic analysis of effective versus vulnerable institutional arrangements. Such discussion of specific, local responses to climate change has been occurring. Nevertheless, the vast majority of funds for global change research is currently being devoted to improving GCMs and allied climatic studies.

This dominance of physical climate research over institutional analysis points to a related issue, the hierarchy of physical over the life and social sciences. This hierarchy constitutes an environmental determinism: the physics and chemistry of climate change set the parameters for environmental and biological change; societies must then best adjust to the change in their environment. The hierarchy is evident in both the temporal

sequence and conceptual relationships of GCMs and other areas of environmental change research. GCM research began over two decades ago. Building on the prominence given to GCMs in the late 1980s, a second tier of research arose which generates scenarios of agricultural, vegetation, and wildlife changes. This research models the interaction of projected temperature and precipitation changes with regional soils, watersheds, timing of snowmelts, wildfire susceptibility, coastal upwelling, and so on.39 Following shortly after, a third tier of research was added which has been devoted to assessing the economic or security consequences of these biotic changes or of the more direct consequences of climate change, such as a rise in sea-level.40 Modes of geopolitical response to the global climate change threat then began to be discussed by political scientists.41 Finally, social scientists and humanists began investigating popular understanding of global climate change,42 furnishing the bottom rung on the ladder from the hard and physical down to the soft and personal.

Of course, global change researchers know that climate change is a social problem, since it is through industrial production, transport and electrical generation systems, and through deforestation that societies generate greenhouse gases. Nonetheless, it is physical change--the mechanical and inexorable greenhouse effect--that is generally invoked to promote policy responses and social change, not the political and economic injustices of the present system.43 Moreover, the research undertaken often belies the stated awareness of the social dimension of environmental problems. Natural scientists Harte and his collaborators,44 for example, stated that "designing conservation policies without considering the role of existing institutions or societal responses to climatic change will likely lead to failure." Yet the same authors are open about their preference for models based on well understood physical and biological mechanisms because these models are the ones that "work best for predicting change." Not only do natural scientists favor their science over social analysis, but, in general, they have benefitted from the prestige and funding that have flowed down from the high-status climate simulations. Despite Harte et al.'s caveat about the need to examine social responses, the politics implicit in their promotion of physical and biological models is technocratic. The prestige and funding given to their science bolsters scientists' confidence that political affairs can be influenced by technical knowledge without (or prior to) analysis of existing social arrangements.45

Again, the physical-natural-social scientific hierarchy is not a necessary one for the construction of environmental problems and research. Over the last fifteen years, fields such as geography, anthropology, and international development studies have become increasingly sophisticated at analyzing environmental change as socio-environmental change. Processes such as deforestation, drought, land degradation, and migration of "environmental refugees" are shown to be, in their causes and their effects, social and environmental at one and the same time.46

The social dynamics are most apparent on the economic level: resource distribution determines whether and for whom a bad year becomes a drought. Inequities in land tenure and rural political power ensure that the rural poor will exploit land vulnerable to erosion, migrate to carve new plots from the forest, or add to the margins of burgeoning cities well before the resources of their original locale are exhausted. Industrialization and other opportunities for off-farm income can result in insufficient labor remaining to keep up traditional conservation practices. Contrary to the conventional wisdom about the effect of population growth, environmental degradation can often be linked to labor shortage.47

Social dynamics are variable in interesting ways. In some areas traditional practices have resisted disruption by linkage into global markets and instead contributed to environmental sustainability, while in other areas social organization has been rapidly restructured with significant environmental consequences.48 To account for such differences one has to consider local particularity and historical contingency. Moreover, the local is not merely local, but "trans-locally" embedded, that is, influenced by institutions, processes, and activities well beyond the immediate locale. The local, in turn, can have distant ramifications, e.g., the neglect of old terraces can lead to accelerated erosion and thus to siltation of reservoirs downstream.49

In a rich sense of the word social, environmental problems invite social diagnosis and response. This will continue to be the case as climate change deepens and extends already existing crises. Many global environmental researchers consider themselves to have a worldview quite distinct from modelers,50 yet, as long as this research remains dominated by physical and natural sciences and emphasizes social change as a response to environmental change, they underwrite, just as the LTG did, moral and technocratic responses. If they are unable to provide insight into the differentiated politics and economics of socio-environmental change, what other responses logically are they leaving? In fact, because it omits any analysis of differentiated interests, undifferentiated discourse offers logically and conceptually no other standpoints for an environmentalist to take.51

## VULNERABILITIES OF UNDIFFERENTIATED ENVIRONMENTAL DISCOURSE

Global formulations of environmental issues have not gone unopposed. As I mentioned in the introduction, global climate modeling and studies of its implications have become subject to scientific dispute; policy

makers, most notably in the U.S.A., have used cracks in the scientific consensus and the unavoidable uncertainty about projections of future climate change to resist making new investments, regulations, and international treaties at this stage. In a complementary vein, influential economists have argued that the effects of climate change will be sufficiently gradual that adaptation mediated through the market and human migration is more cost effective than rapid imposition of emission controls and other checks on economic growth.52 From another angle, various Third World scholars and environmentalists have criticized Western analyses of emissions of gases contributing to the greenhouse effect. It is claimed that these exaggerate Third World contributions and fail to acknowledge the difference between the "survival emissions" of the Third World and the "luxury emissions" of the First World.53

The conceptual critique of the previous sections, however, leads me to identify different vulnerabilities of global environmental discourse, vulnerabilities that stem from different nations and differentiated social groups within nations having different interests in causing and alleviating environmental problems.54 I should first make clear that my critique of global environmental discourse does not rely on the reader identifying wholeheartedly with global modeling, either in the form of the LTG study in the 1970s, or with GCMS and current policy discussions motivated by them.55 The LTG global models were not very detailed--even the SD modelers admitted this--and the possible policy responses could, therefore, be given only in outline. Obviously the fashioning of the contributions of individual countries to a sustainable global system would involve considerable attention to their specific economic, political and social conditions. Such specificity and messiness has been evident during the 1990s global environmental negotiations around the Río and Cairo conferences and in other venues, such as the World Bank's Global Evironmental Facility.56

