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ALAN SOKAL

BEYOND THE HOAX

Science, Philosophy and Culture

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Alan Sokal

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For Marina, my soulmate and companion

And for Serena, who may read this book some day

No tomo la guitarra
por conseguir un aplauso.
Yo canto la diferencia
que hay de lo cierto a lo falso.
De lo contrario no canto.

I do not play the guitar
for applause.
I sing of the difference
between what is true and what is false.
Otherwise I do not sing.

— *Violeta Parra*

Contents

Preface

I have a visceral distaste for books that have been confected by pasting together a collection of loosely connected, previously published essays. And I take a presumptive (though rebuttable) dislike towards the famous academics who foist such non-books on their unsuspecting readers.

So the reader may legitimately wonder: Am I not now publishing just such a compilation? Do I arrogantly conceive of myself as somehow exempt from my own strictures?

The answer, of course, is no. The essays collected in this book were indeed all published previously (with the exception of Chapters 4, 9 and 10), but they form, I believe, a coherent whole. At a superficial level the topic is the relation between science and society; but the deeper theme is the importance, not so much of *science*, but of the *scientific worldview* — a concept that I shall define more precisely in successive chapters, and which is in no way limited to the natural sciences — in humanity's collective decision-making. Whether my targets are the postmodernists of the left, the fundamentalists of the right, or the muddle-headed of all political and apolitical stripes, my refrain is the same: clear thinking, combined with a respect for *evidence* — especially inconvenient and unwanted evidence, evidence that challenges our preconceptions — are of the utmost importance to the survival of the human race in the twenty-first century.

This book belongs to a fairly rare genre: that of a natural scientist writing for the general educated public on cultural issues that are only indirectly related to his field of research and teaching. No one nowadays, by contrast, bats an eyelash when academics whose training is in literary criticism hold forth on questions of sociology, economics and politics; indeed, such wide-ranging cultural critique has become an almost obligatory pursuit for literary intellectuals aspiring to public prominence. But we scientists tend to be more cautious when stepping out of our own field, and with good reason: for we know from personal experience how easy it is to make a fool of oneself even in a closely adjoining subject (say, chemistry for a physicist, or even solid-state physics for an elementary-particle physicist). I too lean strongly toward caution in interdisciplinary endeavors, as the attentive reader will no doubt perceive; despite this, I have decided to stick my neck out an inch or two, because of the importance of the issues at stake.

I am thus well aware of the potential hazards — not just for the writer, but more importantly for his or her readers — of venturing publicly beyond one's own domain of scholarly competence. As the eclectic conservative polymath Richard Posner observes in his often-illuminating, sometimes-infuriating book *Public Intellectuals* (2001),

> the public gives more weight to credentials than it should when an academic is opining outside of the area of his expertise. One reason is the tendency to exaggerate the degree to which a given human being is a unity — a single, consistent self whose behavior follows a predictable pattern. He is "good" or "bad," "kind" or "cruel,", "wise" or "foolish," a "genius" or an "intellectual lightweight," and so forth.

But, Posner continues,

> Most people, including most academics, are confusing mixtures. They are moral and immoral, kind and cruel, smart and stupid — yes, academics are often smart *and* stupid, and this may not be sufficiently recognized by the laity. They are particularly likely to be both smart and stupid in an era of specialization, when academic success is likely to crown not the person of broad general intelligence but rather the person with highly developed intellectual skills in a particular field, and both the field and the skills that conduce to preeminence in it may be bulkheaded from the other fields of thought. The brilliant mathematician, physicist, artist, or historian may be incompetent in dealing with political or economic issues.[1]

So, what to do? Shall we all stick to our own narrow field, all the better to avoid embarrassing mistakes? I do not think that Posner is suggesting that, and his own multifaceted career — as law professor and federal appeals-court judge, but also as philosopher, economist, literary critic and cultural commentator — shows the contrary. The only solution, I think, is to pay less attention to credentials and more attention — *critical* attention — to the content of what is said.[2]

I am immodest enough to think that my ideas on science, philosophy and culture may be of interest to the general public, and occasionally even to specialists in the fields I intrude upon. But I am also modest (or simply realistic) enough to recognize that my ideas could be mistaken. (How true this is, after

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[1] Posner (2001, pp. 50–51), italics in the original. The bibliography for this preface begins on p. xx below.

