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Critical Political Ecology

The politics of environmental science

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The chapter highlighted how approaches under "orthodox," or positivist scientific method may have contributed to inaccurate explanations by building "laws" of nature without recognizing how such laws reflect the experiences of the people who make them. Moreover, such frameworks of science claim to produce politically neutral findings in either the short-term dissemination of results, or in long-term directions, or paradigms, of scientific inquiry. Such claims are criticized within science studies, which seek instead to demonstrate how such apparent "laws" may reflect the experiences or actions of specific social groups rather than be universally applicable to all.

The discussion also highlighted the impacts of new thinking concerning non-equilibrium ecology upon orthodox environmental explanations or notions of stability, or "balance" in nature. Non-equilibrium ecology has demonstrated that disturbance and flux are prevalent in ecosystems, and that many supposed zones or periods of stability may be identified largely through social expectations of what "nature" is supposed to be. A more politicized analysis of environmental science may therefore seek to indicate how notions of equilibrium or "wilderness" have reflected particular groups' viewpoints, or represented some other groups (such as shifting cultivators) as disrupters of ecological balance. A further politicized analysis might seek to show how new insights from non-equilibrium ecology have been resisted by different political actors. These themes are addressed in more detail in later chapters.

The chapter concluded by summarizing further debates from Philosophy of Science that propose more localized and diversified alternatives to universal (and inaccurate) "laws" of nature. These debates – such as semantic and Critical Realism – offer possibilities for the determination of statements of environmental causality to be determined more locally and more relevantly than environmental orthodoxies or "laws" of nature. Under a "critical" political ecology, discussion focuses on how supposedly neutral and unchallengeable environmental science may reflect the perspectives of particular groups; and on how such science may be made more politically transparent and reflective of more people. The next chapter now introduces insights from Sociology of Scientific Knowledge that complement this chapter in showing how environmental science is inherently political.

4 Social framings of environmental science

The objectives of this chapter are to summarize further problems with environmental science resulting from debates about language and social divisions. The chapter will:

- introduce debates from Sociology of Scientific Knowledge concerning the role of framings and language in influencing how environmental information is collected and presented;
- discuss the drawing of "boundaries" – between different social groups; scientists and "lay" people; or human and non-human objects – and their importance for the politics of environmental science; and
- outline different approaches to acknowledge the influences of different social framings on the evolution of environmental knowledge and explanations, with implications for making current environmental science more transparent and representative of different social groups.

This chapter builds on the discussion of Philosophy of Science in Chapter 3, and forms a further illustration of how social norms and experiences have become absorbed into scientific statements commonly considered as both factual and universal. Understanding how such social framings influence science is a crucial component of a "critical" political ecology. Later chapters discuss how we can change existing science toward more transparent and socially representative outcomes.

Social framings of science and knowledge

The preceding chapter discussed the importance of perspective, or local experience, in how scientific inquiry proceeds. Indeed, according to debates such as semantic or transcendental realism, the local perception and evaluation of different biophysical processes can be crucial in determining how environmental "changes" are considered to be environmental "problems."

The local perception or evaluation of environmental changes may be referred to as "framings." This term refers to the principles and assumptions underlying political debate and action. An environmental debate, for

example, may consider whether to instigate a logging ban, a national park, or a tax on timber operations as alternative ways to reduce deforestation in one locality. The frame of such a debate, however, would be the assumption that deforestation is a degrading and uncontrolled practice, and needs effective action to address it. The analysis of underlying frames and assumptions in political debate is also an important aspect of discourse analysis and psychoanalytical research (see Silverman, 1993). Peet and Watts (1996: 37), for example, use the concept of framings when they refer to "environmental imaginaries," or the frameworks through which different individuals or societies perceive and evaluate aspects of environmental change.

The identification of frames, however, is not always easy. Frames are generally implicit rather than explicit, and a distinction has to be made between an explicit policy position or choice, and the more tacit frames that give rise to explicit positions.

> The frames that shape policies are usually tacit, which means that we tend to argue *from* our tacit frames *to* our explicit policy positions. Although frames exert a powerful influence on what we see and how we interpret what we see, they belong to the taken-for-granted world of policy making, and we are usually unaware of their role in organizing our actions, thoughts, and perceptions.
>
> (Schön and Rein, 1994: 34)

In order to reflect on how frames influence politics, we have to become more aware of them, and how (and from whose actions) they were constructed. Indeed, to acknowledge the importance of frames is also to accept the importance of constructivism in general in political analysis, and in relation to how notions of ecological reality have evolved.

> Constructivist policy analysis recognizes not only that issue framings do not flow deterministically from problems fixed by nature, but also that particular framings of environmental problems build upon specific models of agency, causality and responsibility. These frames in turn are intellectually constraining in that they delimit the universe of further scientific inquiry, political discourse, and possible policy options.
>
> (Jasanoff and Wynne, 1998: 5)

Frames therefore have influence in defining the basis of transcendental realism in justifying empirical projects on specific themes, and in shaping the nature of knowledge production in general. But assessment of frames should not just be limited to those that are labeled as important at present, but also seek to consider alternative framings that may not currently be considered important in political debates.

There are a variety of approaches to framing. The objective of this section is to outline some key types of framing, and the mechanisms in which they can influence the gathering and ordering of environmental knowledge.

Problem closure

The most direct way in which social factors may influence the nature and purpose of empiricism is through problem closure. Problem closure is the pre-definition of the purpose of inquiry, and is consequently effectively the transcendental structures that establish the basis of empiricism (see Chapter 3).

One typical example of problem closure in environmental terms may be the approach to deforestation that identifies the purpose of forest conservation to be the preservation of wilderness for aesthetic reasons, rather than the potential loss of resources available to local settlers. Policies that may result from such problem closure could include the proposal of parks or exclusionary land-use measures that would prevent local access to timber or non-timber products (indeed, this was observed in Guinea by Fairhead and Leach, 1996). Similarly, a dominant approach to climate change policy is to define the problem in terms of reducing atmospheric concentrations of greenhouse gases, rather than in preparing different societies to reduce vulnerability and exposure to the effects of climate change (see Shackley, 1997; Demeritt, 1998). Because of this problem closure, proposed policies have tended to identify the reduction of greenhouse gas concentrations as their primary purpose, rather than increase the ability of different societies to adapt to climate change (see Chapters 6 and 7 for fuller discussions).

According to Habermas (1974), much problem closure occurred through the production of knowledge for "technical cognitive interest" alone – or the economic exploitation, or mechanical control of objects. In this sense, the oppression of modernity had its own implicit problem closure of instrumental control of nature and society. The purpose of alternative, or liberatory, politics therefore was to provide different purposes for knowledge relating to other, non-exploitative uses.

Semiotics and metaphors

Predefined economic objectives are, of course, important in framing the nature and purpose of data collection. But problem closure and framing is also performed by and through language. Indeed, linguistic approaches to political frames are more encompassing than criticisms of economic exploitation because all communication and description is performed through language. When Mary Douglas, for example, defined "pollution" simply as "matter out of place" (1978: 35) she was indicating that there is nothing essentially bad about materials that constitute pollution, but instead that the definition of pollution depended on social regulations of

where, when, and how much of such materials exist. A similar expression is "wild flowers in the wrong fields are weeds" (McHenry, 2000). In both cases, the words "pollution" and "weeds" imply an environmental problem, but the items constituting such problems are not always considered problematic.

The use of such words to indicate problems beyond the constitution of their parts can be seen as an application of Searle's (1995) distinction between "brute" facts and "institutional" facts (see Chapter 3). Words such as "pollution" and "weeds" imply a negative function and meaning to particular constituents (such as emissions or plants) that in other locations, quantities or periods may not be considered problematic (the emissions and plants on their own may be considered, according to Searle, to be unproblematized, or "brute" facts). The use of such words can be explained under semiotics as signifiers of environmental processes considered inherently bad, when there are, in actuality, wide disagreements about the universality of such statements.

