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Critical Political Ecology

The politics of environmental science

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8 Democratizing environmental explanations

This chapter now starts seeking solutions to some of the problems described in this book. So far, the book has outlined the problems of environmental science, and the difficulties of explaining environmental degradation without also reflecting social and political framings. But is it possible to explain environmental problems in ways that do not reflect politics? How can scientific practices be reformed to overcome the problems of environmental "myths" (or environmental orthodoxies) that have been shown to be inaccurate and unhelpful in so many contexts?

The chapter will:

- summarize new approaches to environmental explanation that acknowledge the institutional basis on which causal or truth statements are built. These "institutional" approaches to explanation may be considered more democratic than the generalizations of orthodox environmental science because they reveal the tacit politics contained within causal statements, and allow greater possibility for reframing explanations in favor of localities or under-represented social groups.
- present case studies of institutional science, and how these might allow forms of scientific progress by demonstrating the errors of environmental orthodoxies. Institutional forms of explanation may provide a middle ground between the inaccurate generalizations of orthodox science, and the more phenomenological accounts of local environmental problems many scientists fear are relativist and non-generalizable.
- discuss the implications of such alternative forms of explanation for debates about scientific realism and the status of "global" environmental problems. Democratizing environmental explanations in favor of localities does not suggest championing "local" above "global" concerns. Instead, the aim is to acknowledge how existing explanations reflect different framings, and to seek ways of addressing global problems that are more relevant to the concerns of local people.

This chapter therefore contributes to a "critical" political ecology by proposing means by which the tacit politics within scientific analysis may

be made more transparent, and by providing ways to engage critically with existing scientific explanations. Chapter 9 builds on this discussion by examining how scientific debate about environment in general may be made more transparent and accessible.

Democratizing explanations

So far, this book has discussed various ways in which environmental science is embedded within social and political practices. But what are the implications of this embedding for seeking better explanations of environmental problems?

The purpose of this chapter is to examine how far practices within environmental science can be reformed to acknowledge social and political framings, and to increase the chance of making explanations more relevant to diverse social groups and localities. In essence, this task is to democratize environmental explanations because it seeks to open environmental science up to greater transparency, and to reflect a wider range of social framings and knowledge sources.

Such a challenge, however, raises a number of dilemmas about democratization and scientific realism that form the basis of this chapter's discussion. As discussed in Chapters 1 and 3, defenders of orthodox science (e.g. Gross and Levitt, 1994) fear that democratizing environmental explanations may result in a slide toward relativism – or the belief (in an extreme form) that all truth claims about environmental change should be taken as equally plausible (see Box 3.5 concerning the differences between realism, relativism, and constructivism). Against this, many philosophers and sociologists of science point out that orthodox scientific "laws" and generalizations can never be taken to be universally accurate because they are based on such selective assumptions and modalities (see Harré, 1993; Tennant, 1997). Indeed, it is important to appreciate that a focus on the "construction" of environmental science does not imply that environmental change is unreal or imagined, but instead indicates an interest in how causal statements about biophysical processes have been made, and with which political influences and impacts.

Some important questions about democratizing environmental explanations include whether increasing transparency and framings of environmental science may allow the evolution of more accurate, universal explanations of environmental problems, or the emergence of several, and co-existing, "plural" explanations of environmental change. A further question is whether such pluralism may imply greater scientific realism in general. Some environmentalists and Critical Theorists have also suggested that "science," by its very nature, is exploitative of people and environment, and hence needs to be reformed in order to reflect more socially aware objectives (see Chapters 1 and 5).

This initial section introduces three key themes in the democratization of environmental explanations. The first theme is the belief of some

Critical Theorists that science needs to be changed in its very nature from exploitation to social emancipation. The second theme is the approach of science studies more generally adopted in this book, of analyzing environmental science in order to reveal tacit politics and assumptions. The third theme is how far such analysis may also allow a more critical engagement with hegemonic science by seeking ways to falsify environmental orthodoxies (or "myths") with explanations that are apparently more accurate. The possibilities of democratizing environmental explanations by both revealing tacit politics, and through some attempts at scientific realism, are then discussed more fully later in the chapter.

Critical Theory and liberatory science

The main objective of this chapter is to examine debates within science studies and new philosophies of science concerning greater awareness of social framings of science. But it is worth referring briefly to some old debates in social theory concerning the ability of science to act as an emancipatory or liberatory force.

As discussed in Chapter 5, some early forms of environmentalism within the new social movements of Europe and North America during the 1960s drew inspiration from the rejection of science and technology as the means through which industrial societies applied instrumental or exploitative rationality. In particular, the Critical Theorists, Habermas and Marcuse, debated how to reform science for better social development and liberation of the human spirit. Specifically, this debate would focus on whether science was problematic because it was used for exploitative purposes, or whether there was something inherently exploitative in the current forms of science adopted. Habermas, for example, argued that scient*ism* – rather than science itself – was the chief problem, and hence sought ways to increase the positive use of science for human needs (see Leiss, 1972; Alford, 1985; Vogel, 1996). Marcuse, on the other hand, sought to reform science itself to incorporate new values and objectives within its methods. As reported in Chapter 5, Marcuse wrote:

> the domination of nature has remained linked to the domination of man [sic] ... If this is the case, then the change in the direction of progress, which might sever this fatal link, would also affect the very structure of science – the scientific project. Its hypotheses, without losing their rational character, would develop in an essentially different epistemological context (that of a pacified world); consequently, science would arrive at essentially different concepts of nature and establish essentially different facts.
>
> (*One Dimensional Man*, 1964: 166–167)

And he later wrote:

> [We need] a science and technology released from their service to destruction and exploitation ... [for the] collective practice of creating an environment ... in which the non-aggressive, erotic, receptive faculties of man [sic], in harmony with the consciousness of freedom, strive for the pacification of man and nature.
>
> (*An Essay on Liberation*, 1969: 31; see also Vogel, 1996)

Marcuse was writing specifically about his definition of human nature, or the lost vitality and eroticism characteristic under the oppressive circumstances of industrial society (see Chapter 5). Yet later theorists have adopted similar approaches, particularly from debates in Critical Realism (Bhaskar, 1986; Collier, 1989). Such theorists have also argued that seeking social emancipation – or the escape from social injustices – cannot be achieved by using existing forms of scientific knowledge as a guide to these injustices. As a result, there is a need to reconsider the basis upon which to measure and explain injustice and social agency.

But despite these calls for reform in scientific analysis, there have been some barriers to change. As Morrow (1994) and Vogel (1996) have noted, such comments refer entirely to the practice of science itself, yet few efforts have been made to integrate these concerns with debates about scientific methodology. Indeed, such discussions about "science" as a form of social explanation now look rather vague and general beside the use of natural science as a guide to explaining biophysical change. Indeed, many observers might now consider these two uses of the word "science" to be separate debates, and consequently there is a need to understand the emergence of scientific research as a separate and legitimate institution beyond such criticisms (Jasanoff, 1990).

This separation of debates about exploitative and explanatory uses of science may also be seen in some approaches to environmental research. As noted in Chapter 5, much mainstream environmentalism has adopted a contradictory attitude to science, by first criticizing the instrumental domination of nature by science and technology, yet also using the knowledge created by orthodox natural sciences to describe the alleged ecological crisis without acknowledging the problems with this science (Yearley, 1992). Similarly, Dickens's (1996) study of Critical Realism and environment sought to achieve a more democratic and emancipatory explanation of environmental degradation. Yet this study was based upon many orthodox definitions and explanations of environmental degradation that could also be criticized for not being democratic, and need not be seen to be the only way that Critical Realism can be applied to environment (e.g. see Jackson, 1997; Forsyth, 2001b).