My argument, then, is not that there are many governments who actually make policy as if moral-technocratic responses based on global modeling will be sufficient or successful.57 Rather--and this makes the critique more general than modeling or global discourse--I want to draw attention to the surprises, from unpredicted outcomes, unintended conflicts, and unlikely coalitions, that tend to follow attempts, at whatever level, to discount the differentiated social dynamics and difficult politics of socio-environmental change. Let me then illustrate these possibilities for surprise not with examples concerning global issues, but with four specific cases drawn from recent locally-centered socio-environmental studies:

1) Ribot describes deforestation in Senegal, where there has long been a concern over depletion of forests exploited for woodfuel (including charcoal) and at the same time an awareness of problems of enforcing forest conservation policies.58 The current policies may be characterized as a system of forest reserves to protect the shrinking forests, the establishment of extractive regions designated by official forestry agents, quotas and a limited season for charcoal production, and the organization and control of the production through permits, licences and, like most other rural sectors of the economy, a system of co-operatives. These policies follow a model, commonly advocated by international conservation organizations, of a neutral State acting in the best interests of the nation ensuring the conservation of its natural resources.

The outcome has not been a decrease in the rate of deforestation. The quotas imposed are well below the urban demand, generating pressure for circumvening the official policies. This has engendered a myriad of means for producing outside the designated seasons and regions and for centralizing control of production in the hands of a few increasingly powerful individuals. To maintain this system powerful individuals have a strong incentive to secure control over the institutions and operation of the different state bodies, which they do. The pre-colonial system of patrons and clients underwritten by political-religious authorities, which had been undermined under French colonialism, has been revived and strengthened under this forest policy regime. The newer, more disciplined organization of production and distribution has also intensified the deforestation, and the regulation by forestry agents of the official and unofficial systems has reduced the ability of local villagers to exclude production from their vicinity. In short, the policy of forest preservation, formulated without attention to the inequalities of social relations of Senegal, has produced an outcome clearly not intended by those who urge the protection of the world's remaining tropical forests.

2) A long series of development schemes in the Gambia river basin have failed to achieve their goals of intensifying rice production and reducing food imports. A scheme begun in the 1980s, based on share cropping with specified planting, irrigation and weeding requirements, has had more success, but, Carney and Watts show, it has also produced new struggles among men and women within peasant households.59 Women have traditionally created and farmed rice in their own individual plots, separate from their work on household land. Men have, however, claimed household status for the plots established during rice projects, with the produce under their control. The current project, moreover, has increased women's labor, leading to women claiming individual status for their paddy, or, at least, remuneration for their work. In response, in some ethnic groups women have secured ownership, in others a share of the crop, in others nothing. Those receiving nothing have engaged in other gardening or trade activities or formed for-hire labor groups under the umbrella of their women's associations, which have become more active politically. The conflicts within the peasant household, which is clearly not a unitary entity,

are not just based on force and formal property rights, but involve struggles over meaning, over representations of what men and women expect of each other. Moreover, the outcome of these struggles varies from one ethnic group to another. And the new labor coalitions were certainly not anticipated by the development planners. In this and other ways domestic struggles extend and connect with other politics, that is, "dissent is manufactured."

3) Schroeder (in this volume) describes an analogous situation in the context of development projects promoting tree planting as a form of ecological stabilization in the Gambia.60 After initial attempts to establish village woodlots failed, the emphasis shifted to fruit trees. These would provide quicker returns and distribution of the benefits could be more clearly defined. At the same time, however, the survival of these trees depended on their being planted within the borders of market gardens. It was assumed that the gardeners, who are women, would care for the young trees. Women, according to the prevailing development rhetoric, are more ecologically responsible. The market gardens, ironically, were the outcome of earlier development projects aimed to help women. The cash from these gardens compensated for declines of household income from the peanut crops managed by the men, but the women's superior earning power also led to conflict between husbands and wives. Further conflict has now ensued as men claim the fruit of the women's labor in the new orchards and the trees begin to shade out the gardens. Again, the conflicts within the peasant household are simultaneously struggles over meaning and struggles over land, labor, and production.

4) In Nancy Peluso's account of the coercive dimension of internationally endorsed conservation schemes, such as wildlife reserves in Kenya, she analyzes how environmentalists have been drawn into coalitions with the State and militarized institutions.61 Many conservation schemes require or assume state control over natural resources, whereas this is often resisted by local peoples who have been gaining some of their livelihood from the resources in question--elephant tusks, game, products from the forests, and so on. Indeed, some of the very practices condemned by conservationists arise as a consequence of previous State interventions. The Maasai of Kenya, for example, began killing rhinoceroses and elephants (and later allegedly collaborating with ivory poachers) only after a long history of measures to restrict their traditional migratory cattle-grazing and when it was clear that compensation in the form of jobs and income from tourism would never meet the original agreements. In response to poaching, the World Wildlife Fund and its partners not only endorsed, but provided aid to programs equipping rangers with training, weapons and other equipment. Peluso observes that, even before Richard Leakey's high-profile crackdown on poaching got underway in 1989, "the government was already using its mandate to protect and manage resources to assert [militarily] its authority" in a region near the Somali border. Conservation schemes have thus given the state and militarized institutions opportunities to gain more control of territory and peoples under a benevolent banner.