[2] This same point is made eloquently by Noam Chomsky (1979, pp. 6–7): see the quotation on pp. 32–34 below.

all, even within my own specialty of mathematical physics!) It goes without saying, therefore, that I welcome critical commentary from both experts and non-experts. For instance, Chapters 6 and 7 of this book constitute forays into the philosophy of science, a field in which I am entirely self-taught; and if I have made a botch of it, I would be most grateful for those better-trained in philosophy than myself to demonstrate where I have gone wrong. Likewise, Chapters 8 and 9 touch on broader questions of history and politics, and I will be happy if those who disagree with my ideas would come forward and give their counterarguments. That is how knowledge progresses.

Near the beginning of his book, Posner observes that, nowadays,

> because of the information overload under which the public sweats and groans, to gain traction as a public intellectual an academic normally must have achieved, however adventitiously, a degree of public fame or notoriety. Without that it is difficult to arouse the interest of even a sliver of the nonacademic public in one's opinions on matters of concern to that public. Many public intellectuals are academics of modest distinction fortuitously thrust into the limelight, acquiring by virtue of that accident sufficient name recognition to become sought-after commentators on current events.[3]

Alas, this cynical but astute comment describes my own career as a "public intellectual" rather precisely (aside from becoming a "sought-after commentator on current events", a trap I have studiously avoided). In the summer of 1994, having becoming acquainted — thanks principally to Paul Gross and Norman Levitt's *Higher Superstition*[4] — with the phenomenon of postmodernist literary intellectuals pontificating on science and its philosophy and making a complete bungle of both, I decided to write a parody of postmodern science criticism, to see whether it could get accepted as a serious scholarly article in a trendy academic journal. A few months of library research later, I emerged with my masterpiece — bearing the enigmatic title "Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity" — and submitted it to the cultural-studies journal *Social Text*. I gave it a 50–50 chance of being accepted.[5] Little did I know that the editors of

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[3] Posner (2001, p. 5).

[4] Gross and Levitt (1994). My own views on this important book can be found in Chapter 4 below.

[5] That my subjective probability was 50% is proven by the fact that I offered two friends a bet *in either direction*, at 1–1 odds, on whether the article would be accepted for publication. The prize would be dinner at a nice restaurant. Both friends chose to bet that the article would be accepted, and I had to pay up on both bets.

Social Text were at that very moment preparing a special issue of their journal, entitled "Science Wars", with the principal aim of attacking Gross and Levitt! In April 1995 my article was accepted for publication in *Social Text*; precisely a year later it appeared in print[6]; I revealed the hoax a few weeks later in another magazine, *Lingua Franca*[7]; and my life has not been the same ever since.

I honestly had no idea how big a hoopla my little "experiment" would stir up. I had expected it to be a significant but modest scandal within a small academic community, meriting a mention on page 10 of the *Chronicle of Higher Education*. It didn't even cross my mind that the story could make the front page of the *New York Times* — granted, on a slow news day — followed in quick succession by the *International Herald Tribune*, the [London] *Observer*, and — seven months later, after the French realized that some of their own most celebrated intellectuals were a primary target — *Le Monde*.[8] All this ferment led me to publish, the following year, in collaboration with my Belgian colleague Jean Bricmont, a book-length critique of the abuse of scientific concepts and terminology by prominent French postmodernists and their American acolytes.[9]

In retrospect, I now see that I underestimated the interest of the general public in intellectual questions. Nowadays, more than half the adults in the United States have attended college[10], and many — despite the daily pressures of earning a living and raising a family — retain a lively interest in scientific, social and political questions. Moreover, there exists by now a not insignificant cohort of adults who recall having endured, as undergraduates, an English, cultural studies or women's studies course overly filled with Lacanian or deconstructionist verbiage, and who may have doubted their own intellectual competence as a result. Who can blame them if they now

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[6] Sokal (1996a), reproduced here with annotations as Chapter 1.