The problem with the discussion of "science" or social oppression as the cause of environmental degradation under early Critical Theory is that it presupposes the nature of exploitation, and then seeks to find political strategies to avoid this problem. As discussed in Chapters 5 and 6, such assumptions about causes of environmental degradation are not always warranted, and reflect wider discourses of opposition to capitalism and modernity rather than a full appreciation of the diverse causes of biophysical change. Furthermore, such an approach separates assumed causes of environmental problems from politics, rather than acknowledging the influence of political debates upon the construction of explanations. An alternative approach is to look at scientific discourse in order to identify the hidden politics and assumptions, and then use this knowledge to assist in social reform.

Revealing the tacit politics of science

A further approach to democratizing environmental explanations is to analyze the discourses and practices of science in order to indicate the tacit – or hidden – implications of science for political debates. This approach is generally the position adopted by Sociology of Scientific Knowledge (SSK). As Wynne summarized:

> A key element of SSK is that it involved identifying (and problematizing the role in knowledge-establishment of) tacit contextual commitments and assumptions, of the kind which have become routinized and taken-for-granted in the prevailing cultural fabric, and which may have shaped accepted "natural knowledge."
>
> (1998: 339)

Much of this book has already summarized the objectives of SSK (see especially Chapter 4) and the purposes of revealing the tacit politics of science. These approaches can assist in the democratization of science by indicating how far "black box" statements about environmental causality have reflected the perceptions and experiences of only limited social groups, or how far scientific boundaries and debates contribute to the coproduction of science and politics. Revealing the tacit assumptions within science portrayed as being universally applicable and politically neutral both weakens the power of that science to influence policy decisions, and empowers social groups not represented in science to challenge existing explanations. Furthermore, deconstructing science in this way does not presuppose causal structures or "real" explanations of environmental degradation in the manner of the discussions in Critical Theory above.

Each chapter of this book seeks to reveal the tacit politics within environmental science, and so it is unnecessary to explain these approaches in this section. Yet it is worth noting that this book also asks how far revealing the tacit politics of science may also allow the construction of more accurate or relevant forms of environmental explanation, especially for social groups not represented in currently hegemonic scientific discourses. Such a question, however, is controversial because it questions some basic assumptions about scientific realism and relativism that are commonly misrepresented and need clarification.

Can environmental "myths" be falsified?

Some observers have expressed frustration at the deconstruction of scientific discourse associated with Sociology of Scientific Knowledge. Perhaps most importantly, critics have suggested that deconstruction alone is insufficient to replace unrepresentative science with something more accurate (Wildavsky, 1995). Another fear is that a discussion of science based upon poststructuralist debates about discourse is anti-empirical (e.g. Bryant and Bailey, 1997: 192), or may be easily delegitimized by natural scientists who see such discussions as impractical and even dangerous to progress (e.g. Gross and Levitt, 1994; see Segerstråle, 2000). Consequently, some scholars have suggested that science studies should seek ways to engage with orthodox falsification in order to replace inaccurate and unjust explanations of environmental degradation.

Such views bubbled over in a debate between two science studies scholars, Hans Radder and Brian Wynne. Criticizing Wynne, Radder wrote:

> Just to say that … knowledge is not "simply" or not "automatically" falsified may be comfortably vague, but it is also disturbingly unhelpful, especially when we are confronted with difficult and far-reaching political epistemological questions. Can we still believe, and act upon, the knowledge claims of climate scientists, or can't we? …To put it bluntly, there is *nothing* in the constructivist account of the global warming issues that urges us to be (or indeed, not to be) "more precautionary in practice."
>
> (1998: 329–330, emphasis in original)

To which, Wynne replied:

> Radder argues that the realism–relativism issue is crucial … by this he appears to mean that such works must take sides on truth claims… I simply say that this is not the point. … I argue that SSK [Sociology of Scientific Knowledge] can help illuminate that problem in a new and meaningful way, but not in any direct and final way. It is a sterile, misleading, false and unhelpful way to define political interaction to suppose that it can be based upon such positive convictions.
>
> (1998: 339, 342)

The crucial point made by Wynne is that orthodox "testing" of conflicting environmental statements requires taking sides on truth claims – or assuming that one side may be more accurate than the other. (A similar process is called "purification," after Latour, as discussed in Chapter 4.) Instead, under more sociological and constructivist approaches, it is important also to ask both how far either side may reflect wider social contexts, and how each side has emerged in conjunction to the other rather than by itself as an independent claim about reality. Radder's argument is that SSK needs to be more aggressive in attacking truth claims made from orthodox science.

This chapter seeks to reconcile both positions by examining ways in which environmental science might be reformed in order to demonstrate the errors of environmental orthodoxies (or dominant, yet questionable explanations), and seek to replace these with more diversified and localized explanations. Such an approach does not, however, suggest that alternative explanations allow "direct and final" falsification of orthodoxies, but a greater illumination of how, and under what conditions, they may be considered accurate or inaccurate. As Latour wrote, such a process represents a notional "Parliament of Things," an exercise that does not in principle reject the general philosophy of scientific progress:

> We want the meticulous sorting of quasi-objects to become possible – no longer unofficially and under the table, but officially and in broad daylight. In this desire to bring to light, to incorporate into language, to make public, we continue to identify with the intuition of the Enlightenment.
>
> (1993: 142)

Such "meticulous sorting" may contribute to the democratization of environmental explanations by providing greater accountability for how scientific "facts" have evolved. This knowledge allows greater ability to criticize hegemonic explanations of environmental degradation, and provides more scope for alternative framings of environmental explanations. This chapter describes some approaches to achieving such a "Parliament" of explanations through reforming scientific techniques. Chapter 9 builds on this by examining political arenas and infrastructure that may empower such analysis further (for example, the approaches of sustainable livelihoods and environmental entitlements, in the section entitled "Environmental Adaptations in the Developing World," pp.253–258).

Before this discussion, however, it is necessary to examine the concepts of "truth" and falsification, before considering alternative approaches to environmental explanation.

Integrating social framings and scientific realism

So, how is it possible to integrate social framings and scientific realism in order to produce more accurate and relevant alternatives to environmental orthodoxies and "myths"? This section examines some general debates about environmental science and social contexts within scientific methods themselves. (Chapter 9 provides a broader discussion of the democratization of scientific debate in general.)

The democratization of scientific method, however, raises important questions that relate to some key scientific controversies. First, does challenging universalizing environmental explanations imply the adoption of relativism? One of the greatest fears among defenders of orthodox science is that the deconstruction of existing explanations – or analyzing the social and political embeddedness of scientific statements – is that it suggests all truth claims are relative, and that scientific progress is not possible.

Second, does diversifying and localizing environmental explanations imply denying the existence of "global" environmental problems, or championing "local" framings above others? Similarly, does localizing science entail imposing predefined notions of locality or identity onto social groups in ways that are not warranted (as discussed in Chapter 7)?

Third, is it reasonable to seek some form of realism at all, or is this simply a reiteration of processes of purification that may only result in the establishment of alternative hybrid structures of knowledge rather than some ultimately more accurate vision of reality?

This section summarizes new thinking from sociology and Philosophy of Science about integrating social framings and scientific explanations, including themes of semantic and critical realism introduced in Chapter 3. The section first discusses new thinking about environmental "truth" and falsification. It then discusses so-called institutional approaches to explanation, and the implications for debates about scientific realism.

Beyond environmental "truths" and "falsehoods"

One of the most important challenges for integrating social framings and scientific realism is the need to redefine orthodox notions of scientific progress.

As discussed in Chapter 3, the concept of scientific progress is an essential component of orthodox science and refers to the process of producing scientific statements that increasingly represent reality. According to logical positivists (in the early part of the twentieth century), progress lay in "proving" "laws" of nature by verifying these apparent trends in new datasets. Under the critical rationalism of Karl Popper (in the mid to late twentieth century), verification was replaced by falsification, or the testing of theories or hypotheses.

Both verification and falsification sought to achieve scientific progress by seeking evidence for the accuracy or inaccuracy ("verisimilitude") of different "laws" or theories. This form of scientific progress also draws upon the philosophy of truth known as the correspondence theory of truth. Under this theory, a statement – such as the environmental orthodoxy that deforestation causes erosion – may be defined as "true" if it can be shown to correspond to an existing and accepted definition of how it should be (Leplin, 1984; Allen, 1993; Psillos, 1999).