For example, as discussed in Chapter 2, deforestation and erosion are still considered by various scientific or popular environmental debates to be equivalent to "degradation," when this equivalence is challenged by a variety of land users and scientists worldwide. (In some locations too, such as in Thailand, the act of deforestation is also identified as a "crime" under domestic law.) Part of this confusion is also due to the use of clumsy terms such as deforestation and erosion to refer to a variety of assumed environmental changes and impacts that may not always occur as the result of cutting down trees or the movement of soil. "Degradation," "deforestation," and "erosion" are all inelegant summaries of various constituent elements that may themselves all be challenged by identifying disagreements about the meaning and impact of what these words are supposed to mean.

The problem experienced in this example is the implicit assumption that language conveys an accurate and generally agreed representation of reality. In practice, however, language has evolved over time as a result of successive episodes of problem closure and the development of specific terms to capture the simultaneous occurrence and evaluation of physical events (Castree, 1995). Such co-evolution of language with social evaluations and political objectives of development implies, as Haraway (1991: 3) wrote, "grammar is politics by other means."

The politics of language in shaping environmental science has been illustrated in regard to the use of metaphors in both shaping empirical research, and then in replicating social perceptions in powerful ways. Writing on Critical Realism, Bhaskar (1991) highlighted that metaphors allow the rapid reference to a presumed common public sphere of presumed "fact" (see also Ortony, 1993; Lewis, 1996). According to Bhaskar, metaphor could be used as either "conversational references," denoting a term for a hypothetical activity; or "practical references," involving the physical measurement or fixing of hypothesis. In this case, the conversational application of metaphor created the transcendental structure necessary to presuppose the gathering of empirical data.

Metaphors can also reinforce social perceptions when used as a condensed expression of ecological reality. For example, referring to the Earth as a "lifeboat"; a rainforest as a "living fossil"; or human impacts on the environment as a "time bomb" clearly suggest a particular meaning with political purpose. Yet even referring to biophysical reality as an "ecosystem" or "forest" is also metaphorical because, as Demeritt (1994: 177) wrote, "human knowledge of nature comes to us already socially constructed in powerful and productive ways ... ecology is a discourse, not the living world itself." Using metaphors – or indeed all language – uncritically is to risk reification, or the presumption that the concept used to discuss an item is the item itself. Smith (1988) used the term "cerning" to refer to the act of circling or enclosing supposed units of society in such a way as to suggest the subjects are exactly as referred to by language, and that there is no political disagreement about such definitions. The term is used as an alternative to "discernment," which implies a more critical analysis of the concepts used to describe reality (see also Castree, 1995; Shapin, 2001).

The importance of such debates for framing is the need to explore how far there may be political disagreement about certain terms used as accurate representations of reality, and to ask how far proposed policy may have implications for different sectors of society. In effect, exploring framings means questioning how, when, and by whom such terms were developed as a substitute for reality. For example, the term "desertification" emerged within scientific communities as an indication of rapid degradation of fragile dryland ecosystems (see Chapter 2). This term was developed initially by visitors to drylands with tacit assumptions of land being used for agricultural or livestock production, and also the view that local settlers were in some way unable to perform adequate land management (Stebbing, 1937). The term "desertification" implies a sense of permanent despoliation, of land suddenly covered in sand. Research conducted more recently suggests greater agency of factors beyond social control in determining the non-equilibrium ecology of drylands (e.g. Dougill *et al.*, 1999), and accordingly, a greater self-determination of the needs of people living in such a zone. Replacing one metaphor ("desertification") with others (such as "dryland degradation," or "problems of drought") may be ways to indicate greater engagement with what we now know to cause environmental problems in drylands, and the problems as actually experienced by people living there (see also Biot, 1995; Mortimore and Adams, 1999). Box 4.1 describes a further linguistic analysis of the term "tropical rainforest," which has been claimed to represent similar inaccurate and unhelpful images of ecology.

Box 4.1 Tropical rainforests and language: one radical view

The influence of language on the framing of environmental problems has been discussed in a deliberately confrontational manner by the British biogeographer, Philip Stott (1999). Stott argued that the complexity of tropical ecosystems cannot be adequately captured by the simple phrase "tropical rainforest." Moreover, this phrase can easily be manipulated by different political actors to indicate a variety of other themes that are not necessarily applicable to the ecosystem(s) known as "tropical rainforest." The word(s) "tropical rainforest" (or *tropische Regenwald*) are generally considered to have been used first by the German biologist, Andreas Franz Wilhem Schimper (1856–1901). Yet the concept has since been used to indicate various themes of forested wilderness; ever-wet tropics; and diverse fecundity since. Such underlying themes, however, do not necessarily indicate the understandings of biologists working in rainforests, or the relationship with other (if related) tropical ecosystems such as savanna. Indeed, all tropical forests have advanced in extent notably since the end of the last Ice Age some 16,000 years ago. "Whereas 'cup' and 'cupness' clearly relate to an object in which the boundaries are not noticeably fluid, when exactly, by contrast is a savanna woody species a tree and not a shrub?" (Stott, 1999: 9).

Stott analyzed the linguistic content of ten documents about rainforests published on a variety of websites from NGOs or centers offering information about rainforests. Such discourse analysis revealed a number of inherent assumptions about the overall value of rainforests to human society that may suggest first that "one" clear ecosystem of the "tropical rainforest" may exist, and second that different organizations may be placing particular normative values on "rainforests" that come more from social discussions about how forests should be seen. For example, one statement from the Rainforest Information Center (Australia) stated: "rainforests have been called the womb of life..." One Fundamentalist Christian organization in Arizona, USA (Kid's Quest) stated, "we are reminded that trees are created to be pleasant..." Such comments clearly reflect human valuations of forests, and overlook the importance of other ecosystems (such as savanna) in upholding biodiversity or in providing other uses to humans. Another common concept that rainforests are the "lungs of the earth" is particularly confusing because lungs take in oxygen and emit carbon dioxide, whereas this statement is meant to imply the opposite (although frequently forests actually *do* emit carbon dioxide).

The objective of this research is not to suggest that "tropical rainforests" should not be valued or protected, but to make people more aware of the ways in which scientific discourse is used to carry a variety of values that are not necessarily accurate in relation to the biophysical entit(ies) known as rainforests. Indeed, such uses of scientific discourse may present a simplified account of rainforest biology, such as overlooking the diversity of rainforests, or the complex relationship between forest disturbance and biodiversity (as discussed in Chapter 2, some forms of disturbance may enhance biodiversity). Moreover, such assumptions may encourage policies that penalize farmers engaging in limited forms of cultivation and forest use. According to Stott, such policies are unjust because they are based on outsiders' mythical beliefs about the importance and fragility of rainforests. Stott argues there are few material reasons for needing rainforests, and calls rainforest conservationism a "New Age form of colonialism." Other biologists, however, might consider this to be an extreme view, and would seek ways to allow rainforest conservation with the protection of local livelihoods.

Source: Stott, 1999; www.ecotrop.org.

Social divisions: gender, class, and race

Social divides such as gender, class, and race may also impact both on the transcendental structures that guide the collection of empiricism, and on the role of science in reinforcing such divides. The investigation of the relationship of social divides and epistemology, however, is controversial. On one hand, it seems reasonable to expect that different social groupings have different environmental perceptions and framings; indeed, much research on environmental orthodoxies has revealed this (Jewitt, 1995, 2000; Rocheleau *et al.*, 1996; Rocheleau and Edmunds, 1997; Jackson, 1997). Yet on the other hand, the repeated and uncritical use of existing classifications of society may enact another form of cerning, and hence reify groups, or the generalized association of particular behavior or environmental framings associated with such groups. One important aspect of such cerning is not to assume, despite the importance of differences, that such categories can be neatly divided and assessed independently, without acknowledging their mutual embeddedness (see Leach *et al.*, 1997).