The kinds of surprises in these four examples are, I believe, the norm, not the exception for environment, development and conservation projects and policies. Some might conclude that no outside intervention should be attempted; there is always sufficient social complexity to produce unplanned consequences. This is not my point; in a world of interconnected economies, exchange rates, and structural adjustment, there is no such thing as non-intervention by outsiders. Moreover, if, in acknowledgement of differentiated social dynamics, we had highlighted the interest of corporations or dominant industrialized nations in environmentally destructive activities, we would still be far from capturing the difficult politics of socio-environmental change. The lesson, instead, that I would draw is that environmental scientists and activists need to take a position within the new coalitions and conflicts and work from there as the complex social processes unfold. To the extent that they discount their responsibility for the undesired outcomes of policy proposals, they are more likely to reinforce the constraints on, rather than enhancing the possibilities of, engaged participants who are shaping interrelated, yet not common nor global, futures.

## REFLECTION: THE CONSTRUCTION OF THIS CRITIQUE AND THE POTENTIAL RECONSTRUCTION OF UNDIFFERENTIATED SCIENCE-POLITICS

It should be clear that I oppose global environmentalism. I consider its science of undifferentiated dynamics to provide inadequate explanations, and policies based on such science not only unlikely to achieve their intended effects, but also likely to produce undesired ones. Instead of global environmentalism I want to assert the need for a differentiated politics in all environmental discourse. Yet undifferentiated moral and technocratic discourse is pervasive, often being used comfortably by many who might not think of themselves as fitting the label technocrat or moralist.62 How can an interpretation such as mine be expected to influence this state of affairs? When I reflected on this question, inconsistencies and other problems in the preceeding sections struck me. Some additional work was needed, it seemed, to make sense of the construction of this critique and of its relation to the potential reconstruction of undifferentiated science-politics. Indeed, the self-conscious style of this concluding section follows from noting that interpreters of science have more or less assumed that their critique is cultural politics. This is not self-evident; the connection, I believe, needs exploration.

The most obvious role for this essay seems to be that critical science and/or culture interpreters, presumably making up a large fraction of this volume's readers, will appreciate the virtues of its critique of global environmentalism and proceed to disseminate and extend the critique. This reception would be pleasing; through some trickle down or "diffuse out" process, a cadre of critics would make it harder for global environmental scientists and activists (from hereon, "global environmentalists" or "GEers") to remain comfortable with undifferentiated discourse. But, whether the critique of undifferentiated discourse comes from me or from a larger group of critics, if cultural politics is to extend beyond critique, the question remains: how does such an interpretation influence the original state of affairs?

GEers who have their attention drawn to the kind of critique contained in this essay might have an “ah ha!” experience, and from that point on reject globalized and undifferentiated discourse. Yet, to hope for that influence is inconsistent with the sociological perspective on science I have promoted here, namely, that interpretations and action, both scientific and social, are bound together, jointly reinforced by the the formulation of problems, the tools available, the audiences being addressed and enlisted to act, the support (financial and otherwise) elicited, and so on (proposition1).

In light of my promoting this sociological perspective, a different role for this essay might come from critical interpreters of science and/or culture appreciating and advancing this principle of interpretation. Again questions of cultural politics would remain, but in this case the questions can be teased out further: What are critical interpreters supposed to do with and through interpretation that situates scientists as agents in a web of social resources? Can scientists be drawn into the audience for critical, situating interpretations? If so, how can their work build on (or in) such interpretations and lead to change in the original state of affairs? Let me explore these questions and in the process explicate as far as I can the method of interpretation that this essay is promoting.

Consider the combination of conceptual critique with practical critique. Conceptually, global environmental science is unable to provide insight into the differentiated politics and economics of socio-environmental change; practically, policy or politics based on such science is vulnerable to surprises, from unpredicted outcomes, unintended conflicts, and unlikely coalitions. Evidently, by including a section on vulnerability of undifferentiated discourse, I thought that I needed to go further than conceptual critique of the science. In fact, I wanted my practical critique to say more than the resulting policies are flawed and likely to result in undesired effects. By emphasizing surprises of the kind "environmentally motivated projects lead to household conflict and breakdown" or "conservation leads to coercive environmentalist-State coalitions" I was raising the level of polemic, hoping to prod GEers morally--surely they would want to change their ways if they considered these kinds of consequences.63

Looking back, it is clear that even before I mentioned the striking surprises, propositions 1 and 2 foreshadowed this moral prodding. By arguing that certain politics (here, the moralistic and technocratic tendencies) and also the science that facilitates them are not dictated by the nature of reality, it follows that scientists and other social agents can choose whether or not to contribute to such science-politics. They are thus partly and jointly responsible for the consequences. Proposition 3 then built on that: In order to urge GEers to acknowledge that responsibility I wanted to stress that their science-politics does have significant consequences; policies based on undifferentiated analyses make unintended effects and undesirable surprises inevitable.

Yet, why should one expect conceptual, practical, and moral critique, even when combined, to provide an adequate way of shifting discourse? Countervailing pragmatic and practical reasons can be readily identified that help us understand why in this case GEers might be attracted to moral-technocratic politics: a) Moralistic recruitment to a cause and appeals to universal interests can be effective as political tactics--human rights campaigns in times of severe political repression demostrate that; b) More generally, political mobilization usually depends on stressing commonality of interests and playing down differences--since the Apollo space photographs of the earth and, more recently, the end of the Cold War, it has become popular to speak of the common future of earth's inhabitants; c) For scientists, a technocratic outlook is an understandable orientation--they would rather apply their special skills and institutional location as best as they can to benefit society, than to expend energy in political organizing for which they have little experience or aptitude; and d) it is difficult to communicate well with others engaged in a discourse without using the common language, which, as I have noted in the case of global environmental discourse, makes extensive use the terms of management and/or moralistic recruitment and education. In short, in an extension of propositions 1 and 2, many people know we have global environmental problems because their institutional, linguistic and social location facilitates global discourse and the tendencies to moral-technocratic politics.