This orthodox approach to falsification and scientific progress, however, has been criticized since the 1960s by a variety of philosophers and sociologists of science. Chapters 3 and 4 have already reviewed much of these criticisms, referring mainly to the ability to generalize so broadly from limited empiricism in socially explicit framings, and the hidden politics and social values within the social regulation of scientific practice itself (see Laudan, 1977, 1990; Harré, 1986, 1993; Latour, 1987; Shapin, 1994). The seminal critiques of Kuhn (1962) and Lakatos (1978) in particular pointed to the social shaping of hypothesis testing within socially determined paradigms or networks of scientists, rather than a uniformly meaningful "tide" of knowledge advancing via science (see Chapter 6).

Further work has underlined the social contexts through which falsification can take place. Larry Laudan's *Progress and its Problems* (1977) rejected the relevance of "truth" as a guiding principle in scientific progress because a long succession of debates in philosophy has illustrated the difficulty of knowing when "truth" has been achieved. Concepts such as "scientific progress," and "conjecture and refutation" may therefore reflect episodes of topical political debate rather than a gradual progression toward scientific realism. Laudan wrote: "if scientific progress consists in a series of theories which represent an even closer approximation to the truth, then science cannot be shown to be progressive" (1977: 126).

Steve Shapin's *A Social History of Truth* (1994) also argued that "truth" and "reality" are defined according to the norms and conventions of specific times and places. His study of social norms and networks of medicinal scientists in seventeenth-century England led him to propose that social norms set the conditions of "truth" that science aimed to satisfy, rather than the orthodox belief that science uncovers truth in essence. Bruno Latour (1987, 1993), of course, has argued that the process of "purification" offered by science in effect only replicates predefined framings of hybrid objects made by historic social relations, rather than establishing real and universally applicable explanations and causal linkages in a socially independent nature (see Chapter 4).

Such criticisms suggest that orthodox approaches to falsification overlook semantic and linguistically driven approaches to truth that present alternatives to the correspondence theory of truth. As introduced in Chapters 3 and 4, semantic and linguistic boundings (cernings) of environmental problems acknowledge the importance of the observer in both identifying and attributing meaning to concepts or objects that may or may not be considered true (Levin, 1984; Norris, 1995). Under such alternative conceptions of truth, conceptualizations of "reality" are seen to be dynamically shaped according to the language, social framings, and agendas of the society and scientists who helped formulate them over time, and such conceptualizations continue to be shaped by further political interaction. Hence, the use of orthodox falsification, through the testing of hypotheses by empirical investigation, may therefore present proof of the existence of particular framings of reality, as reflected in the hypothesis and empiricism, rather than alternative framings relying on different perceptions and the empiricism to match these. Yet equating such scientific practice and findings with "truth" may be to legitimize them as "reality" when the same investigation using different boundings may yield equally valid empirical results.

These kind of arguments, however, have frustrated many defenders of

scientific realism, who refuse to believe that all concepts of truth are socially driven, or who still hope for some ability to refer objectively to ecological truth. The co-founder of the Worldwatch Institute, Lester Brown, for example, has urged that we need to revitalize economic policies so that prices and incentives reflect "the ecological truth" (2001: xvii), as though this "truth" is both singular and known. Such matter-of-fact approaches to environmental realism overlook the political contestations over truth, and the semantic and institutional bases on which many environmental "problems" are experienced and discussed.

The tendency to rely only upon the correspondence theory of truth has also beleaguered perennial debates between environmentalists and eco-optimists concerning the "truth" underlying the state of the environment. Such debates have often been associated with specific reports and the production of statistics from both sides. The *Limits to Growth* report of 1972 (Meadows *et al.*, 1972) was one early statistical prediction of ecological degradation, and was followed by *The Global 2000 Report to the President* (USCEQ, 1980), which was also pessimistic about environment. The more optimistic *The Resourceful Earth* (Simon and Kahn, 1984) followed as a further statistical response to suggest that degradation was not so serious. The most recent example of this "tit-for-tat" publication of statistics has been *The Skeptical Environmentalist* by the statistician Björn Lomborg (2001), which again provided optimistic statistical summaries of environmental degradation in different ecosystems or locations (see Box 8.1).

Such publications provide interesting information about the levels of uncertainty about environmental degradation. But they are also couched within the terms of existing environmental discourse and scientific concepts, rather than accepting that these terms impose structures onto complex biophysical and social realities that may not always be best suited by these concepts (see Chapter 2). As such, these publications adopt the correspondence theory of truth, in which the definitions of "problems" such as deforestation, desertification, and erosion are accepted as "real" and measurable. These studies, however, avoid discussion about how far, under what conditions, and for whom these conceptualizations of degradation actually do represent problems. Simply measuring the state of predefined concepts of environmental degradation as a test of the truth of environmental degradation may only add to political contestations of environmental policy.

Integrating social framings of environment with scientific realism therefore requires the rejection of orthodox models of falsification and the correspondence theory of truth. There is little point in seeking to democratize framings of environment if the measurement of environmental degradation uses categories and concepts of degradation that are themselves contested and variable. Instead, there is a need to acknowledge the political factors that lead toward the conditions for truth to be established, rather than simply to assume that "truth" is already defined and agreed upon. So-called institutional approaches to explanations offer ways to integrate scientific realism with such variable framings of truth.

Box 8.1 ***The Skeptical Environmentalist* and statistical analyses of environmental degradation**

Ever since the publication of the *Limits to Growth* (Meadows *et al.*, 1972), there has been much environmental debate providing statistical claims and counter claims concerning environmental degradation and resource depletion. The generally concerned *Global 2000 Report to the President* (USCEQ, 1980), for example, was followed by the optimistic *The Resourceful Earth* (Simon and Kahn, 1984). In 2001, a further book was published, *The Skeptical Environmentalist* by the statistician, Björn Lomborg (2001), which provided further optimistic rejections of environmental concern. Indeed, the book included a foreword by Julian Simon, the co-author of *The Resourceful Earth*.

The Skeptical Environmentalist urged readers to be aware of two key concerns. First, much environmental concern is the result of the so-called "Litany" of unnecessarily pessimistic press coverage, sensationalist reports, and doomsaying that appeal to people because they are instantaneously newsworthy. Second, Lomborg urged a reevaluation of the "facts" to measure the "real state" of the world, by providing a variety of statistics that question many projections about environmental problems such as increasing pollution, deforestation, biodiversity, climate change, and water resources. The book's optimistic conclusion is that "children born in the world today – in both the industrialized world and developing countries – will live longer and be healthier, they will get more food, a better education, a higher standard of living, more leisure time and far more possibilities – without the global environment being destroyed. And that is a beautiful world" (2001: 352).

Predictably, the book invoked much immediate criticism. The World Resources Institute (WRI) used its website to list nine reasons to criticize *The Skeptical Environmentalist*. Reasons included alleged pseudo-scholarship because of selective quotation of statistics; the lack of specific environmental training by Lomborg; and a confusion of statistical association with actual causality in many figures cited. WRI also alleged the book contained a variety of errors and confusions on specific topics such as the confusion of wild and farm fish production, or the avoidance of damage to forests resulting from agricultural conversion. Perhaps most fundamentally, WRI accused Lomborg of confusing the issue of measuring growing human prosperity without asking if this causes environmental damage. WRI went on to publish its own report on declining forests worldwide to refute many of Lomborg's statements. The co-founder of the Worldwatch Institute, Lester Brown, refused to enter into any face-to-face discussions with Lomborg.