There are many reasons to indicate the importance of social differentiation in explaining the social basis of environmental explanation. For example, writing about feminist political ecology, Rocheleau *et al.* wrote:

> Environmental science and "the international environmental movement" have been largely cast as the domain of men. In fact, while the dominant and most visible structures of both science and environmentalism may indeed be dominated by men, mostly from wealthier nations, the women of the world – and many men and children with them – have been hard at work maintaining and developing a multiplicity of environmental sciences as well as grassroots environmental movements.
>
> (1996: 6)

Furthermore, debates in environmental racism show how the location of waste dumps, highways, or similarly undesirable structures have been linked to localities where inhabitants are people of color or recent migrants (Westra and Lawson, 2001). Similarly, social class – whether defined in conventional terms of working class, or socially less powerful

groups in general – is a crucial element in defining which environmental framings may become dominant, or who may receive a higher than average distribution of environmental services or potential hazards. It is highly unlikely, for example, that a wealthy snburban dweller would frame environmental needs in similar terms to poor inner-city squatters.

It is not the intention of the book at this stage to discuss the implications of such framings (these are discussed in more detail in Chapters 5, 6, and 7). The purpose of this initial discussion is to highlight the crucial importance of such social divisions to the achievement of a "critical" political ecology, or a more diversified and meaningful environmental explanation. But in addition, there are severe problems of establishing such a more democratic framing for environmental science based upon social divisions. Three main types of problem may be identified.

First, it is difficult to achieve a more balanced and representative analysis of less powerful groups in society because the language, science, and assumptions we use to do so are all imbued with the historic social evaluations that helped create the marginalization of such groups (Longino, 1990). The Royal Society of London, for example, excluded women from membership when it was established in the seventeenth century. In the eighteenth century, literature was excluded from "science" because it was considered "feminine." Goethe's reputation as a poet was said to ruin his reputation as a scientist (Barr and Birke, 1998: 112). Feminist critiques of science have argued that women have effectively been written out of history, or excluded from creative input into explanation (Harding, 1986).

The exclusion of women may have led to the reflection of stereotypical gender roles in much scientific discourse. For example, Martin (1991) noted that accounts of sexual reproduction portrayed sperm in active terms such as "active," "forceful," and "self-propelled," whereas eggs were described more passively as "swept," "transported," or "drifting down" fallopian tubes. Early scientific accounts of reproduction in plants also reflected metaphors from human society. Linnaeus, for example, writing in the eighteenth century, used words such as "nuptials" to denote fertilization of plants; "wedding gowns" to describe the blooming of trees and shrubs prior to pollination; and "bridal beds" to signify flower petals (Schiebinger, 1993: 23). It is therefore important not to see science and research as neutral tools to redress the balance of explanation in favor of marginalized groups, but instead to appreciate there is also the need to redress the tools themselves.

The second main problem is that attempts to focus on particular groups may tend to reduce the representation of social diversity to reified and stereotypical categories that only add to the need to express social differentiation. For example, Haraway (1991: 243) argued that the research seeking to acknowledge the importance of "gender" by looking only at women is to avoid the dynamics that lead to the cerning and marginalization of women in the first place. Similarly, it is also misleading to equate "people of color" with "race." It is important to note that each

social differentiation such as gender, race, and class are not static and may vary within themselves and over time. Such groupings also reflect power relations and marginalization of society in general. Indeed, in *Death of Nature*, Carolyn Merchant (1980) used nature as a metaphor for women.

This desire to represent marginalized sectors of society also raises a third main problem of redressing social divisions in science. The problem relates to the epistemological impacts of undertaking such a task, or the desire to redress environmental priorities *on behalf of* groups considered to be marginalized or disempowered. Social concerns seeking to redress social imbalances along lines of gender, race, sexuality, and also environmentalism are generally associated with the so-called "new" social movements that emerged initially in Europe and North America in the 1960s. Such new social movements differed from the old, class-based movements because they were considered to be either classless, or the activities of one class (usually a "middle" class) on behalf of all society (see Habermas, 1981; Offe, 1985). This theme is discussed in more detail in Chapters 5, 6, 7, and 9. But, as noted in these chapters, it is not always clear if such well-meaning attempts to improve conditions for marginalized groups by more powerful sectors of society may not replicate pre-conceived identifications of such groups. Indeed, the priority should not be to "get" women, or other apparently marginalized groups, "into" science and its institutions, but instead to see how science and institutions may be reformed in order to understand more effectively how social exclusions have been created. Indeed, as Box 4.2 shows, there are many forms of inequality and exclusion with environmental science along the lines of gender.

A "critical" political ecology seeks to indicate how far explanations of environmental problems reflect – or fail to reflect – the perspectives of different social groups. Yet, successfully democratizing environmental science involves questioning existing definitions of environmental problems (problem closure); the linguistic basis of science and reference; and the problems in identifying, communicating, or empowering the perspectives arising from different social groupings. The next section now considers the implications of a politicized approach to framings for political approaches to understanding how environmental science reflects social norms and divisions.

Contested boundaries and hybrids

The preceding discussion outlined how the process of "framing" – through complex processes of problem closure, language, and social participation – may lead to the reification of particular viewpoints as scientific "fact." For example, it is sometimes difficult to use terms such as "desertification" or "tropical rainforest" without also adopting many of the inherent valuations associated with them. This section now discusses how sociologists of scientific knowledge have approached this problem, in order to make environmental science more transparent. Three concepts are worthy of

Box 4.2 Gender differences within academic research on environment

As with any organization or network of people, the composition of people who conduct academic research on environment may reflect inequalities in social groupings such as class, gender, and race. For example, one study in 1996 of social scientists in the USA reported that "geography" (as one discipline focusing on environment) contained the lowest percentage of women Ph.D.s (24 percent of all PhDs were women) when compared to clinical/counseling psychology (65 percent); anthropology (54 percent); sociology (62 percent); political science (29 percent); and economics (25 percent) (Holden, 1996, in Luzzarder-Beach and MacFarlane, 2000: 408).

A more specific survey of physical geographers in 1995 and 1996 (Luzzarder-Beach and MacFarlane, 2000) further indicated other divisions: many more women were at the (more junior) level of "assistant professor" than men, and some 29 percent of women had achieved tenure status, compared with 59 percent of men. More women researchers were seen to be prominent in "biogeography" than other fields of physical geography, reflecting claims made elsewhere that biology represented the most likely route of entry for women into science (The *Economist*, 1996). Men, by comparison, were more prominent in the fields of geomorphology and climatology. Concerning research techniques, 9 percent of women questioned saw laboratory work to be prominent in their research, compared with 30 percent of men.

It is, of course, difficult to draw clear conclusions from these kinds of inequalities observed between women and men in the field of physical geography. It is unclear, for example, how far such trends reflect the generally fewer applications by women to physical geography PhD programs, or whether there are other factors restricting female advancement. It is interesting to note, however, that women physical geographers complained of more frustrations in their career than men. For example, 73 percent of women PhDs questioned described frustration at the competition for research funding (compared with 50 percent of male PhDs); 50 percent (versus 18 percent) complained at the lack of peer communication; and 39 percent (versus 16 percent) protested at apparent barriers in the tenure process. Whatever the reason for poor female recruitment, it does seem that women see more barriers to advancement in the career of physical geography than men.

Source: Luzzarder-Beach and MacFarlane, 2000.

noting as ways to describe the problems of language, or discourse, in attempting to explain complex reality.