[7] Sokal (1996b). *Lingua Franca* (1990–2001, R.I.P.) was an irreverent and sometimes hilarious chronicler of the foibles of academia. Though it is now, sadly, defunct, some of its best work has been collected in Star (2002).

[8] Scott (1996), Landsberg (1996), Ferguson (1996), Weill (1996). This and much other commentary is collected in Editors of Lingua Franca (2000).

[9] Sokal and Bricmont (1998), originally published in French in 1997.

[10] As of 2005, 53% of the population 25 years old and over had attended at least some college. More precisely, 16.8% attended some college but obtained no degree, 8.6% obtained an associate's degree, 18.1% a bachelor's degree, and 9.5% an advanced degree. The figures are slightly higher for the cohorts under 55 years old. See U.S. Census Bureau (2007, Tables 214 and 216).

feel a bit of Schadenfreude when the emperor is revealed to be at least partly naked?[11]

Alas, much has changed in the past decade — and not for the better. Back in the 1990s, conservatives could still make rhetorical headway by insisting that postmodernist academics posed a dire threat to reason and scholarship.[12] This was always an exaggeration — even in those days, the pomo orthodoxy in a handful of elite literature departments paled in comparison with the capitalist orthodoxy in economics departments and business schools — but it did at least contain a grain of truth.[13] Ten years on, that zeitgeist is unrecognizable. The assault on reason and science now clearly comes from the right, led by an unholy (and uneasy) alliance of big corporations seeking to escape environmental and safety regulations and religious fundamentalists seeking to impose their dogmas on education and health policy.[14] Even some card-carrying right-wingers are now, it seems, having second thoughts about George W. Bush's "faith-based Presidency".[15] The grand old man of American conservatism, Barry Goldwater, is assuredly turning over in his grave.[16]

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[11] I stress that the nakedness of the emperor (and the empress) is *not* proven by the mere fact that my parody was accepted for publication; rather, it must be established by a separate argument. See Chapter 5 below for further discussion of this point; and see Sokal and Bricmont (1998) for detailed evidence of pseudo-scientific charlatanry in the writings of Jacques Lacan, Julia Kristeva, Luce Irigaray, Bruno Latour, Jean Baudrillard, Gilles Deleuze, Félix Guattari, Paul Virilio and assorted others.

[12] See, for instance, Kimball (1990), D'Souza (1991) and Himmelfarb (1994), to cite only the best-known of these jeremiads. For a detailed and brilliantly scathing assessment of both the conservative critics and their leftist academic targets, see Jacoby (1994).

[13] For my own part, I chose to critique postmodernist leftists not because I saw them as the principal threat to rationality and science — which they were not — but because I saw their ideas as undermining our shared commitment to the struggle for social justice. As Bricmont and I put it in the preface to our book *Fashionable Nonsense: Postmodern Intellectuals' Abuse of Science* (1998), "our book is not against political radicalism, it is against intellectual confusion. Our aim is not to criticize the left, but to help defend it from a trendy segment of itself" (p. xiii). Or in the eloquent words of Michael Albert, editor of *Z Magazine*: "There is nothing truthful, wise, humane, or strategic about confusing hostility to injustice and oppression, which is leftist, with hostility to science and rationality, which is nonsense" (Albert 1996, p. 69). For further discussion, see Chapters 2 and 3 below.

[14] For an extensively documented account, see Mooney (2005).

[15] See Suskind (2004) for an extremely revealing account.

[16] Senator Goldwater's views on the incipient American theocracy can be found in a trenchant 1981 speech:

> There is no position on which people are so immovable as their religious beliefs. There is no more powerful ally one can claim in a debate than Jesus Christ. Or God,

It thus transpires that even sociologist of science Bruno Latour, who spent several decades stressing "the social construction of scientific facts"[17], now laments the ammunition he fears he and his colleagues have given to the Republican right, helping them to deny or obscure the scientific consensus on global warming, biological evolution and a host of other issues:

> While we spent years trying to detect the real prejudices hidden behind the appearance of objective statements, do we now have to reveal the real objective and incontrovertible facts hidden behind the *illusion* of prejudices? And yet entire Ph.D. programs are still running to make sure that good American kids are learning the hard way that facts are made up, that there is no such thing as natural, unmediated, unbiased access to truth, that we are always prisoners of language, that we always speak from a particular standpoint, and so on, while dangerous extremists are using the very same argument of social construction to destroy hard-won evidence that could save our lives.[18]

> or Allah, or whatever one calls his supreme being. But, like any powerful weapon, the use of God's name on one's behalf should be used sparingly. The religious factors [*sic*] that are growing throughout our land are not using their religious clout with wisdom. They are trying to force government leaders into following their positions 100 percent. If you disagree with these religious groups on any particular moral issue, they cajole, they complain, they threaten you with loss of money or votes or both. ...
>
> I am frankly sick and tired of the political preachers across this country telling me as a citizen that if I want to be a moral person, I must believe in "A," "B," "C," and "D." Just who do they think they are? And from where do they presume to claim the right to dictate their moral beliefs to me? And I am more angry as a legislator who must endure the threats of every religious group who thinks it has some God-granted right to control my vote on every rollcall in the Senate. I am warning them today: I will fight them every step of the way if they try to dictate their moral convictions to all Americans in the name of conservatism. (Goldwater 1981b, p. 20590; see also Goldwater 1981a,c for similar sentiments)

Goldwater would equally be appalled at the spectacle of "conservatives" who assert the President's prerogative to jail anyone he chooses, for as long as he wishes, without trial or judicial recourse — for in the same 1981 speech he stressed that

> Being a conservative in America traditionally has meant that one holds a deep, abiding respect for the Constitution. We conservatives believe sincerely in the integrity of the Constitution. We treasure the freedom that document protects. (Goldwater 1981b, p. 20589)

[17] This is the subtitle of Latour and Woolgar (1979). For further discussion of Latour's ideas on the nature of scientific knowledge, see Chapter 6 below.

[18] Latour (2004, p. 227), italics in the original. A similar change of heart seems to have overtaken (at least in part) Harry Collins, a prominent sociologist of science who in the 1980s was

That, of course, is exactly the point I was trying to make back in 1996 about social-construction talk taken to anti-realist extremes.[19] I hate to say I told you so, but I did. As did, several years before me, Noam Chomsky, who recalled that in a not-so-distant past,

> Left intellectuals took an active part in the lively working class culture. Some sought to compensate for the class character of the cultural institutions through programs of workers' education, or by writing best-selling books on mathematics, science, and other topics for the general public. Remarkably, their left counterparts today often seek to deprive working people of these tools of emancipation, informing us that the "project of the Enlightenment" is dead, that we must abandon the "illusions" of science and rationality — a message that will gladden the hearts of the powerful, delighted to monopolize these instruments for their own use.[20]

While the essays in this book are all animated by a common concern — namely, for the centrality of *evidence* in all matters of public debate — they apply this concern to different targets: first academic postmodernists and extreme social constructivists, then purveyors of pseudoscience in its myriad forms, and finally purveyors of religion (*all* religions, without the slightest deference toward the powerful mainstream religions). It is no accident

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identified with radically constructivist positions ("the natural world has a small or non-existent role in the construction of scientific knowledge", Collins 1981, p. 3; see footnote 9 in Chapter 5 below). Collins is now keen to defend the objectivity of science from misuse by political and commercial vested interests:

> The ready acceptance of the idea that science is politicized through and through rules out the possibility of complaint when we find that certain scientific and technical arguments are hopelessly biased by their sources. For example, do we never want to say that the tobacco industry has for years falsified the implications of epidemiological studies out of a concern for selling more cigarettes? Do we want to say, rather, that this was just the tobacco industry's point of view and that the only fight there is to be had with them is a political fight, not a scientific fight? (Collins and Evans 2002, p. 280)

[19] See Chapters 2 and 3 below.

[20] Chomsky (1993, p. 286). See also Albert (1992), Chomsky (1992) and Ehrenreich (1992) for related commentary.

that the essays in the last part of the book, which deal with the subjects of greatest political and social relevance, are also the longest.