Yet more generally, *The Skeptical Environmentalist*, and its criticisms reveal further insights into the shaping of environmental knowledge. From a Cultural Theory perspective, the book represented a classic example of the "Individualist" myth of nature, and WRI represents the "Egalitarian" myth (see Chapter 4). In both cases, the statistics produced by either side reflect the worldview that nature is either resilient or fragile. Furthermore, the statistical measurement of predefined concepts such as "deforestation" may preclose the meaning of such environmental changes, and therefore deny alternative framings of how such changes may be experienced. Many of the positive scenarios described by Lomborg do not apply to all people. It is also worthwhile noting that, despite Lomborg's criticism of environmental doomsaying for attracting media attention, his book also touted publicity by being so overtly contrarian and dismissive of environmental concern. The implications of the controversy surrounding *The Skeptical Environmentalist* are therefore to place more attention to how each side makes its arguments, and how this influences how we understand environmental change, rather than to accept either side as universally true. Such statistical analyses do not provide an objective image of the "real" world.

Source: Lomborg, 2001; http: //www.wri.org.

"Institutional" forms of explanation

Institutional forms of explanation are approaches to science that acknowledge the social framings and institutions that make explanatory statements possible. Institutions may include semantic framings, transcendental (or phenomenological) experiences of reality, or the networks and conventions that may influence the production of apparently real causal statements (see Chapters 3 and 4). These approaches are called institutional because they acknowledge these institutions openly, although it is worth noting that orthodox "laws" and generalizations are similarly contingent on institutions, but these are not acknowledged under orthodox science.

A variety of philosophers of science have claimed that such institutional approaches to science allow the chance to reconcile scientific realism with sociological and semantic analyses of truth. Aronson *et al.* (1994) write:

> most of the problems associated with fending off ... anti-realist attacks result from a failure to separate metaphysical [ontological], semantic and epistemological issues ... Most scientific discourse is not about the natural world but about representations of selected aspects of that world. Our conceptions of what nature is are mediated by our representations of nature in models, which ... are subject to important constraints. Constraints on our best representations of naturally occurring structures and processes mostly reflect historical conditions for the intelligibility of those representations and the experimental procedures we have devised for manipulating them.
>
> (1994: 2, 4)

Similarly, Nancy Cartwright commented:

> Philosophers distinguish phenomenological from theoretical laws. Phenomenological laws are about appearances; theoretical ones are about the reality behind the appearances. The distinction is rooted in epistemology. Phenomenological laws are about things which we can

at least in principle observe directly, whereas the laws can be known only by indirect influence. Normally for philosophers "phenomenological" and "theoretical" mark the distinction between the observable and the unobservable.

(1983: 1)

Some defenders of orthodox science have argued that such distinctions are already acknowledged within the frameworks of orthodox science (e.g. Levitt, 1999: 357). For example, Bunge wrote: "physicists do not ignore phenomena: on the contrary, they often start with them. But they do not limit themselves to what appears to us" (1991: 267).

But the key difference between this kind of attention to phenomena, and the deeper critique of orthodox science adopted by science critics, is that orthodox scientists do not acknowledge how different social boundings or networks may influence either the construction of truth in philosophical terms, or the practice and enforcing of "truth" within policy. Instead, institutional forms of explanation point to the localized, and semantically bound influences on the creation of apparently truthful explanations and descriptions, as alternatives to explanations or descriptions based upon universalizing, or propositional truth statements characteristic of orthodox science.

Such boundaries of causal statements may be defined in various ways. Searle (1995), for example, distinguished between "brute" and "institutional" facts in order to indicate the influence of predefined purposes for different objects within different social settings (see Chapter 3). Drawing on transcendental, or Critical Realism, Bhaskar (1991) argued that science proceeds through the combination of so-called conventional referring – or denoting terms for hypothetical activities – and then practical referring – or the fixing of this term through official description and measurement (Lewis, 1996). In this sense, science produces "transitive" (or socially constructed and changeable) explanations and descriptions of "intransitive" (or underlying and unchanging) reality.

One implication of such institutional approaches to explanation is that apparent "laws" of nature emerge because they make sense to the society or network that produces them. "Laws" can also exist unchallenged as long as their creators maintain the boundaries around the truth claim, or the members within the institution remain a homogenous unit, even if alternative framings may provide conflicting explanations involving the same subject matter. The continued strength of institutions upholding different truth claims may help to explain how environmental orthodoxies (or generalized beliefs about environmental explanation) continue to be adopted and promoted as true in various institutional settings, despite the increasing occurrence of apparently contradictory evidence.

Figure 8.1 provides a comic illustration of this phenomenon. The figure presents a humorous cartoon of snakes attending a class on "nature," and is based on a well-known joke in England about how English people have

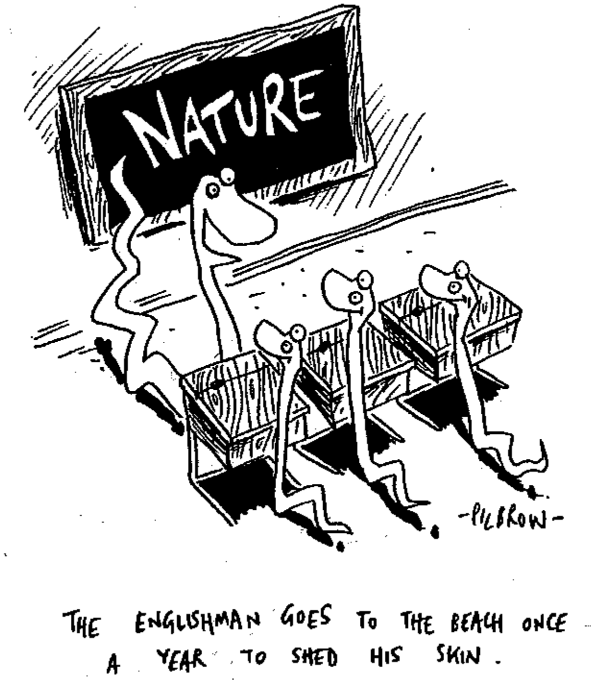

Figure 8.1 A cartoon representation of the problem of scientific explanations based on empirical evidence framed by people with different experience

Source: Reproduced with permission of Giles Pilbrow.

the tendency to be so excited about experiencing hot weather on holiday that they take few precautions against sunburn. In the cartoon, the snakes explain the perceived reality of the English behavior in terms that the snakes (but not the English) find meaningful. The humor in this cartoon is that the causal statement is apparently real and empirically testable (some difference in verisimilitude may be found, for example, between beaches in colder northern England, and those in sunny Spain). But the resulting explanation of English behavior reflects only the reality of the snakes (who really do have to shed their skins), and not the humans. Perhaps less amusingly, however, the cartoon is also a good representation of how some explanations of environmental problems in many locations are based upon the same combination of empirical evidence and framings imposed by outsiders.

This example illustrates a point made elsewhere in this book that scientific "laws" only hold true under certain conditions and assumptions. There is a need to show caution because they may encourage us to have too much confidence in these laws as reality. As Nancy Cartwright argues in *A Dappled World*: "the impressive empirical successes of our best physics theories may argue for truth of these theories but not for their universality ... Laws, where they do apply, hold only *ceteris paribus*, ..." (1999: 4).

The implications of these arguments are to shift the consideration of environmental realism from the application of blanket, universalizing statements that are either "true" or "false" (as characteristic of orthodox science), toward the appreciation that a variety of statements may be considered true or false according to the strength of the truth conditions that bind them. In essence, it is more important for a "critical" political ecology to consider the political factors underlying truth conditions about environmental change, than to assess predefined notions of ecological truth (see also Aronson *et al.*, 1994).

Truth conditions may take a variety of forms, based upon historical or linguistic framings of environmental change. For instance, dominant beliefs about the loss of wilderness, forestry, and heritage may provide tacit framings about what should, and should not, be considered worthy of protection (Howarth, 1995; Neumann, 1998). Similarly, some debates about watershed management in Asia have tended to assume the only purpose of land-use policies in mountain areas is to ensure provision of water to lowland cities rather than also sustainable agriculture in the uplands (Hamilton, 1988; Alford, 1992; see Chapter 2). Yet changing the truth conditions and boundaries of empirical analysis may reveal empirical results that question the accuracy of previously bounded statements. Indeed, this has occurred in numerous studies (such as concerning the role of upland agriculture in watershed degradation) and has resulted in findings that contradict the previously unchallenged assumptions of the preceding framings. Such studies have often formed the basis of debates about environmental orthodoxies and evidence that challenges them (for example, concerning the belief that erosion and deforestation are always degrading, or that deforestation always causes erosion and water shortages: see Ives and Pitt, 1988; Ives and Messerli, 1989; Calder, 1999).