First, concepts or explanations such as "desertification" or "deforestation" may also be referred to as "black-boxed" (after Bruno Latour, 1987). According to Latour, a concept or term can be said to be black-boxed when their internal nature is taken to be objectively established, immutable, or beyond the possibility for human action to reshape it. The concepts of "shifting cultivation," or "pollution," for example, may be seen to be black-boxed within many popular debates of environmentalism

when they are framed as automatically degrading, or when people see no need to discuss what these terms might mean or why they are seen to be damaging.

Second, the process by which such framing has influence is through the imposition of boundaries. Boundaries may be drawn at specific times and places to make the frame relevant to the creation of knowledge or policy. The drawing of a boundary around social groups, biophysical entities, or their interactions, is, in effect, to establish an ordered vision of events. The resulting structure therefore reflects the viewpoint of the boundary creator, and provides a precedent for explanation that may eventually be accepted as "fact" (see Kukla, 1993; Barnes *et al.*, 1996; Gieryn, 1999).

Third, Bruno Latour (1993) again captured some epistemological effects of such boundary closure through the concept of "hybrids." Hybrid objects are commonplace objects or "things" that appear to be unitary, real, and uncontroversial, but in practice reflect a variety of historic framings and experience specific to certain actors or societies in the past. A hybrid may be compared with the "institutional facts" of Searle (1995), the "cyborgs" of Haraway (1991), and with "environmental orthodoxies" that signify commonly accepted explanations of environmental degradation based upon only partial experiences and values. The evolution of hybrids, through the interplay of framing and boundary drawing, has profound implications for what we understand as "ecology," and who participated in creating this concept.

According to Latour, the ability to draw boundaries between "nature" and "society" is dependent on a dichotomy that can only be maintained by so-called "purification," or the separation of two distinct ontological zones of human beings and non-humans. Yet Latour's argument is that such purification can only take place superficially on the basis of concepts that are hybrid blends of human and non-human. As a result, the objective of purification – or the establishment of rational, neat explanatory devices for causal relations between nature and society – are doomed to failure because they overlook the interrelated experience of nature and society, and the inaccurate simplicity of the nature–society dualism. As an alternative, it is necessary to look more at the process of "translation" – or the creation of networks between social and natural objects – as the means to identify how we have experienced "nature" in specific ways. Figure 4.1 illustrates what is meant by "purification" and "translation." In this diagram, the first social dichotomy is between objects that are supposedly "purified" between "nonhuman" or "nature" and those that are "humans" or "culture." The second dichotomy is between these two groups of objects and those that are not, or not yet, categorized into these groups. Latour's point is that both dichotomies are false, and that any attempt at purification is likely only to reflect questions of social choice.

By focusing on translation instead of purification, research looks more at the experiential and cumulative construction of apparent "facts" over time as the result of particular actors' boundary decisions, rather than

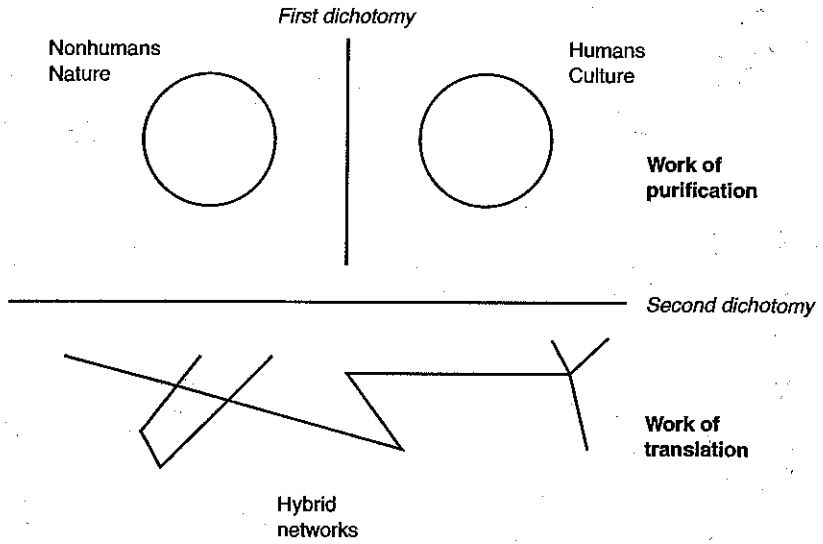

Figure 4.1 Purification and translation
Source: Latour, 1993: 11.

the belief that such facts are objective and universal representations of reality, from which further objective causal links may be identified. Latour wrote:

> Maybe social scientists have simply forgotten that before projecting itself on to things society has to be made, built, constructed?... Dualism may be a poor solution, but it provided 99 per cent of the social sciences' critical repertoire, and nothing would have disturbed its blissful asymmetry if science studies had not upset the applecart.... By trying the impossible task of providing social explanations for hard scientific facts – after generations of social scientists had tried either to denounce "soft" facts or to use hard sciences uncritically – science studies have forced everyone to rethink anew the role of objects in the construction of collectives, thus challenging philosophy.
>
> (1993: 54–55)

A practical manifestation of hybridization, or the cumulative construction of a perceived "fact" out of diverse experiences and framings, is a "quasi-object" (ibid.: 51). This term is related to Haraway's own metaphor of "cyborg" for so-called artefactual nature, in which the preexisting biophysical reality may not be represented totally by the concepts such as "plants" or "animals" that have emerged in a similarly situated way to metaphors and quasi-objects. Haraway wrote:

> Organisms are *biological* embodiments; as natural-technical entities, they are not preexisting plants, animals, protistes, etc., with boundaries already established and awaiting the right kind of instrument to note them accurately. Biology is a discourse, not the living world itself. But humans are not the only actors in the construction of the entities of any scientific discourse; machines (delegates that can produce surprises) and other partners (not the "pre- or extra-discursive objects," but partners) are active constructors of natural scientific objects.
>
> (1991: 298, also in Demeritt, 1994: 181)

The drawing of boundaries between "nature" and "society" is therefore a key way in which social framings, either coupled with, or influenced by actual experiences of environmental change, have led to the establishment of "factual" or universal statements based upon those combined experiences and valuations. Yet there are also less obvious ways in which such "boundary-work" (Gieryn, 1999) can be emplaced. Usually, the adoption of historic boundaries presented as "fact" may have the effect of replicating past dichotomies in the analysis of new problems and the drawing of new boundaries. Much criticism of exploitative economic development, for example, has highlighted the apparent adoption of an Enlightenment-based dualism between "people" and "nature" as innately damaging to "environment" and the interconnectedness of humans and other species (e.g. Worster, 1979; Atkinson, 1991). Yet, in addition, boundary-work may also be used to criticize the assumptions contained in any statement that does not examine critically the implicit boundaries contained within it. For example, in a linguistically based critique of William Cronon's (1991) examination of the impacts of development on "nature" in the USA West (*Nature's Metropolis: Chicago and the Great West*), Demeritt drew reference to the uncritical adoption of equilibrium-based notions of ecological science as a basis for the narrative.

> In categorical statements such as, "In nature's economy, all organisms, including human beings, consume high grade forms of the sun's energy," Cronon (1991: 150) matter of factly states what nature is. This certainty, however, is dependent upon the silent appropriation of ecological science and the trophic-dynamic ecosystem models pioneered by Eugene Odum. Ecology is a discourse, not the living world itself. By conflating the two in categorical statements about first nature, Cronon (1991: xvii) fixes the very "boundary between human and nonhuman, natural and unnatural," that his book so brilliantly shows to be "profoundly problematic."
>
> (1994: 177)

The drawing of boundaries, therefore, effectively allows the establishment of an order and framework from which to proceed. Yet the construction of items as a result of drawing boundaries can always be done alternatively;

given different problem closure, language, and social divisions. The decision to place boundaries in particular forms around different problems, or in favor of particular groups, therefore facilitates the achievement of political objectives of those who draw the boundaries. The replication of boundaries may simply follow from a lack of awareness of potential alternative framings; or may result from an intention to enforce the political objectives associated with the boundaries; or because it may also support new and different political objectives in a further debate. As Demeritt (ibid.: 174) commented: "environmental historians rely upon ecological science for explaining concepts like ecosystem and equilibrium that organize their narratives."