Having pointed to the practical facilitations of the moralistic and technocratic tendencies, I cannot expect these tendencies to be undermined by a mere counter-interpretation, that is, something working mostly on an intellectual and textual level. One needs to understand and counteract the wider sources of the popularity of undifferentiated discourse in order to oppose it.64 Indeed, recall the social studies of science view of the

heterogeneous construction of scientific activity: "to support their scientific theories and other work scientists employ heterogeneous resources." A straightforward extension of this perspective would be to say that GEers employ heterogeneous resources to support their global environmentalist activity. This perspective, especially when combined with the previous sections' emphasis on differentiated analysis, could have led me to analyze the multi-faceted ways politics become woven into environmental knowledge.

The logical extension of my framework would have been to investigate particular cases of environmental knowledge making, and in light of the diverse facilitations observed,65 to contribute to building conditions favourable to alternative science and politics. Indeed, this is an ideal I will return to at the end of this essay. In the absence of the detailed work on particular cases, proposition 2 could, by analogy, lead critical readers to interpret generalizations such as propositions 2 and 3 themselves as my attempt to make space for social studies of science in environmental discourse while avoiding dealing with the particularities, messiness, and other difficulties of achieving change (here, the change to be achieved would be in environmental analysis and policy).66

Let me acknowledge these inconsistencies. I could, by way of excusing myself, point to the character of this volume, the need to avoid specialized discussion if I were to reach readers from many disciplines, the limitations on the essay length, the constraints of devoting time to my primary research and to other commitments, and so on. For all these reasons it would not have been possible or appropriate to present any differentiated, locally-centred, trans-local analyses of the politics of environmental knowledge making.67 I think, however, that I can proceed in a way that is more helpful and generally applicable than this somewhat defensive response.

There is a positive method of interpretation of science-politics implied in my essay that centers around heuristics. As I think of them, heuristics are propositions that stimulate, orient and guide our inquiries; they are useful provided that we remember that they break down when too much weight is given to them. Let me tease out the different ways that propositions 1-3 can be applied heuristically to contribute to reflection on and intervention within the politics of knowledge.

One point of entry is to begin from what I will call heuristic 1: Assume that scientists seek logical consistency among their different ideas. This allows me to use heuristic 2: Identify how the form of different scientific theories logically admits particular forms of intervention in the world. In this spirit I stated, for example: "In the absence of any analysis of differentiated interests, undifferentiated discourse offers logically/ conceptually no other standpoints [other than moral/technocratic politics] for an environmentalist to take." Heuristic 3 then follows: Use the logic of the science-policy connection to tell a generalized story with a moral, hoping that the moral is an effective prod for some GEers to seek changes in their science and politics. In this spirit, I described the scenario of the two islands and the possibility of research on differentiated socio-environmental dynamics, and then amplified this by highlighting the undesirable surprises that follow from undifferentiated analyses.68

Note that heuristic 3 leaves to each GEer the task of mobilizing the heterogeneous resources needed to effect change in their own particular circumstances. In other words, while the moral appeal can have some rhetorical value, it does not identify in any detail the materials to use in bringing about change. Note also that, without heuristic 1, the logical connection between representations and interventions (using heuristic 2) would not be very telling (i.e., heuristic 3 would not have much rhetorical power). Scientists would feel free to persist in developing their undifferentiated models despite someone pointing out the logical connection with policy interventions and outcomes of which they disapproved.

Suppose, instead, we lessen the weight placed on heuristic 1 and simply assumed that scientists are somewhat constrained by issues of logical consistency in the formulation of their science and their policy proposals. This revised version leads to other heuristics that begin to expose more of the diverse facilitations involved in environmental knowledge- and policy-making:

Heuristic 4: Frame the logical extension of scientific theories into practice and policy as an "accusation," e.g., "This science supports a moral and technocratic politics." The intention would be to provoke responses that might reveal more of the diverse practical as well as intellectual resources that the particular GEers are employing. Responses elicited could include: "I am not a technocrat"; "I do not condone coercive conservation--I know that in my heart"; "By what framework can you interpret my motives [differently from the way I do]?" Some of these responses might stop the exchanges dead in their tracks, but if the conversation continues it becomes possible to ask questions, such as, "What do you think about the observation that global environmental scientists have, in practice, shifted readliy between the language of enlisting the readers to change and the language of management and control?"; "How would you incorporate unequal agents and the dynamics of differentiation into your analyses?"

Whether by means of such dialogue or working with written materials, heuristic 5 can be employed: Examine the ways that particular GEers address the logical extensions. That is, using these extensions as starting places or "null hypotheses," consider how the particular GEers address differentiated politics (e.g., ask who makes the changes they propose); how they position themselves (e.g., ask who are their sponsors,

allies, audiences); how they use science (e.g., ask what are their preferred categories, data sources, mathematical and computer tools, etc.).

These heuristics can lead us a little distance towards analyzing the heterogenous resources drawn into the construction of any scientific-political activity. From the point of view of cultural politics the desirability of such an analysis is that it would enable the interpreter or reader to identify multiple sites of potential intervention--none decisive on its own (they need to be linked to lead to effective change), but each more do-able than moral-technocratic prescriptions for change (heuristic 6). To move further towards this ideal, however, requires heuristics and "shifts of positioning" that go far betond this essay.69

Reflection on my critique has led me to reformulate the three propositions of this essay in terms of a set of heuristics with which to begin to expose more of different and unequal GEers' actual, particular constructions of globalized environmental discourse. Yet, the original propositions can still be read, whether one agrees with them or not, as attempts, like the frameworks they critiqued, to cut through the unequal and heterogeneous practical and conceptual facilitations of science and political mobilization. I have not eliminated this tension; by either reading, the interpretation of science-politics introduced in this essay provides some important resources to probe and intervene in the networks that GEers build to support their science-politics. But cultural politics of science should call for practical engagement in these processes, not just critical interpretation. Between undifferentiated science-politics and its interpretation, and between interpretation and reconstruction lies a world of difference--and of on-going differentiation.