Kukla (1993) summarized this problem by referring to different kinds of epistemic boundaries in the discussion of truth statements. Epistemic boundaries are constraints on a belief coming from the stock of concepts in a mind. In this sense, the boundaries and resulting truth statements reflect the principles of semantic realism, or the classification of the world according to meaning. In addition, there are also syntactic boundaries, or those referring to the logical ordering of objects. Under syntactic ordering, there may also be abductive boundaries, when alternative concepts never occur because of the configuration of the system or social "machine" that orders them; and implementational boundaries, when a system recognizes a concept as true, but acts as though it is false. Environmental orthodoxies may therefore be examples of abductive boundaries because they give the impression that no alternatives exist; and local adaptations or resistances to land-use policies based on orthodoxies (such as those listed in Chapter 2) are implementational boundaries because people persist in constructing livelihoods despite the continuation of supposedly degrading practices like erosion and deforestation. Using the political theorist James Scott's terminology, universalizing orthodoxies may be examples of top-down development consistent with "seeing like a state"; and the local adaptations of citizens in opposition to these theories are akin to "weapons of the weak" (Scott, 1985, 1998).

These different kinds of boundaries offer ways of assessing how political activism or powerful networks may influence the formulation of environmental explanations. Yet, in addition, this form of analysis also allows the chance of democratizing environmental explanations by falsifying more powerful and generalizing environmental explanations. This possibility arises when truth statements under one set of epistemic boundaries (or truth conditions) are apparently contradicted when empiricism on the same topics is conducted under a different set (for example, as when predictions of degradation from population increase, deforestation, or erosion are contradicted by evidence of local adaptations).

Commonly, under orthodox science, such apparent disagreements are treated in black and white terms of correspondence to predefined truths; or are dismissed as local anomalies; or occasionally are claimed to represent the desire to romanticize "local" agriculture and ethnic groups despite the pressing logic of orthodox environmental science. Yet, in effect, these alternative framings of environmental problems represent a further insight into biophysical reality from a new perspective, and which can provide a more accurate (and usually more socially relevant) explanation of change than the larger-scale generalization.

One approach to explaining this co-existence of different epistemic boundaries is the concept of type hierarchies. Type hierarchies may be defined as the structural relationships between accounts of reality with different semantic structures (Harré, 1993; Aronson *et al.*, 1994: 127). For example, the words "animal," "dog," and "Fido" all refer to natural kinds that adopt different levels of generality when referring to the same object. Similarly, a Ferrari is not a horse, but both are vehicles.

The significance of type hierarchies to environmental science is that scientific statements or explanations are bounded within semantic structures of meaning, and lead to a similar hierarchy of associated statements of causality in different settings. For example, the semantic structures of equilibrium (or "balance of nature") ecology might be associated with notions of lost wilderness, and the need to restore equilibrium in order to avoid catastrophe. Under such framings, it is logical to see interlocking statements linking, for example, deforestation to erosion, or reforestation to global ecological stability. Finding alternative evidence against these "laws" might therefore be seen to be contrary to the semantic structure of the explanations as a whole, and therefore dismissed as inaccurate, or even actively resisted by researchers and policymakers in the dominant system (see Chapter 6), all of which regularly occurs to the evidence and people who challenge orthodoxies (see Chapter 2). As Harré noted:

> laws of nature are always understood as embedded in a background system of kinds, an interlinked ontology of type hierarchies . . . It is only by virtue of the relevant type-hierarchy that the content of ontological presuppositions can be filled out, and the range of beings relative to which the assessment of the plausibility of the statement of a law can be made.
>
> (1993: 114, 113)

Or, as Aronson *et al.* write in relation to the semantic norms of science:

> A theory is plausible when two conditions are satisfied. It must be capable of yielding more or less correct predictions and retrodictions, the familiar criterion of "empirical adequacy." We could call this a "logical" criterion. But it must also be the case that the content of the theory is based on a model which is type-wise drawn from a chunk of a type-hierarchy which expresses the common ontology accepted by the community. We could call this an "ontological" criterion.
>
> (1994: 191)

Type hierarchies have important implications for a "critical" political ecology, or the analysis of the political conditions that lead to the establishment of environmental "truths." According to the description of type hierarchies above, the continued existence of "laws" of nature also requires the co-existence of a self-enforced community (or indeed, epistemic community) to support it. This co-existence of social structures and scientific explanations indicate how social norms shape scientific statements as "truth"; how such social structures may exclude alternative conceptions of truth; and that reformulating the norms and boundaries of truth statements may reveal alternative – and possibly more accurate – explanations.

The political implications of such self-enforcing communities for the democratization of environmental science are discussed further in Chapter 9. The purpose of this chapter is to demonstrate how these debates about scientific practice might lead to the democratization of environmental explanations. But before some case studies of this kind of research are presented, it is worth asking how far such challenges to orthodox environmental science challenge debates about scientific realism.

Does democratizing science enhance realism?

The previous sections have argued that there are different ways of looking at the world instead of the simple binary distinction of "true" and "false" commonly adopted under the frameworks of orthodox science and the correspondence theory of truth. As an alternative, semantic approaches to truth are particularly useful for environmental themes because so much debate about environment focuses on "problems" that are inherently institutional and semantic in nature. The word "institutional" implies that problems of risk or degradation of complex ecosystems always represent some element of social framings of when, how, and for whom changes or events present problems.

As noted throughout this book (and especially in Chapter 2), concepts such as erosion, forest loss, and pollution – although frequently contributing to environmental degradation or risk – may not always be human induced, and may themselves be metaphors or summaries for associated and cumulative factors such as soil fertility, biodiversity loss, or resilience of affected people and systems. Explaining such institutional factors through the propositional, universalizing "laws" of orthodox science avoids the contextual factors that make such environmental changes meaningful in different ways to different people. Referring instead to the semantic basis of environmental explanations illustrates how they fit into interlocking systems of type hierarchies or associated explanations that reflect overriding social values and experiences within each semantic institution. As Aronson *et al.* noted:

> it is our contention that laws [of nature] are "ontologically localized" to specific types of phenomena. Which law applies to a system depends on the location of the type to which that system belongs in the type-hierarchy that expresses the common ontology of a certain field of phenomena.
>
> (1994: 153–154)

Adopting a contextual and semantic basis to environmental explanation offers the possibility to democratize environmental science in two key ways. First, it strengthens the criticism of dominant environmental explanations (so-called environmental orthodoxies) by showing that contrary evidence (such as the suggestion that more people can produce less erosion) may not be statistical anomalies from generally true trends, but may reflect alternative systems of managing and framing environmental change. Second, conducting research on alternative framings of environmental change may also produce new insights, or surprising refutations of orthodox thinking that question the accuracy of the orthodox explanations (e.g. that erosion or water shortages may not increase, in total, after deforestation). Such insights may be seen as forms of democratization because they indicate how hegemonic environmental explanations reflect culturally specific framings of problems. They also weaken the apparent universality of these explanations. Furthermore, they offer possibilities for building new explanations based on new framings from previously unrepresented social groups.

But do these challenges to orthodox notions of environmental change also mean a step toward greater accuracy and scientific realism? Or do they simply demonstrate that environmental problems may be explained in different ways, using different framings and political priorities? This question has immense practical importance in leading to more informed and biophysically accurate environmental management practices in various locations, and in challenging the authority of many political actors that claim scientific accuracy as a means to increase their credibility and legitimization (see Chapter 6). Claiming a relativistic approach to science – in effect saying that different framings present equally valid explanations – may weaken political criticisms of different environmental management policies or organizations because it suggests that the only deciding factor should be the value systems adopted by each. Yet concluding that alternative explanations may also be distinguished on grounds of ultimate accuracy may enhance political criticisms because it weakens, or even effectively falsifies, the scientific approaches they are based upon.