The implicit acceptance of proposed boundaries is therefore a key way in which either propositional truth claims about reality, or historical observations of pattern, may become accepted as "fact." Yet "boundary-work" may also be applied to the social regulation of science and policymaking. As discussed in Chapter 3, one tenet of so-called science is the belief in self-regulation of results by peer review and criticism. Such regulation also has a strong disciplining effect on both scientists (or knowledge producers in general) and on who can participate in both the production of knowledge, and the regulation of findings. According to Gieryn:

> Epistemic authority does not exist as an omnipresent ether, but rather is enacted as people debate (and ultimately decide) where to locate the legitimate jurisdiction over natural facts.... Real science is demarcated from several categories of posers: pseudoscience, amateur science, deviant or fraudulent science, bad science, junk science, popular science. Boundary-work becomes a means of social control: as the borders get placed and policed, "scientists" learn where they may not roam without transgressing the boundaries of legitimacy, and "science" displays its ability to maintain monopoly over preferred norms of conduct.
>
> (1999: 15–16)

Indeed, one might wonder how responses to this book may demonstrate elements of the above statement. It has already been noted, for example, that raising concerns about environmental orthodoxies in conferences full of orthodox development practitioners such as watershed scientists and foresters leads to much resentment. According to Ian Calder (whose book, *The Blue Revolution*, 1999, questions much orthodox thinking on watershed management): "Sometimes it feels like you need to have a motorbike waiting outside with its engine running after you have given a paper" (Calder, pers. comm. 2000).

The implication of such social regulation of science is that only particular forms of knowledge or explanatory frameworks may be accepted as "science" or "legitimate" by particular organizations and actors. Usually this screening and disciplining is defended in terms of protecting society from ideology, or non-rigorous "pseudoscience" that may wrongly claim to have the privileged status of "scientific" knowledge (e.g. Bunge, 1991). But the impacts of such screening go further, in blurring the lines between scientists as knowledge producers, to scientists as policy advisors, or custodians of public debate about topics of environmental concern. In effect, this may mean the institutionalization of existing concepts and explanations (hybrids or orthodoxies) as non-negotiable "fact," and the use of these hybrids for further explanation: the process of "purification" so criticized by Latour. Furthermore, they also construct a definition of science that is used as a means to show authority in political debate about "nature" or "environment," that may both strengthen their political position, and weaken would-be alternative conceptions. Jasanoff commented:

> In denying the existence of role ambiguity [between science advisors and policymakers] these discursive repurifications implicitly rely on some objective grounding in nature and scientific roles as their source of authority.
>
> (1987: 226, also see Jasanoff, 1990; van der Sluijs *et al.*, 1998)

The social framings of knowledge and science are therefore enacted politically through the drawing of boundaries around contested and variously experienced interfaces between nature and society. The resulting concepts – identified and produced by the historically powerful sectors of society – reflect, in actuality, a "hybrid" combination of experience, framings, and evaluation of events that give order to complex reality. Such hybrids are then further institutionalized as "fact" by succeeding scientific debate, the regulation of science, and the use of such hybrids to support further political objectives in later debates.

Such processes may be referred to as "coproduction" and "hybridization," and are discussed in relation to environmentalism in the following chapter. Before this, however, it may be useful to summarize different theoretical approaches to understanding the influence of social framings and boundaries on environmental science. These different approaches are used later in the book.

Theorizing the social institutions of environmental science

It is clear, then, that the production of knowledge through mechanisms known as "science" or other means are contingent upon a variety of social processes, involving the framing or purpose of knowledge; the language used to express it; the social groupings and contexts in which it is sought and presented; and the political purposes to which it is put. Before this book analyzes the evolution of debates within the field specifically known as "political ecology" (see Chapter 5), it is important to summarize the implications of this current chapter on theoretical approaches to social framings of environmental knowledge.

There are clearly many alternative conceptualizations of science to the frameworks of "orthodox" science described in Chapter 3. Orthodox science has been described, simply, as the search for universally applicable "laws" of nature based upon practices that guarantee accuracy and lack of political bias. Instead, the alternative models of science are largely based upon the social controls that exist in how science evolves, is regulated, and is applied. Such social controls may be described as "institutions" – or shared norms, language, framings, etc. – that may exist among scientists, their practices, or their objectives (Jasanoff *et al.*, 1995).

The following discussion lists three important approaches to theorizing institutional approaches to the evolution of scientific knowledge about environment. These approaches may be applied to various aspects of environmental science, or a "critical" political ecology. The discussion ends with a summary of four potential models of science that provide a framework for comparing different approaches to scientific explanation.

Pragmatism and institutions of science

The Philosophy of Science known as "pragmatism" is largely attributed to the works of Charles Peirce, William James, John Dewey, and later Richard Rorty (Rorty, 1989a, b). The early applications of pragmatism within philosophical debates referred mainly to its approach to the definition of truth. Yet, increasingly, the term is used to refer to the social institutions that may also uphold supposed truth statements, and hence it is worthwhile noting the concept in this chapter focusing on how social divisions and language support different explanations of reality.

Pragmatism may be seen to refer to 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. For pragmatists, "truth" is just the name of a property that all true statements share. The term "pragmatism" refers to the necessary limitations such social solidarities place on the extent to which scientists – or the networks to which they belong – can produce explanations that go further than their own experience and objectives. In this sense, pragmatists seek to understand how social networks (or institutions, or solidarities) may be the determining factor in understanding complex reality, rather than placing innate faith in the predictive power of science itself (see also Light and Katz, 1996; Proctor, 1998; Williams, 2001).

In a well-known quotation, Rorty wrote:

> Those who wish to ground solidarity in objectivity – call them "realists" – have to construe truth as correspondence to reality. So they must construe a metaphysic which has room for a special relation between beliefs and objects which will differentiate true from false beliefs. They must also argue that there are procedures of justification

> of belief which are natural and not merely local... By contrast, those who wish to reduce objectivity to solidarity – call them "pragmatists" – do not require either a metaphysic or an epistemology. They view truth as, in William James's phrase, what is good for *us* to believe.
>
> (1989b: 36–37)

The term, "pragmatism," is often used to denote this very focused inspection of social solidarities and truth statements. (This approach is discussed further in Chapter 8.) Yet elements of pragmatism may also be seen in many other approaches to scientific knowledge that emphasize the importance of consensus-building and shared norms and experiences. These other approaches – such as Cultural Theory or narrative and storyline analysis – adopt more sophisticated means of explaining how such social solidarities emerge.

Cultural Theory and the myths of nature

Cultural Theory is a further framework for explaining social solidarities in environmental explanation. It is mainly influenced by the work of the anthropologist Mary Douglas, who argued that the variability of an individual's involvement in social life can be adequately captured by two dimensions of sociality: group and grid. "Group" refers to the extent that an individual feels incorporated into bounded units. "Grid" indicates how far an individual's life may be affected by externally imposed rules of prescriptions (see Thompson *et al.*, 1990: 5). Cultural Theorists usually denote their difference from other forms of cultural theory by using a capitalized C and T.