**ENDNOTES**

[1] The first three sections of this paper are drawn, with revisions, from Peter J. Taylorand Frederick H. Buttel, "How do we know we have global environmental problems?: Science and the globalization of environmental discourse," Geoforum 23, no.3 (1992): 405-416. I gratefully acknowledge Fred Buttel's collaboration in the original paper and the permission of Geoforum for me to use excerpts in this essay. The comments of Paul Edwards, Saul Halfon and David Takacs, together with the bibliographic advice of Paul Edwards and Clark Miller, have helped me revise the original paper. Jesse Ribot's feedback on my rendering of his research (note 58) and Kim Berry's summary of the Carney and Watts study (note 59) have also been valuable.

[2] In its earlier years, modern environmentalism promoted other science-based, global formulations of environmental problems, for example, Ehrlich's "population bomb" (which built on population biology) and the Meadows et al.'s (1972) "limits to growth" (derived from the application of system dynamics to population and resources). See Paul R. Ehrlich, The Population Bomb (New York: Ballantine, 1968); and Donella Meadows, Dennis Meadows, Jørgen Randers, William Behrens, The Limits to Growth (New York: Universe Books, 1972). The current manifestation is, however, more broad based.

[3] Sheila S. Jasanoff, "Science, politics, and the renegotiation of expertise at EPA," Osiris 7 (1992): 1-23; Simon Shackley and Brian Wynne, "Representing uncertainty in global climate change science and policy: Boundary-ordering devices and authority," Science, Technology, and Human Values 21, no.3 (1996): 275-302.

[4] Compare the treatments in scientific journals, for example, by Reid Bryson, "Will there be a global 'greenhouse' warming?," Environmental Conservation 17 (1990): 97-99; William E. Reifsnyder, "A tale of ten fallacies: The skeptical enquirers' view of the carbon dioxide/ climate controversy," Agricultural and Forest Meteorology 47 (1989): 349-371; Charles C. Mann, "Extinction: are ecologists crying wolf?," Science 253 (1991): 736-738; Paul R. Ehrlich and Edward O. Wilson, "Biodiversity Studies: Science and Policy," Science 253 (1991): 758-762; William W. Kellogg, "Response to Skeptics of Global Warming," Bulletin of the American Meteorological Society 72 (1991): 499-511; and the Marshall Institute, Scientific Perspectives on the Greenhouse Problem ( Washington DC: Marshall Institute, 1989). In the popular press, compare Anil Agarwal and Sunita Narain, "Global Warming in an Unequal World: A Case of Environmental Colonialism," Earth Island Journal Spring (1991): 39-40; Anonymous, "Species Galore: Avoiding Extinctions Should Not Be an Overriding Goal for Environmentalists," The Economist 320, no. 7724 (1991), 17; and William D. Nordhaus, "Greenhouse economics: count before you leap," The Economist 316, no. 7662 (1990): 21-24.

In the case of global climate science, partly in response to the challenges and partly in response to the "untidy political processes" involved in forming policy, many scientists have withdrawn into more neutral positions than taken from the mid-1980s to the early 1990s; see Sonja A. Boehmer-Christiansen, "A scientific agenda for climate policy?" Nature 372 (1994): 400-402 and Paul N. Edwards, "Global comprehensive models in politics and policy making." Climatic Change 32, no. 2 (1996): 149-161.

[5] In a similar spirit, sociologists of science Shackley and Wynne argue that the "criteria for 'good science' with respect to GCMs [atmospheric circulation models] are not being defined solely from within science itself, but are in part products of the interactions of science with other domains, particularly the policy world"; "Global climate change: The mutual construction of an emergent science-policy domain," Science and Public Policy 22, no.4 (1995): 218-230. See also Sheila S. Jasanoff and Brian Wynne, "Scientific knowledge and decision making," State of the Art Report on Climate Change, ed. Steve Rayner (Richland, WA: Batelle--Pacific Northwest Laboratories, 1995).

[6] See, for example, Randall Collins and Sal Restivo, "Development, diversity, and conflict in the sociology of science," Sociological Quarterly 24 (1983): 185-200; S. Leigh Star, "Introduction: The sociology of science and technology," Social Problems

35, no.3 (1988): 197-205; Steve Woolgar, Science: The Very Idea (London: Tavistock, 1988).

[7] John Law, "On the methods of long-distance control: Vessels, navigation and the Portuguese route to India," Power, Action, Belief ed. John Law, (London: Routledge & Kegan Paul, 1986): 234-263; Bruno Latour, Science in Action: How to Follow Scientists and Engineers through Society (Milton Keynes: Open University Press, 1987); Peter J. Taylor, "Building on construction: An exploration of heterogeneous constructionism, using an analogy from psychology and a sketch from socio-economic modeling.," Perspectives on Science 3, no.1 (1995): 66-98.

[8] Taylor, "Building on construction," "Technocratic Optimism, H.T. Odum, and the Partial Transformation of Ecological Metaphor after World War II," Journal of the History of Biology 21, no.2 (1988): 213-244," "Re/constructing socio-ecologies: System dynamics modeling of nomadic pastoralists in sub-Saharan Africa," The Right Tools for the Job: At work in twentieth-century life sciences ed. Adele Clarke and Joan Fujimura (Princeton: Princeton University Press, 1992), 115-148.

[9] Although the term “global” is used by many as synonymous with “international" or "trans-national,” I use "global" in this paper strictly in the sense of “the world as a whole.” My analysis is intended to apply to international environmental research only if it i) slips into, or rides the coattails of, globalized (in the strict sense) discourse, or ii) treats agents as undifferentiated (see 11). Notes 29, 36, 45, 50, 51 also help to maintain these distinctions and focus).