This question is the root of disagreements between scholars who seek a more realist vision of environmental problems; or those who see the analysis and revealing of how statements are made to be criticism enough (such as the debate between Hans Radder and Brian Wynne above, p. 207). In general terms, these different approaches may be labeled as a conflict between scholars favoring generally favorable approaches to environmental realism (particularly critical realists), and those looking more to the social institutions and networks influencing the production of scientific "laws" (notably pragmatists or network theorists) (see Rose, 1990; Proctor, 1998).

Under the Critical Realism of Roy Bhaskar (1975, 1991), for example, environmental reality may be compared to three levels of knowledge: empiricism (simple experiences); actualism (experiences, and the events that give rise to experiences); and realism (the underlying ontology and structures that give rise to events and experiences) (see also Chapters 1 and 3). Identifying new explanatory statements that contradict or improve on existing (orthodox) statements may therefore be likened to "peeling an onion" as each layer of underlying reality is revealed. Critical realism therefore supposes a progressive attitude toward scientific progress, by assuming that new insights and framings increase our knowledge of the world's underlying structures. (Yet, as noted in Chapters 1 and 3, critical realists differ from classical Realists by not equating scientific laws with reality.)

Against this, critics of scientific realism have suggested this approach may be too optimistic about indicating underlying ontology. Hannah (1999), for example, has argued that Critical Realism – as defined by Bhaskar – may over-privilege the perceptions and actions of local observers as necessarily indicative of underlying structures rather than social conventions. Similarly, pragmatists such as Richard Rorty (1989a, b) argue that scientific explanations reflect social and political networks rather than underlying reality. As noted in Chapter 4, the philosophy of pragmatism

implies three key tenets: the rejection of essentialist concepts of truth; the perception of no epistemological difference between facts, values, morality, and science; and a belief that social networks or solidarities determine scientific inquiry.

The evidence of research that contradicts environmental orthodoxies suggests that both some elements of Critical Realism and pragmatism may be relevant to the democratization of environmental science. Clearly, some of the more overt generalizations of some environmental orthodoxies, such as "deforestation always causes biodiversity loss," or "population increase always increases degradation" (see Chapter 2), are demonstrably inaccurate when applied universally to all locations. Yet the rejection of such orthodox statements is only dependent on the semantic interpretation of all aspects of these statements. For example, the words "degradation," "deforestation," or "erosion" have to be defined according to how these words are meant to represent different ecological changes and the magnitude of each. Any criticism of orthodoxies using institutional approaches to science is hence done on a more nuanced and less binary basis than orthodox falsification based on the correspondence theory of truth and the rejection of propositional hypotheses. Accordingly, the "rejection" of orthodox generalizations also does not mean that, for instance, deforestation may *never* lead to erosion, or population increase may *never* accelerate the exhaustion of resources. It is important to reject the universality and dogmatism of orthodox environmental generalizations. But this can only be done by simultaneously revising what is meant by falsification and scientific progress.

Similarly, the ability to revise generalized environmental explanations has, to date, generally emerged only when research has been conducted on the practices and experiences of different social groups, or – in the case of Cultural Theory – in the analysis of different worldviews (or "myths" of nature) (see Chapter 4). Such alternative framings can only exist where there are social solidarities to support them. Identifying alternative, or localized, framings of environmental explanation *does* challenge the universality of orthodox environmental explanations. But finding such alternatives does not suggest that these alternative framings should be seen as universal replacements for environmental orthodoxies. (For example, the realization that erosion is not necessarily caused only by agriculture, or that declining soil fertility is a more important threat to agricultural productivity than erosion alone, should not imply that erosion should be discounted as a problem in all locations – see Chapter 2.)

As Proctor wrote: "If Critical Realism could be criticized for being rather too epistemologically confident in its reality claims, pragmatism could likewise be criticized for being too epistemologically tentative" (1998: 367). Making environmental science more biophysically accurate and socially relevant requires revealing both the inaccuracies and social framings of existing environmental explanations at the same time. Doing both does not imply creating a new and universally more accurate scientific explanation, but it does challenge the pretensions of orthodox science to achieve universal accuracy.

The following section now presents some case studies of how environmental science may be reformed to integrate social framings with scientific realism. Such approaches help to achieve a "critical" political ecology by demonstrating the social and political bases upon which different explanations of environmental degradation are made.

Approaches to diversifying and localizing environmental science

This section provides some examples of recent approaches to integrating biophysical explanation with social and political contextualizations of environmental problems. The examples cited reflect a variety of positions regarding the acceptance or criticism of attempts to use science in a realist manner.

Degradation syndromes and "science in places"

One initial approach to integrating environmental science with local environmental perceptions is so-called "science in places" or "degradation syndromes" (NRC, 1999). These concepts have been used within the contexts of orthodox environmental science to explain how environmental problems may be region-specific rather than universal (see Kasperson *et al.*, 1995, in Chapter 7). The word "syndrome" is used to imply the coexistence of several forms and causes of environmental degradation within a locality.

Three types of syndrome have been identified. Utilization syndromes refer to locations where land uses have exceeded local ecological criteria for sustainability, such as in the Dust Bowl, the Sahel, or in locations of mass tourism. Development syndromes refer to locations where overt attempts at land development have led to degradation, such as in the Aral Sea, the Asian Tigers, or the agricultural Green Revolution. Sink syndromes are where regions or localities have become despoiled through the disposal of wastes such as by smokestacks or toxic dumping. The term "science in places" refers to the need to tailor-make the application of environmental science to locations where such syndromes are experienced. The NRC wrote:

> Making knowledge more usable means enhancing the capacity of groups around the world not only to *obtain and interpret it, but also to critique it and to adapt it to their own place-specific contexts*... Aggressive and inclusive fostering of local capacity in science and technology must therefore be a centerpiece of any strategy for the sustainability transition.
>
> (1999: 297, emphasis added)

The concepts of degradation syndromes and science in places offer a means to acknowledge the role of locality in the experience and causes of environmental degradation. The statements of the NRC, above, however, suggest that acknowledging the importance of locality should mean adapting existing science to local areas, rather than allowing local areas to create their own framings and explanations. This approach reflects many of the assumptions of orthodox science in assuming it is necessary to understand environmental change first before applying these understandings to localities, rather than acknowledging that science and politics are coproduced. The "fostering of local capacity" discussed in the statement above does suggest some form of local inclusivity. But if this capacity is designed to increase the adoption of predefined scientific explanations, then it may serve to extend scientific networks from outside the locality, rather than support the development of locally framed environmental explanations.

The approaches of degradation syndromes and science in places may therefore be criticized by constructivist environmental scientists for not going far enough in localizing and diversifying environmental science. But in contexts where environmental risks may be agreed to be "global" by all localities, such extension of scientific knowledge may be extremely valid. The following section discusses the problems of distinguishing "local" and "global" environmental problems and science. But first, we assess some alternative means of diversifying and localizing environmental science.

Events ecology

Events ecology is an attempt to reform the frameworks of orthodox ecological science by integrating studies of environmental degradation with the application of a causal–historical analysis of human–environment relations. Events ecology adopts a critical stance to orthodox generalizations, or "laws" of nature, and adopts insights from the new, non-equilibrinm ecology, including an awareness of historical changes in landscape, and historical framings in explanations themselves (Vayda, 1996; Vayda and Walters, 1999).

Unlike orthodox approaches to ecological explanation, events ecology seeks to identify individual ecological events and then seek explanations for these by posing a number of open-ended questions. This approach adopts a partly phenomenological attitude by seeking to understand "events" as local changes of significance, rather than as "facts" that can be incorporated into preexisting theories, or "factors" that imply events have causal significance. Researchers ask themselves a variety of counterfactual questions about the event in question, and whether antecedent events would have had influences upon it.