Cultural Theory is different to many other social and cultural accounts of behavior by proposing that social groupings or individuals may fall into five (and only five) ways of life that may indicate different elements of grid and group. The five groups are hierarchy (or high levels of both grid and group); egalitarianism (high group, but low grid); fatalism (high grid, low group); individualism (both low grid and group); and autonomy (the position where grid and group have least meaning). In many discussions, and in this book, however, only four groups are referred to, as it is commonly believed that the fifth category (of autonomy), by definition, either cannot exist or cannot be discussed alongside the other groups. Consequently, further references to Cultural Theory in this book will refer only to the first four groups.

Some typical examples of the four groups could include a state actor (a facilitating or hierarchical role); a political activist or NGO (egalitarian); powerless and marginalized workers (fatalist); and transnational companies (profiteering or individualist). The existence of these four ways of life indicate that Cultural Theory is, in part, a structuralist form of explanation – although it is worthwhile noting that the structures are not deemed to be permanently rigid, and that different ways of life may be

adopted over a period of time by the same group or individual. Yet the structural and definitive claims of Cultural Theorists that different social circumstances may be analyzed according to these ways of life are, at the same time, the main strength, yet also the main criticism of Cultural Theory.

There is much application of Cultural Theory in general debates in society (e.g. Douglas, 1987), but in environmental terms, it has been widely used in explanations of environmental uncertainty, environmental perception, activism, and the varied generation of knowledge (e.g. see Thompson and Rayner, 1998a, b). Indeed, one of the most influential books concerning environmental orthodoxies, *Uncertainty on a Himalayan Scale* (Thompson *et al.*, 1986), was written from the perspective of Cultural Theory, although the book did not make this explicit. Most significantly, Cultural Theory translates the five ways of being to corresponding "myths of nature," which represent visions of environmental stability or fragility according to each way of life. Figure 4.2 shows the myths of nature, and how they relate to the different ways of life.

The different visions of environment are called "myths" because they are both true and false representations of environmental belief and experience, which both form a structure of everyday life but also provide only a partial experience of environmental reality (see Chapter 2).

> The myths of nature, in consequence, are both true and false; that is the secret of their longevity. Each myth is a partial representation of reality. Each captures some essence of experience and wisdom, and each recommends itself as self-evident truth to the particular social being whose way of life is premised on nature conforming to that version of reality.
>
> (Thompson *et al.*, 1990: 26)

The myths may be summarized as follows. *Nature benign* (individualist) presents an image of environmental impacts having little long-term damage, and consequently social and economic policies relating to environment should be as laissez-faire as possible in order to allow the least interference with human actions. *Nature ephemeral* (egalitarian), on the other hand, represents an image of nature as fragile and susceptible to rapid change, and potentially irretrievable degradation. *Nature perverse/tolerant* (hierarchical) indicates a more managerialist attitude to environment, in which environmental change has some limited impacts, and potentially worse impacts, but both may be managed by careful monitoring and the observance of limits. *Nature capricious* (fatalist) is a picture of a random world; there is no point learning about environmental change or attempting to manage degradation, as change will occur regardless. (The perspective of the hermit, or autonomy, is of *nature resilient*: there is a rejection of dualisms of humanity and nature, environmental change is seen as inevitable, but urgency and need to change policy are eschewed.)

Yet, importantly, the adoption of different myths may change as a result of environmental surprises, or more gradual transitions in social perception and debate (see Price and Thompson, 1997).

The advantages of this framework is that it provides an overview of all possible positions for environmental perception, and links such environmental perceptions to underlying cultural positions, based on the sharing of beliefs. Cultural Theory importantly notes that there are plural environmental rationalities, that may coexist, or replace each other over time, and which account for different forms of environmental understanding. As Cultural Theorists state in relation to the myths, the point is to understand how each myth is based on different cultural standings rather than an absolute and privileged understanding of environmental reality: if you have to ask which myth is right, then you are wrong.

But, in addition, Cultural Theory also highlights the epistemological impacts of dominant political and social institutions in terms of the state (hierarchy); economy (individualism); civil society (egalitarianism); and the disenfranchised (fatalism). Indeed, the group of the fatalists may not usually be identified in social debate because, by definition, fatalists may lack the voice or political power to represent their views in political

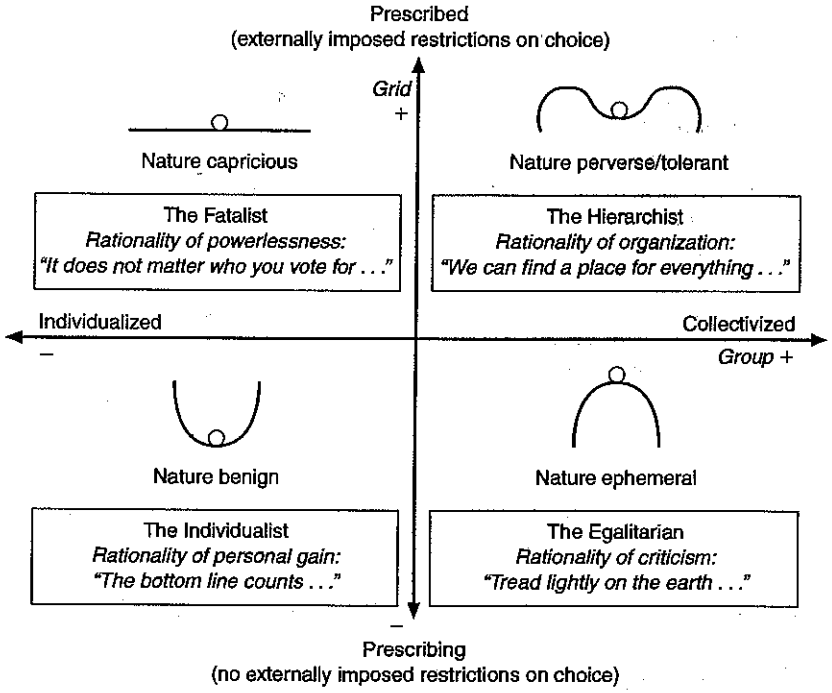

Figure 4.2 Cultural Theory and the "myths of nature"
Source: adapted from Schwarz and Thompson, 1990: 9.

arenas. Environmental research on Cultural Theory and scientific knowledge has argued that there is a clear link between the framings, laws, and empiricism conducted under different "myths of nature" that can lead to environmental "laws" and explanations that are in different ways "mythical" because they are based on partial experiences and evaluations of biophysical reality (Schwarz and Thompson, 1990).

Cultural Theory, therefore, offers the potential of a form of analyzing social studies of "nature" and environmental change that highlight the underlying and structural basis of how knowledge is generated, and is then maintained in order to support the social institutions that create it. Critics of Cultural Theory, however, point to two key alleged failings. First, many social scientists working to identify various levels of social differentiation argue that the five ways of life are far too reductionist, and ignore the variety of ways in which social experience may be expressed through different themes of culture, gender, race, political standpoint, age, wealth, education, and so on. Furthermore, the linguistic basis of each way of life, or "myth of nature" may also be ignored under Cultural Theory if it is assumed that the definition of each myth is pre-established and universally applicable to different locations worldwide. Linked to this, the historical evolution of alternative conceptualizations of, for example, environmental fragility or environmental resilience, may also be ignored by the (relatively simple) reliance on so few (and pre-defined) ways of life. Cultural Theorists counter such points by arguing that the five divisions are actually more numerous than most other social analyses of change, which commonly place individualists (or market) against either hierarchy (state) or egalitarian (e.g. social activists) positions. Furthermore, they claim that the myths incorporate historical events and evolution of terms, but that there is a limit to how far each "myth" or way of life is constructed only by history.