Part I of the book sets the stage, so to speak, by dealing with a comparatively lightweight target (academic postmodernists). Chapter 1 reprints the parody article, together with a series of detailed (and heretofore unpublished) annotations in which I explain the various jokes and solecisms and quote from some of the cited references. Chapters 2 and 3 explain the political importance of the issues at stake in the debates over truth and objectivity. Chapters 4 and 5 return to academia, and focus on the flaws of extreme social constructivism in the social and cultural studies of science.

Part II of the book addresses in more detail the philosophical issues concerning truth and objectivity that were raised in Part I. Chapter 6 is an updated version of the philosophical intermezzo from *Fashionable Nonsense*; it is intended as an (opinionated) introduction to contemporary debates in the philosophy of science, aimed at the general educated reader with no special background in either philosophy or science. Chapter 7 addresses some subtler issues in the philosophy of science, but it still requires no background in philosophy or science beyond that provided by Chapter 6. These two chapters were co-authored with Jean Bricmont.

Part III goes on to treat weightier social and political topics using the same lens. Chapter 8 analyzes the paradoxical relation between pseudoscience and postmodernism, and investigates how extreme skepticism can abet extreme credulity, using a series of detailed case studies: pseudoscientific therapies in nursing and "alternative medicine"; Hindu nationalist pseudoscience in India[21]; and radical environmentalism. This investigation is motivated by my suspicion that credulity in minor matters prepares the mind for credulity in matters of greater import — and, conversely, that the kind of critical thinking useful for distinguishing science from pseudoscience might also be of some use in distinguishing truths in affairs of state from lies. Chapter 9 takes on the largest and most powerful pseudoscience of all: organized religion. This chapter focusses on the central philosophical and political issues raised by religion in the contemporary world: it deplores the

[21] In this section, one of my main goals is to help popularize the brilliant work of Meera Nanda, whose book *Prophets Facing Backward: Postmodern Critiques of Science and Hindu Nationalism in India* (2003) has been extensively debated in Science Studies and in South Asian Studies, but is not widely known outside of academia. The lessons of Nanda's work go far beyond her native India; the bottom line is that abstract philosophical debates can have serious real-world consequences.

damage that is done by our culture's deference toward "faith", and it asks how nonbelievers and believers can find political common ground based on shared moral ideas. Finally, Chapter 10 draws some of these concerns together, and discusses the relationship between epistemology and ethics as they interact in the public sphere.

My motivations in writing this book are thus both intellectual and political, but I have tried hard to keep the two questions separate. Sympathy with an author's motivations (political or otherwise) can never constitute a valid reason for accepting his or her arguments, and opposition to those motivations can never constitute a valid reason for rejecting them; the arguments must be analyzed in their own right. The reader will judge how well I have done this.

Nearly every scholarly work is the fruit of extensive discussions in which the author tests and refines his or her half-baked ideas, and this one is no exception. But the general rule holds with extra force in a transdisciplinary endeavor such as the present book, in which I have strayed far beyond my own domain of professional expertise. I am therefore exceedingly grateful to those philosophers, historians and other scholars — some of them personal friends, others known to me only via e-mail — who have patiently answered my often-naive queries and have saved me from numerous embarrassing blunders. (All blunders that remain should be blamed on my parents.) As these kind souls are thanked in the acknowledgements at the end of each chapter, I shall refrain from repeating their names here (it would nearly fill the page). However, I wish to give special thanks to Jean Bricmont for a careful reading of the manuscript and for giving permission to include here two of our co-authored essays. Helena Cronin also made many valuable suggestions; the book would almost certainly be better if I had implemented more of them. Last but not least, I am grateful to Latha Menon for implanting the idea of this book in my head some years ago when we first met, and of helping bring it to fruition when I finally felt ready. (I also salute her courage in resisting the conventional publishers' wisdom that footnotes are the kiss of death for any book aspiring to a not-purely-academic readership.)

Finally, this book is dedicated to the two greatest joys of my life: Marina, who has read and commented on innumerable drafts; and Serena, who will read her daddy's book some day if she feels like it.