For example, Walters (2001) asked: "Why did mangrove planting emerge and spread in a specific island of the Philippines at a specific time?" Two possible explanations could be investigated by the questions:

"Were there any threats from storms that made mangrove planting advisable?" or "Were there any shortages of local construction materials?" In this example, the answer to the second was affirmative. In some senses, events ecology represents a successful attempt to integrate orthodox ecology with insights from historical anthropology and oral histories.

The objective of events ecology is to place the local historical events underlying ecological change as the primary objectives in seeking explanation, rather than meta-narratives associated with much political ecology such as the role of the state or the influence of global capitalism. Similarly, this approach also questions predefined ecological theories such as succession.

"Hybrid science"

The concept of "hybrid science" also seeks to integrate a variety of social and natural science techniques in the search for a locally framed explanation of environmental problems. Yet unlike events ecology, hybrid science can also be used to show the errors of predefined, orthodox "laws" of nature, or to reveal the institutional bases that different explanations rely upon. It gains its name because it uses a hybrid blend of different knowledge sources, and because it acknowledges Latour's arguments that physical objects are a hybrid blend of society and nature (Forsyth, 1996; Batterbury *et al.*, 1997).

A variety of studies have illustrated the principles of hybrid science. One study in Thailand (Forsyth, 1996), for example, questioned long-standing assumptions about environmental degradation in mountainous zones sometimes called the "Theory of Himalayan Environmental Degradation" (see Chapter 2). According to this "theory," population increase within traditional upland agrarian communities is expected to lead to the cultivation of steeper and steeper slopes, with resulting increases in deforestation and soil erosion, and claims that upland agriculture causes lowland problems of sedimentation and water shortages (see Eckholm, 1976). Much research in Nepal has already questioned these assumptions (see Thompson *et al.*, 1986; Hamilton, 1988; Ives and Messerli, 1989; Metz, 1991).

The study in Thailand sought to test the Himalayan "theory" by assessing what had occurred following the establishment of one village in a mountainous region and the consequent growth in population. The research used a variety of knowledge sources, including detailed oral histories and questioning; historical analysis of land-use, land-cover changes using aerial photographs and a Geographical Information System (GIS); and historic measurements of soil erosion on slopes. The findings revealed, however, that – counter to expectations – local farmers had *not* used steeper slopes more frequently, but instead had realized that these slopes were more vulnerable to erosion and declining soil fertility. Instead, farmers had used relatively less steep slopes (of below 20 percent) more frequently, where declining soil fertility (rather than erosion) was a greater problem. The study also showed – again counter to expectations – that overall forest area in the locality had actually increased since the establishment of a local land-tenure system in the 1970s (although forest quality had declined). Finally, the research suggested that much sedimentation onto the lowlands may not be the result of upland agriculture alone, but instead be caused by deep gullies that preexisted agriculture, and which were characteristic of granite land elsewhere in the tropics.

The implication of this study is that the orthodox beliefs concerning the ecological impacts of upland agriculture are highly overstated. The study also suggests that some proposals to manage degradation in this area – such as controlling erosion on steep slopes, or reforesting large areas – may not address underlying biophysical problems of either sedimentation or declining soil fertility, and may interfere unnecessarily with local livelihoods. (Other work in the region has also suggested that reforestation may not help water shortages: see Alford, 1992.) The use of so-called hybrid science therefore indicated the failings of orthodox generalizations, and gave greater insights into the complexity and different framings of environmental problems.

Other studies have also used principles of hybrid science. Fairhead and Leach's (1996) study of historic changes in the forest–savanna convergence zone in Guinea, for example, used a variety of satellite imagery and local oral histories to question orthodox beliefs about the prevalence and causes of deforestation (see Chapter 2). Sillitoe (1993, 1998) used in-depth chemical testing of soil nutrients to indicate the value of local soil conservation practices in Papua New Guinea. Robbins (1998) used GIS to compare the implications of different forest classification techniques on the identification of "forest" and "forest land." Rocheleau and Edmunds (1997) stressed the need to reframe environmental explanations in terms of local qualitative experiences of problems. Dahlberg and Blaikie (1999) adopted a similar approach to achieve "closure" on controversies about land degradation in Botswana, and, by comparing different accounts of environmental change side-by-side, to establish how and why they differ.

The aim of hybrid science is not to uncover biophysical change in a final and complete realist manner, but to reveal how far hegemonic discourses of degradation may actually match the experience of people within specific localities. The practice of hybrid science (or similar inquiries) may also empower political ecology by showing the political basis necessary for different accounts of ecological "reality" used to justify different policy options, and by giving the means to challenge orthodox environmental explanations that are presented as unassailable "truth."

Hybrid science also advances orthodox explanations of environmental degradation in two other key ways. It challenges fixed approaches to spatial scales of inquiry by conducting research within scales identified by people who experience environmental problems. Second, hybrid science is a form of integrated assessment that examines the social solidarities underlying environmental explanation simultaneously with the study of environmental problems themselves. As discussed in the following section, such dual appreciation of explanations, and the social structures that uphold them, is needed to understand how environmental explanations become dominant.

Implications for the analysis of "local" versus "global" environmental problems

The key arguments of this chapter have been that local alternatives to global environmental generalizations present advances in both local relevance and physical accuracy of environmental explanation; yet that all forms of environmental explanation reflect a wider social framing and solidarity such as a network or community. But do these mean that there are no such things as globally "real" explanations and "laws"? Similarly, do these imply that some global ecological concerns about environmental protection should be forgotten or dismissed because all people do not share them?

The answer proposed by this book to these questions is "no": there is no need to dismiss either the potential existence of globally applicable "laws" of nature, or the value of ethical statements that aim to revise environmental behavior worldwide. Instead, the objective of this book has been to demonstrate that existing environmental explanations are *not* universally accurate representations of reality, and that many political views of ecology are either not shared by all, nor as scientifically justified as commonly presented. For example, the belief of Lester Brown (2001) that it is an urgent ecological need to recover large areas of the planet with trees in order to stop erosion, sequester carbon, or restore biodiversity may actually not be biophysically accurate. Instead, such views reflect the historic co-evolution of science and politics from social and scientific networks that have prioritized trees (with all their implications of wilderness, heritage, and relative cost-effectiveness to alternative means of mitigating climate change, etc.), and which have not accepted alternative framings and empirical contradictions to these statements as acceptable influences. (See also the discussion of carbon-offset forestry in Chapter 6.)

In essence, this book has rejected current definitions of environmental reality, rather than the existence of reality itself. This statement underlies all realist scientific inquiry: the separation of epistemology (of knowledge about environment) and ontology (the underlying generating mechanisms and structures of environmental change). Simply questioning the relevance and applicability of currently dominant explanations of environment does not imply rejecting the principle of realist biophysical mechanisms, or indeed (in the most optimistic case) of the possibility of getting close to knowing them. But it does imply adopting a critical view to how these laws reflect different social and political influences, and – importantly for so many environmental orthodoxies – how they both support and restrict

varying options for social and economic activities on the grounds of alleged scientific truth.

As discussed above (pp.218–222), a crucial question underlying all inquiry is how far resilient explanations based on powerful networks may also coincide with accurate understandings of ecology in a realist sense (or, in Bhaskar's words, how far transitive structures may also reveal intransitive reality). In the global context, this question may mean asking if some apparently universal "truths" (such as perhaps that pure water freezes at 0 °C) are genuinely "brute facts" (Searle, 1995), or "immutable mobiles" – items that are universally accepted in different networks or cultures (Latour, 1987). (Brute facts were discussed in more detail in Chapter 4, and immutable mobiles were discussed in Chapter 7.) The first approach would suggest that such "facts" are reality; the second would stress the universality of social networks that make such a "fact" adopted in a maximum number of locations and cultures. Yet if apparent truth claims are not overtly attached to different social networks, these could represent a form of truth. Latour wrote:

> If they [truth claims about the real world] are not attached, people know exactly what nature is; they are objective; they tell the truth; they do not live in a society or culture that could influence their group of things, they simply group things in themselves; their spokespersons are not "interpreting" phenomena, nature talks through them directly.
> (1987: 206; also in Ward, 1996: 111)

Clearly, this book has argued that there are many political and methodological reasons to explain why certain environmental explanations have been portrayed as universal and unassailable, despite increasing evidence to the contrary. Yet even Critical Realists such as Roy Bhaskar, who have been considered more optimistic about scientific realism than many other critics of science, would still say that apparently universally agreed "facts" (if they do exist) are still reflective of social needs that have made such boundings of environmental processes and impacts appear as "truths." If these needs change, boundings will be different, and new apparent "truths" would emerge.