[10] See also Diane M. Liverman, “Vulnerability to Global Environmental Change,” Understanding Global Environmental Change: The Contributions of Risk Analysis and Management, ed. Roger E. Kasperson, et al. (Worcester, MA: Earth Transformed program, Clark University, 1990), 27-44.

[11] Later in the essay I subsume global environmental discourse within a larger class, namely, environmental discourse for which the agents are undifferentiated. The form of my critique is intended to apply to this larger class.

[12] Meadows et al., The Limits. See also Taylor, "Re/constructing socio-ecologies," for a more detailed sociological analysis of a closely-related system dynamics environmental modeling project.

[13] See the useful summary in Robert McCutcheon, Limits of a Modern World (London: Butterworths, 1979).

[14] Francis Sandbach, "The rise and fall of the Limits to Growth debate," Social Studies of Science 8 (1978): 495-520; David L. Sills, "The environmental movement and its critics," Human Ecology 3 (1975): 1-41.

[15] See especially H.S.D. Cole, et al., eds., Models of Doom: A Critique of the Limits to Growth (New York: Universe, 1973).

[16] Mihajlo D. Mesarovic and Eduard Pestel, Mankind at the Turning Point (New York: Dutton, 1974).

[17] Lincoln Gordon, "Limits to the growth debate," Resources 52, Summer (1976): 1-6.

[18] Brian P. Bloomfield, Modelling the World: The Social Constructions of Systems Analysts (Oxford: Blackwell, 1986).

[19] Sandbach, "Rise and Fall."

[20] Craig Humphrey and Frederick H. Buttel, Environment, Energy, and Society (Belmont, CA: Wadsworth, 1982),110.

[21] Frederick Buttel, Ann Hawkins and Alison Power, "From limits to growth to global change: Constrasts and contradictions in the evolution of environmental science and ideology," Global Environmental Change 1, no.1 (1990): 57-66.

[22] Donella Meadows, Dennis Meadows, Jørgen Randers, William Behrens, "A response to Sussex," in Cole, Models of doom, 216-240; Bloomfield, Modelling the world.

[23] For example, Jay W. Forrester, "Educational implications of responses to system dynamics models," World Modeling: A Dialogue, ed. C. West Churchman and Richard O. Mason (New York: American Elsevier, 1976), 27-35.

[24] John Sterman, "Testing behavioral simulation models by direct experiment," Management Science 33 (1987): 1572-1592.

[25] The science here is not exceptional; all model-making ultimately depends on certain assumptions being accepted on the basis of their plausibility, rather than on tight correspondence with empirical data; see Peter J. Taylor, "Revising models and generating theory," Oikos 54 (1989): 121-126. Economists, in particular, are unapologetic about this; see Milton Friedmann, Essays in Positive Economics (Chicago: University of Chicago Press, 1953).

[26] Forrester, "Educational implications"; see also Meadows, "A response to Sussex," 238.

[27] For a detailed analysis of this issue in a non-hypothetical case, El Salvador, see William D. Durham, Scarcity and Survival in Central America: Ecological Origins of the Soccer War (Stanford, CA: Stanford University Press, 1979). The hypothetical scenario is derived originally from John Vandermeer, "Ecological Determinism," Biology as a Social Weapon ed. Science for the People (Minneapolis: Burgess, 1977), 108-122. See also Peter J. Taylor and Raúl García-Barrios, "The dynamics of socio-environmental change and the limits of neo-Malthusian environmentalism," Limits to Markets: Equity and the Global Environment, ed. Mohamed Dore, Timothy Mount and Henry Shue. (Oxford: Blackwell, 1996).

[28] William W. Murdoch, The Poverty of Nations (Baltimore: Johns Hopkins UP, 1980); Amartya K. Sen, Poverty and Famines (Oxford: Oxford University Press, 1981); Carol A. Smith, “Local history in global context: Social and economic transitions in Western Guatemala,” Comparative Studies in Society and History 26, no.2 (1984): 193-228. Similarly pollution, which was modeled in the LTG as an aggregate world level, is differentially distributed by class and race; Robert Bullard, Dumping in Dixie: Race, Class and Environmental Quality (Boulder: Westview Press, 1994).

[29] The politics of attempting to by-pass difficult politics, which are characteristic of modeling and systems approaches, are also evident in many other areas of environmental discourse. Consider: neo-Malthusians' use of aggregate population statistics (Paul R. Ehrlich and Anne Ehrlich, The Population Explosion (New York: Simon & Schuster, 1990)); deep ecology's emphasis on the need for a bio-centric ethic (George Bradford, "How deep is deep ecology: A challenge to radical

environmentalism." Fifth Estate 22, no. 3 (1987): 3-64); conservation biology's celebration of endangered species and losses in biodiversity (Paul R. Ehrlich and Edward O. Wilson. "Biodiversity Studies: Science and Policy." Science 253 (1991): 758-762); and the moderate tone of sustainable development's language (Sharad Lélé, "Sustainable development: A critical review," World Development 19, no.6 (1991): 607-621) in contrast with earlier analyses of dependency and necessary underdevelopment (Paul Cammack, "Dependency and the politics of development." Perspectives on Development: Cross-disciplinary Themes in Development Studies, ed. P. F. Leeson and M. Martin Minogue (Manchester: Manchester University Press, 1988), 89-125).

[30] Taylor, "Technocratic optimism."

[31] Meadows, Limits to Growth, 181.

[32] Meadows, Limits to Growth, 163.

[33] Meadows, Limits to Growth, 183.

[34] Meadows, Limits to Growth, 184.