The second main criticism often made against Cultural Theory, particularly in environmental debates, is that it is relativist, and accordingly gives equal precedence to each "myth" regardless of whether it is possible to establish whether different approaches may be more accurate than others. Cultural Theorists often reject claims of relativism by pointing out that each myth is only a partial vision of reality, and also that all truth claims made under each myth are subject to normal bounds of expectation. As Thompson *et al.* note:

> To say that ideas of nature are socially shaped is not to say that they can be anything at all... "Okay, go and jump in front of the train," say the relativity rejectors ... But of course no one is saying that perception is completely fluid, only that it is not completely solid. Rather, ideas of nature are plastic; they can be squeezed into different configurations but, at the same time, there are some limits. The idea of nature that would have us all leaping in front of trains is outside of these limits, that is, it is not a *viable* idea of nature.
>
> (1990: 25, emphasis in original)

Nonetheless, the main contribution of Cultural Theory toward environmental debate and explanation remains at the macro level of overall visions of environmental fragility or resilience. There is little within Cultural Theory to assess the different accuracies or validities of competing land-management schemes that may be questioned *within* one myth or framing, such as by indicating how serious one particular rate of soil erosion may be, or whether to select one species of food tree or another.

Cultural Theory, therefore, provides a framework for fixing multifarious and opposing perceptions and explanations of environment into a classification that reflects some allegedly deep-seated and universal institutions in society. Alternative approaches are less structural and universal, and instead point to the evolution of language and discourse over time and as the result of differential power interests in society.

Narratives, storylines, and Actor Network Theory

The third main approach to environmental constructivism accentuates the historical evolution of environmental discourse and explanation rather than a supposed structure of different shared values associated with different social actors. The third grouping includes more poststructuralist forms of explanation, particularly influenced by the writings of Michel Foucault.

Various concepts may be classified under this third general grouping. At the most general level, "environmental narratives" are commonly heard environmental concepts and explanations that may be described as dominating discourses (e.g. Cronon, 1992; McComas and Shanahan, 1999). The social and linguistic interpretation of environmental narratives is to focus on how such narratives become adopted as "truth" because of social processes, rather than because of a Realist belief that such narratives reflect biophysical reality as uncovered by science. For example, Harré *et al.* wrote:

> We do not tackle things like the "ecological crisis" as if it were a natural phenomenon. The "crisis of our times" is at root a discursive phenomenon. It comes about through a shift in our ways of seeing and assessing what we see, made possible by the taking up into our discursive resources new vocabularies, new judgmental categories, new metaphors and analogies that have promoted awareness of much that was previously overlooked.
>
> (1999: 3–4)

As Harré *et al.* (1999) discuss, the analysis of narratives may also include the individual syntax and structure of statements to gain political power. Included within this analysis is the possibility that explanations and discourse may be structured in order to portray different actors to undertake particular roles of (for example) victim, villain, and savior to enhance the power of the narrative as an explanatory tool, or as a device to enact

political implications. Narratives, therefore, are close to stories because they have beginnings, middles, and ends that serve a purpose in ordering social actors (and sometimes physical items) into a causal structure. According to Roe (1994), a narrative policy analysis includes the identification of how different narratives within policy debates may conform to aspects of "storytelling," and then to assess how far such stories may be enforced or resisted by different political actors for the sake of influencing wider political uncertainties. In certain occasions, the purpose of such storytelling may be to reinforce the speaker's own position as powerful in political debate. The phenomena of narratives within political debate have also been called "storylines." For example, Hajer wrote: "Storylines are devices through which actors are positioned, and through which specific ideas of "blame" and "responsibility" and "urgency" and "responsible behavior" are attributed" (1995: 64–65).

A crucial element of a "critical" political ecology, therefore, is to assess how far existing scientific explanations of environmental degradation may – in effect – be storylines that represent alternative political viewpoints and the redefinition of preexisting political debates under environmental guises. For example, it has been argued by some observers that the vilification of some shifting cultivation groups in Asia and Africa has reflected long-term resentment of minorities for a variety of cultural and political reasons, and hence has led to them also being blamed for environmental degradation (e.g. Fairhead and Leach, 1996; Schmidt-Vogt, 1998; Fox *et al.*, 2000). Under such categorizations, cultivators may be identified either as villains or victims according to different evaluations. Similarly, the concern against anthropogenic climate change may often be expressed in terms of unregulated selfish business (villains) and powerless island states vulnerable to rising sea levels (victims). Cultural Theory may approach these different positions from terms of opposing egalitarianism (islands) versus individualism (business). Under a storyline analysis, however, the different evaluations are seen not to reflect universal institutions in society, but instead are considered situation-specific and resulting from different actors' influence over time.

In terms of construction of knowledge, storylines and narratives have importance in ordering society into preexisting structures of "blame" and "reward," that can lead to the framing of further empiricism and explanation. Second, the interaction of different narratives can lead to the formation of further apparent truths and "facts." The concept of "discursive argumentation" (e.g. Davies and Harré, 1990), for example, highlights how social interactions are themselves framed within wider contexts of argumentation, and that each statement made in argumentation is intended to change the other's position. Partly because of such interactive argumentation, the emerging positions of agreement are influenced by the participants in the argument and the nature of the argument, rather than an objective and asocial establishment of "factual" reality. The interactions between different narratives and arguments may, therefore, lead to the

enforcement of a perceived reality and framing of the external world that is a product of the argument. Hajer calls these "discourse coalitions": "Discourse coalitions are defined as the ensemble of (i) a set of story lines; (ii) the actors who utter these storylines; and (iii) the practices in which this discursive activity is based" (1995: 65). Similarly, van der Sluijs *et al.* (1998) have identified the term, "anchoring devices" to refer to statistical or "factual" consistencies in political debates about environment or science that reflect the bargaining positions of different political negotiators rather than any certainty about the nature of the statistic or "fact" to begin with. For example, they argue that the climate change negotiations have apparently maintained the predication that global temperatures will rise by between 1.5 °C to 4.5 °C between the next 50 to 150 years, even though a variety of alternative predictions have emerged in the meantime. Yet instead of engaging in debates about the accuracy and meaning of the statistical prediction, negotiators have continued to use these figures in order to maintain constancy from which to negotiate other, more pressing concerns. As Hajer wrote:

> Storylines are essential political devices that allow us to overcome fragmentation and come to discursive closure.... The point of the storyline approach is that by uttering a specific element one effectively reinvokes the storyline as a whole. It thus essentially acts as a metaphor ... they allow the possibility for problem closure ... a storyline provides the narrative that allows the scientist, environmentalist, politician, etc. to illustrate where his or her work fits into the jigsaw.
> (1993: 56)

A further step toward constructivism, and the scientific model of extended translation, is Actor Network Theory (ANT) (Law, 1991; Long and Long, 1992; Law and Hassard, 1999). ANT is an approach to narratives and storylines that highlights the influence of historic actors and networks in establishing both political prioritizations for environmental debate and hybrid boundaries between "nature" and "society." Early work on ANT by Callon (1986) referred to an analysis of the scientific analysis of scallop production and scallop collectors in France. The scientists and scallop collectors could each be seen to be identifying and then recruiting different elements of "society" and "nature" (including the scallops themselves) into their own networks in order to support the particular explanation of production of scallops proposed. In this sense, ANT refers clearly to the extended translation model of scientific knowledge, in which the boundaries between what is considered "real," "natural," and "social," with implications for policy and land management, are a function of the different networks reflecting different actors and purposes of analysis. In this sense, "actor" does not necessarily refer to the overt scientists or individuals involved in each network, but to the French word, *actant*, meaning the active involvement of objects, individuals, or groups on behalf of a

purpose. ANT may therefore be seen as a particularly advanced approach to the impacts of historical science and politics on "relational materiality" – or the construction of facts and reality according to different perspectives. It is also increasingly a sociological tool in the identification and reflexive critique of the individual in shaping and reporting reality (see Law and Hassard, 1999).

Different models of science

As a result of these diverse ways of explaining constructivist alternatives to "orthodox" science, Callon (1995) classified science into four main categories. The categories reflect the generative mechanisms for knowledge adopted, and the claimed ability of each model to generalize about the world.