Moreover, this approach also accounts for the continued adoption of many statements we know to be false because they suit dominant social requirements. For example, most people on Earth talk of, and organize their lives according to, the principle that "the sun rises in the morning." Of course, this statement is patently false in a realist context, but there is no need to question the statement until such time as social needs make the epistemic boundaries of the statement inapplicable (such as engaging in space travel). This is an extreme example, but – as demonstrated by environmental orthodoxies – every day, many people worldwide are faced with receiving environmental advice or policies that bear more resemblance to the epistemic boundaries of the advisers than the recipients of the policies, with frequently severe implications on local livelihoods.

There is consequently a need to evaluate the applicability of environmental explanations at different scales *alongside* the existence of the social networks or solidarities that make these statements meaningful at that scale. Many current analyses of the importance of scale in environmental assessment do not make this link with social solidarities (e.g. Clark, 1985; Rosswall *et al.*, 1988; Wilbanks and Kates, 1999). DeHart and Soulé (2000), for example, conducted research to ask if the I = PAT equation (see Chapter 2) works in local places, and answered in the affirmative. Yet this research failed to acknowledge that the framings of environmental problems were imposed from outside these localities, and consequently could be claimed to have made assumptions about the nature of environmental problems in these areas. Evaluating environmental explanations side-by-side with the different social networks and solidarities that uphold them (as in "hybrid science") may help to avoid the projection of environmental explanations onto people or places that find them irrelevant. Integrating social and physical science in this way may also increase our understanding of environmental change.

Table 8.1 shows a simple classification of environmental explanation according to both "local" and "global" scales, and the brute and institutional facts of Searle (1995). The objective of the table is to suggest a framework for assessing the universality of different environmental explanations according to allegedly universal biophysical properties, and the institutional framings placed upon more general aspects of environmental change by different networks or solidarities. The table is not a rigid definition in realist terms of what is a local or global problem, but a guide to different ways of assessing concepts within environmental discourse according to different claims to be seen as either "local" or "global"

Table 8.1 "Local" and "global" environmental problems defined in constructivist terms

		"Local"		*"Global"*
"Brute facts"	1	Local physical variations (e.g. *aridity, tectonic uplift, infiltration rates, soil erodibility)*	2	Uniform physical properties (e.g. *freezing points, thresholds of toxic pollution such as Persistent Organophosphate Pollutants)*
"Institutional facts"	3	Local cultural adaptations/problems (e.g. *shifting cultivation, pastoralism, environmental vulnerability)*	4	Globally-identified problems (e.g. *global deforestation, anthropogenic climate change)*

Source: the author.

scientific statements. Under this scheme, universal biophysical properties, for example, may be seen to be global brute facts, and "global environmental problems" (as discussed in Chapter 7), such as anthropogenic climate change, are global institutional facts, representative of framings and social networks rather than indicating a universally real ecological risk for each location worldwide.

For example, using this diagram, it is possible to indicate environmental orthodoxies (or generalized environmental explanations in common discourse) as resting in category 4 (as reflecting much institutional framing), but commonly portrayed as in category 1 (as unassailable universal truths). Category 3 (or local institutionally defined environmental problems or adaptations) should be afforded more credibility. Ideally, under realist approaches to science, information in categories 1 and 2 should be used as practical guidance to environmental policy. But it should be noted that even apparent brute facts reflect social framings and needs, and are also contingent on many assumptions. For example, the example of the "brute fact" that water freezes at 0°C assumes water is free from impurities, and that the temperature is at sea level, which itself is in flux).

The objective of this table is not to suggest that there are clear environmental problems or properties that can be placed in each column. The aim is to indicate that discussions of how far scientific explanations are accurate at a local or global scale need to acknowledge how (and by whom) these different scales are defined. It is important to note that epistemologizing truth statements in this way does not suggest that local practices should be seen as feasible in all other locations; or that global environmental opinions (such as that forests or wildlife should be preserved for their own right) should be denied as desirable social choices. Instead, there is a need to see the fallibility of many of the alleged scientific truths that are used to legitimize many environmental policies and alleged imperatives. As argued throughout this book, failing to see the shortcomings of environmental science may only serve to restrict local livelihoods and fail to address underlying biophysical causes of environmental problems. The next chapter builds on this analysis of scientific practice, by considering how political reforms and new arenas of debate can empower such new approaches to environmental science, and assist the transparency, accountability, and relevance of environmental explanations.

Summary

This chapter has attempted to answer some of the questions raised in previous chapters concerning the ability to enhance both social relevance and biophysical accuracy of science by focusing on debates concerning scientific method. This discussion contributes to a "critical" political ecology by seeking to democratize environmental science by revealing the tacit politics contained in scientific statements, and by exploring the possibility for challenging and even overturning dominant environmental explanations.

The chapter argued that the universalizing, propositional statements about environmental explanation associated with the frameworks of orthodox science, relying on the correspondence theory of truth, are inadequate to acknowledge the institutional nature of many environmental problems as experienced by different people in a variety of locations and circumstances. As an alternative, the chapter reviewed debates within semantic and Critical Realism that allow some means of integrating social contextualization of environmental change with biophysical accuracy and the possibility of refuting existing, orthodox explanations.

The chapter presented some examples of different methodologies for more realist and socially relevant forms of explanation. These methodologies – such as events ecology and hybrid science – consider local framings of external ecological reality from both the scientist and local citizens' perspectives, with the intention of increasing both our awareness of these framings, and greater relevance of biophysical explanations to different social needs. It was argued that using such techniques allow a greater democratization of scientific practice – because they increase the transparency of explanations, and allow a local approach to explanations on terms determined by people experiencing problems, rather than according to meta-narratives of explanation or fixed spatial scales. The chapter made it clear that democratizing science in this way does not mean rejecting "global" environmental explanations or concerns in principle, but instead the need to understand better how, and by whom, such explanations are claimed to be global or local.

The next chapter now builds on this discussion by examining the political factors underlying the evolution of scientific networks and public access to scientific debate.

9 Democratizing environmental science and networks

This chapter now examines the political institutions and procedures that can increase transparency and public participation in environmental science. If environmental science reflects social and political framings, then how can political debate be reformed to make these framings more visible and relevant to more people? How can people not represented in the framings of environmental explanations be empowered to influence environmental science?

The chapter will:

- discuss the dilemmas of enhancing public participation in environmental science. Some observers have suggested that increasing participation may democratize scientific debates by acknowledging diverse forms of expertise, and by building trust in science. Against this, critics have suggested that scientific consensus and certainty are based upon the enforcement of networks and boundaries that are, by definition, exclusionary.
- examine how environmental assessments and scientific organizations may increase transparency and accountability. Such actions may form new ways of regulating the production of scientific knowledge, and may improve the communication of scientific findings from scientific networks to other groups.
- consider how alternative scientific networks or institutions may be empowered, especially from marginalized social groups or in developing countries. Such networks may often not seek to impose predefined "laws" or explanations of environmental degradation, but build local capacity to achieve inclusive political debate about the management of resources and environmental risks.

In common with Chapter 8, this chapter therefore presents practical means to address some of the problems of environmental science discussed in earlier chapters. The aim of a "critical" political ecology is to conduct environmental politics without using a priori definitions and explanations of environmental degradation. This chapter helps achieve this objective by describing political arenas that allow the discussion of

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