[35] William C. Clark and C. S. Holling, "Sustainable development of the biosphere: Human actvities and global change," Global change ed. Thomas F. Malone and Juan G. Roederer (Cambridge: Cambridge University Press, 1985), 477. See also William C. Clark, "Managing planet earth," Scientific American 261, no. 3 (1989):47-54.

[36] It seems very difficult for anyone to engage in globalized environmental discourse and enlist others to their point of view without slipping into the languages of management and/or moralistic recruitment and education. This was brought home to me in reviewing more recent writings than those of Meadows et al. and Clark and Holling. Quotes from two additional sources illustrate how language that is familiar and well meaning partakes of these two tendencies:

In the discussion papers and notes circulated in preparation for a volume on equity and sustainability--Philip B. Smith, et al., eds. The World at the Crossroads: Towards a Sustainable, Equitable and Liveable World. (London: Earthscan, 1994)--I read of a call for "a total picture of the world" and "rechannel[ing] activity into sustainable forms," phrases that conjure up the hubris of a technocrat. Moralistic language was, however, more pervasive. Recruitment to the cause of responding to "our" common prospect was implied in the recurrent use of "we," "our culture," "our existence," "humanity," and in phrases such as "our built-in limitations of perception," "time available for us to change our ways." One paper discussed whether "society could be changed quickly enough," basing its claims around behavioral characteristics supposedly given to humans by their evolutionary history; that is, we are all fundamentally alike, being members of the same species. Individual behaviour and social dynamics were often expressed in the same undifferentiated terms, with individual metaphors used for social ideas and without mention of any structure between the individual and society: "Will humankind take the fork leading to disaster or... to survival?" Does society have the "will to alleviate poverty?" "Affluent societies can choose," despite the "perennial foot-dragging of the establishment." "Individuals vary [therefore] societies vary." (In the final published volume quotations such as these were accompanied by much more attention to stratification within and among nations (but not the dynamic interactions among strata; see note 45), and the technocratic currents were less apparent.)

The editorial for the journal Conservation Biology--Gary K. Meffe, Anne H. Ehrlich and David Ehrenfeld. "Human population control: The missing agenda." Conservation Biology 7, no.1 (1993): 1-3--speaks of conservation biologists "possess[ing] the professional responsibility to teach humankind about the perils" (p.2) of continued Population growth, "having the obligation to provide leadership in addressing the human population problem and developing solutions" (p.2), and being able to "help promote policies to curb rapid population growth" (p.3). "The population problem is stunningly clear and ought to be beyond denial" (p.2). "The human species ignores or denies" the impending calamity (p.2) [Presumably those who draw attention to the Population problem are excused from this species collectivity.] A brief mention of the "critical importance... of educating and empowering women" (p.3) in the next to last paragraph hints that all people might not be equally responsible, but the concluding paragraph returns to the dominant undifferentiated formulation: "Action is needed from everyone, at every turn...[in the cause of] human population control. Life itself is at stake" (p.3).

Language does not, however, stand on its own and readers should not forget the conceptual argument about the undifferentiated dynamics entailing moralistic or technocratic responses.

[37] Daniel Lashof, "The dynamic greenhouse: Feedback processes that may influence future concentrations of atmospheric trace gases," Climatic Change 14 (1990): 213-242.

[38] Michael Glantz, ed., Societal Responses to Regional Climactic Change: Forecasting by Analogy (Boulder, CO: Westview Press, 1989).

[39] Peter Gleick, "The implications of global climatic change for international security," Climatic Change 15, no.1/2 (1989): 309-325; John Harte, Margaret Torn and Deborah Jensen, "The nature and consequences of indirect linakges between climate change and biological diversity," Consequences of the Greenhouse Effect for Biological Diversity ed. Robert L. Peters and Thomas E. Lovejoy (New Haven: Yale University Press, 1992); Baskin, Yvonne, "Ecologists put some life into models of a changing world," Science 259 (1993): 1694-1696.

[40] United States Department of Energy, "The Economics of Long-Term Global Climate Change: A Preliminary Assessment," 1990; Thomas F. Homer-Dixon, "On the threshold: Environmental changes as causes of acute conflict," International Security 16, no.2 (1991): 76-116.

[41] See special issues of Policy Studies Journal 19, Spring (1991) and Evaluation Review 15, February (1991).

[42] Willett Kempton, "Lay perspectives on global environmental change," Global Environmental Change 1 (1991): 183-208. For a more socially interpretative account of planetary science see Andrew Ross, "Is global culture warming up?," Social Text 28 (1991): 3-30.

[43] For example, B. L. Turner, et al., "Two types of global environmental change: Definitional and spatial-scale issues in their human dimensions," Global Environmental Change 1, no.1 (1990), 15.

[44] Harte et al., "Nature and consequences of indirect linkages."

[45] The complementary moral politics of global climate and environmental change researchers requires a small qualification. Almost all commentators acknowledge that there are rich and poor groups, peoples, and nations; that the rich consume more per capita; and that poverty may compell the poor to "mine" their resources. Acknowledging the statistics of inequality does not, however, constitute an analysis of the *dynamics* of inequality. In the absence of serious intellectual work--conceptual and empirical--heartfelt caveats about the rich and the poor do not substantially alter the politics woven into this research. This discourse has simply separated the moral appeals into two uniform audiences: all the poor must change (e.g., practice family planning); all the rich must change (e.g., reduce consumption). It should be noted that some social science analysts who describe phenomena such as the poor mining their resources recognize that the resource degradation makes sense only in the context of differentiated dynamics, that is, of the exploitation of the poor. Nevertheless, they steer away from stating this out of deference to "policy-palatability" or as an accommodation to the dominance of neo-liberal economics since the early 1980s; see Frederick H. Buttel and Peter J. Taylor, "Environmental sociology and global environmental change: A critical assessment," Society and Natural Resources 5 (1992), 211-230.