The first, obvious, category is orthodox science, or science as rational knowledge. Under this typology, science adopts the frameworks of orthodox scientific methods and the social regulation of findings by the scientific community. As discussed above, this approach to science implies an overall accuracy, logic, and progression to the generation of knowledge, in which the dynamics of the inner system of conjecture, refutation, and further conjecture is the mechanism by which science advances. This position generally acknowledges the role of social directions of science through the testing of theories (under the critical rationalism of Popper, see Chapter 3). But this model more usually assumes that the workings of the scientific method, and the social regulation of findings, reduce any further social impact on the relevance, social framing, or political manipulation of knowledge. This first category, of course, is the most optimistic and forgiving model of science, although many career scientists do not always accept it uncritically.

The second model refers to the advancement of science according to competition between different scientists, organizations, or research programs. The essence of this second model is that the competition for publication, funding, or public recognition is the underlying dynamic in scientific work and progress. In this sense, the second model is still closely related to the first, rational, model of knowledge generation because it is still assumed that scientists adhere to the scientific method and place faith in the social regulation of findings. Yet unlike the first model, the focus on competition points to the social and political factors in the planning and dissemination of research that are not expected to exist within the Mertonian norms of fair practice and open debate expected of the initial model. The writings most closely associated with the second model of science are Kuhn's (1962) analysis of the social basis of paradigm change, and Lakatos's (1978) discussion of competition and paradigms within research programs.

The third model approaches science as socio-cultural practice. Under this approach, scientific knowledge is seen as reflecting the social, cultural, and political influences that created it. Consequently, there is no possibility of scientific progress in the conventional sense of the gradual uncovering of reality through objective research. While it is possible that science as socio-cultural practice may reflect aspects of biophysical reality, the knowledge about that reality cannot be separated from such contexts, in the framing, the sampling, or the purposes to which such science is put. A further implication is that the nature of scientific knowledge is inherently historical, as it reflects the catalog of social change and influence of historical actors that have influenced the evolution of knowledge over the years (see Pickering, 1995).

Finally, the model of extended translation is the most far-flung criticism of orthodox science. Under extended translation, scientific knowledge is not just a reflection of socio-cultural practices, but also a social shaping of boundaries between "social" and "natural" worlds. Social framings of the "natural" world in essence create hybrid blends of social and physical objects, such as Latour's quasi-objects or Haraway's cyborgs. Science is not seen as a rational and epistemologically unbiased process free from social influence, but instead as part of wide networks linking biophysical entities, technical devices, statements of causality, and humans. "Objects," therefore, cannot exist separately from networks in which they are located, but must be seen as an integral part of the networks in which they are located.

The model of extended translation has important implications. First, if "objects" or explanations exist because of the networks that gave rise to them, then changing these networks might give rise to new objects and explanations. For example, as discussed in Chapter 3, Searle's (1995) concepts of "brute" and "institutional" facts proposed that objects might be relabeled according to the function ascribed to them. This might occur when one object such as a "pen" could equally be used as a "back-scratcher," or when expensive environmental equipment is used by local people as building materials. This multiple use for specific objects may be called symmetrical interdependence of the observed (i.e. objects) and the observers (i.e. science, society).

A second implication is that representations of reality generated through extended translation may only be seen to be accurate when the same conditions within the network are recreated at distant places. Under this assumption, Latour (1983, 1988), for example, argued that Pasteur's scientific experiments on anthrax led to the imposition of his laboratory-based assumptions all over France, on the tacit assumption that the laboratory results only succeeded in "the field" when the same laboratory-type conditions are recreated. Similarly, the Universal Soil Loss Equation (USLE) (see Chapter 2) might also be seen as an exercise in extending the experimental network of conditions used to develop the equation in the Plains of the USA to a variety of locations where either physical conditions of soil formation, rainfall, or social and cultural evaluations of erosion are different. More overtly, transferring such scientific knowledge and networks elsewhere may also reinforce or legitimize those networks.

These four models are convenient ways to summarize the different positions between the orthodox, or rational model of science, and

progressively more constructivist positions. Understanding how different explanations of environmental problems emerge as the interaction between complex biophysical processes and politics is a key objective of a "critical" political ecology. The following chapters now build on these discussions by assessing how science and politics co-evolve dynamically.

Summary

This chapter has built on the discussions in Chapter 3 by describing further ways in which scientific statements are shaped by social processes. The chapter summarized debates in Sociology of Scientific Knowledge that refer to the influences of social framings, problem closure, and language on how aspects of environmental change are perceived and then institutionalized within science. This process is also affected by social divisions such as between class, gender, and race, although sometimes it is difficult to remedy these divisions without also reinforcing these divides.

The chapter discussed the important influence of metaphors and narratives upon how environmental problems are seen. Such narratives, or storylines, of environmental degradation such as "deforestation" reflect a history of different experiences of environmental problems by specific social actors, who have had most impact on defining and giving meaning to different explanations of degradation. The study of "boundaries" in science, in terms of who participates in inquiry, and how divisions are drawn around complex "hybrid" objects and processes, offers a way to understand how environmental science has evolved. Democratizing environmental science, or showing how current explanations reflect such historic actions, therefore depends on showing how such hybrid concepts have evolved, and with (and without) whose input.

The chapter concluded by summarizing some different approaches to theorizing social institutions and science. These approaches included pragmatism; Cultural Theory; and a variety of poststructuralist debates such as environmental narratives, storylines, and Actor Network Theory. Such approaches allow a variety of alternatives to the frameworks of orthodox science, which, as discussed in Chapter 3, has contributed to the creation of environmental orthodoxies, or inaccurate and unrepresentative environmental science. Most crucially, the chapter argued that many alternative approaches to science show that truth statements are dependent on social networks that enable consensus to be reached, or for laboratory conditions to be replicated in different locations. Environmental science may therefore appear to succeed when those networks or conditions are recreated. Yet changing these conditions may also lead to different scientific outcomes, and a rethinking of the purposes of science. The following chapters apply these thoughts to a revitalization of political ecology, in order to make environmental politics more aware of the contingent and constructed nature of many environmental explanations commonly assumed to be "fact."

5 The coproduction of environmental knowledge and political activism

The previous chapters have summarized a variety of debates relating to the social and political influences on science. Chapter 3 described arguments in Philosophy of Science that claim scientific "laws" are not universally applicable, but instead reflect a variety of social and institutional influences on how inference is made. Chapter 4 drew largely from debates in the Sociology of Scientific Knowledge to indicate how supposed scientific "facts" about environment reflect wider social framings and discourses, which have also evolved historically. Now, in Chapter 5, we look at how these themes may be combined to identify how social change and environmental science co-evolve dynamically. The chapter will:

- introduce and define the concepts of coproduction and hybridization that describe how environmental knowledge and politics co-evolve dynamically;
- demonstrate how environmentalism, as a "new" social movement, helped shape many general beliefs and discourses about environment that have since been used to explain the causes of environmental degradation; and
- illustrate how such general beliefs – when used uncritically in new contexts – may fail to acknowledge complex biophysical causes of environmental changes, or alternative framings of environmental change by people not included in the formation of the explanations.

In particular, this chapter focuses upon general beliefs such as linkages between environmental degradation and capitalism; or the association of degradation with political oppression and the "domination of nature." The chapter does not suggest that criticisms of capitalism or social oppression are misplaced, but argues it is necessary to see how political activism linked to the criticism of capitalism or oppression has shaped beliefs about the causes of environmental degradation.

This chapter therefore helps to build a "critical" political ecology by showing how science and politics co-evolve, and by arguing that many common assumptions about environmental degradation need to be reconsidered in order to acknowledge such political influences. Chapters 6 and 7

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