[46] Equivalently, ecology is political ecology. See Michael Watts and Richard Peet, eds. Environment and development, Special double issue of Economic Geography, 69, nos. 3-4 (1993): 227-448; Peter J. Taylor and Raúl García-Barrios, "The social analysis of ecological change: From systems to intersecting processes," Social Science Information 34, no.1 (1995): 5-30; Rod Neumann and Richard Schroeder. "Manifest ecological destinies: Local rights and global environmental agendas," Antipode 27, no.4 (1995): 321-448.

[47] Raúl García-Barrios and Luis García-Barrios, "Environmental and technological degradation in peasant agriculture: A consequence of development in Mexico," World Development 18, no.11 (1990): 1569-1585; Taylor and García-Barrios, "Dynamics of socio-environmental change."

[48] Peter Little, "Land use conflicts in the agricultural/pastoral borderlands: The case of Kenya," Lands at Risk in the Third World: Local Level Perspectives ed. Peter Little, Michael Horowitz and A. Nyerges (Boulder: Westview, 1988), 195-212; Paul Richards, "Ecological change and the politics of land use," African Studies Review 26 (1983): 1-72.

[49] Alain de Janvry and Raúl García-Barrios, Rural Poverty and Environmental Degradation in Latin America: Causes, Effects, and Alternative Solutions (Rome: Institute for Food and Agricultural Development, 1989).

[50] Sometimes this contrast flows from the label global environmental issues being used to refer to international environmental issues; see note 9.

[51] A third path, in which analysts point to the existence of rich and poor groups, peoples, or nations, follows an unstable middle ground between analyses assuming uniform, undifferentiated units and those based on differentiated dynamics. Often the analyst shifts attention shifts to one group on its own, usually the poor, and proceeds with a undifferentiated analysis. See note 45.

[52] Nordhaus, "Greenhouse economics." This economic research is another illustration of proposition 1. In his economic analysis Nordhaus, like the economists who criticized the LTG, preserves a privileged role for the likes of himself when he steers policy makers against the new advice of planetary scientists and their environmental allies.

[53] Anil Agarwal and Sunita Narain, Towards a Green World: Should Global Environmental Management be Built on Legal Conventions or Human Rights? (New Dehli; Centre for Science and the Environment, 1992); and Agarwal and Narain, "Global warming." These and allied opposition to global environmental science, it should be noted, center more on disparities among nations than on the differentiated economic and political conditions within nations--a particular construction in its own right; see the section "Sites of 'deconstruction' of global environmental change" in Taylor and Buttel, "How do we know."

[54] See also Ronnie Lipschutz and Ken Conca, eds., The State and Social Power in Global Environmental Politics (New York: Columbia University Press, 1993).

[55] For remarks clarifying the intended scope of my critique see notes 9, 11, 29, 36, 45, 50, 51.

[56] Pratap Chatterjee and Matthias Finger, The Earth Brokers (New York: Routledge, 1994).

[57] Boehmer-Christiansen, "A scientific agenda."

[58] Jesse C. Ribot, "Forestry policy and charcoal production in Senegal," Energy Policy, May (1993): 559-585, and "From exclusion to participation: Turning Senegal's forestry policy around?" World Development 23, no. 9 (1995): 1587-1599.

[59] Judith Carney and Michael Watts, "Manufacturing dissent: Work, gender and the politics of meaning in a peasant society," Africa 60, no.2 (1990): 207-241.

[60] Richard Schroeder, "Contradictions along the commodity road to environmental stabilization"; see also "Shady practice: Gender and the political ecology of resource stabilization in Gambian garden/ orchards." Economic Geography 69, no. 4 (1993): 349-365.

[61] Nancy Peluso, "Coercing conservation: The politics of state resource control," Global Environmental Change, 3, no. 2 (1993): 199-217.

[62] See note 36.

[63] Although such polemic will not draw everyone over to my side, any GEer objecting to it should notice the popularity of crisis rhetoric in GE discourse (see, e.g., in note 36, "life itself is at stake"). In Taylor and García-Barrios, "The dynamics of socio-environmental change," we argue that feeding on fears about the future to promote policies makes coercion and violence become more likely. Coercion is not just an abstract possibility, but one environmentalists more generally must pay attention to.

[64] Taylor, "Re/constructing socio-ecologies," and "Building on construction."

[65] Taylor, "Re/constructing socio-ecologies," and "Building on construction." While not based in particular cases, a broad contextualization of global environmental science is provided by Buttel and Taylor, "Environmental sociology."

[66] To the extent that novel or contested aspects in the social studies of science are employed in this essay, I am also not dealing with the particularities, messiness, and other difficulties of achieving change in social studies of science. Moreover, this critique connects social studies of science, environmental science, and environmental activism, building in a privileged role for someone like myself whose work spans these three areas.

[67] In a fully reflexive extension of the perspective of heterogeneous construction and of proposition 1 I could have teased out the many diverse resources that facilitated, paradoxically, my avoiding the task of such differentiated analysis of knowledge-making.

[68] See, in addition, the section "Sites of 'deconstruction' of global environmental change" in Taylor and Buttel, "How do we know."

[69] See the afterword to this volume, Peter J. Taylor, "Shifting positions for knowing and intervening in the cultural politics of the life sciences."

Undifferentiated science-politics and its potential reconstruction1 PETER J. TAYLOR Pp. 149-174 in Changing Life: Genomes-Ecologies-Bodies-Commodities, edited by Peter Taylor, Saul Halfon and Paul Edwards, Minneapolis: University of Minnesota Press, 1997 INTRODUCTION More than a generation ago scientists detected radioactive strontium from atomic tests in reindeer meat and linked DDT to the nonviability of bird eggs.Â  This science centered environmentalism thus provides the first answer to the title question: We know we have global environmental problems because, in short, science documents the existing situation and ever tightens its predictions (or fills in its scenarios) of future changes.