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PART I

The *Social Text* Affair

[I]t appears that Sokal was really not intelligent or conversant enough with the sources he quotes to write the satire himself. One has to understand the object of one's satire to effectively mock it, and Sokal has not really demonstrated that he understands the critique of science and positivism that he is attacking; instead, by his published responses to his hoax he indicates that he is himself a victim of an obsolete positivist ideology of science. Yet since Sokal's own writings on his stunt lack substantive content, it is difficult to discern what his own positions are, or if he even has positions.

— *Steven Best and Douglas Kellner**

* Steven Best and Douglas Kellner, *The Postmodern Turn* (Guilford Press, New York, 1997), p. 247n18.

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The parody, annotated

What follows is an annotated version of the parody article, "Transgressing the boundaries: Towards a transformative hermeneutics of quantum gravity", that was published in *Social Text* **#46/47** (Spring/Summer 1996), pp. 217–252. The original article and its footnotes (numbered 1, 2, . . .) appear on right-hand pages. Annotations (numbered #1, #2, . . .) are new to this edition and appear on left-hand pages.

Note that there are deliberate blank pages on the left-hand side on p. 58 and pp. 70–90.

Annotations

#1 Current practice in the academic humanities dictates that titles must begin with a gerund, consist of two phrases separated by a colon, and contain at least one play on words; furthermore, the title should preferably give as little information as possible concerning the content of the article. I have here followed these rules to the letter, save for the small violation of the fourth rule caused by the words *quantum gravity*. (This lapse toward concreteness will, I trust, be mitigated by my use of the meaningless phrase *transformative hermeneutics*.) The play on words is, of course, *transgressing the boundaries*. On the one hand it refers to transgressing disciplinary boundaries, as enunciated in the first epigraph: cultural-studies folks love transgression and interdisciplinarity. On the other hand, this phrase alludes to the technical issue of boundary conditions in quantum gravity; here I have had the luxury, as is customary in "cultural studies of science", of making up the science to fit my rhetorical needs.

(P.S. I am aware that this last obloquy is not entirely fair, but I couldn't resist. *Not all* works in the "cultural studies of science" make a total botch of the scientific content; but a goodly fraction of them do, including works by the most prestigious authors in the field. Numerous examples will be praised in this essay.)

#2 Since some hostile commentators (see e.g. p. 3 above) have questioned whether I actually wrote this parody myself, let me set the matter straight: I did. (With the exception of a few phrases that were suggested by friends of mine, to whom due credit will be given in the annotations below.) Though it may wound the *amour propre* of some postmodernist humanities scholars to discover that a mere physicist could learn their jargon well enough, in a few months' library research, to write a half-convincing simulacrum of it, that is, alas, exactly what happened.

Some confusion may have been caused by journalistic reports (especially in the first weeks after the revelation of the hoax) that referred to some people — for instance, historians Barbara Epstein and Ruth Rosen — as my "collaborators". These people gave me valuable advice while I was preparing the article for *Lingua Franca* in which I revealed the hoax (Sokal 1996). But they did not participate in the writing of the parody; indeed, my first contacts with them occurred many months *after* the final version of the parody article had been accepted for publication in *Social Text*.

#3 In this epigraph, as elsewhere in this paper, I have followed the sage counsel of David Lodge (1984, p. 152):

> Morris read through the letter. Was it a shade too fulsome? No, that was another law of academic life: *it is impossible to be excessive in flattery of one's peers.*

Stanley Aronowitz is one of the founding editors of *Social Text*. (As it turns out, I cited him 13 times in this article. I didn't even realize that until Katha Pollitt (1996) laboriously counted.)

#4 I am indebted to mathematician Dick Sacksteder for contributing the preceding two-and-a-half sentences of brilliant obfuscation. My first draft was too blunt, asserting the nonexistence of the real world in sentence 2 rather than sentence 4:

> Not long ago, most Western intellectuals believed that there exists an external world, whose properties are independent of any individual human being and indeed of humanity as a whole; that these properties are encoded in eternal physical laws; and that human beings can obtain reliable, albeit imperfect and tentative, knowledge of these laws by hewing to the objective procedures and epistemological strictures prescribed by post-Enlightenment scientific method. Recent poststructuralist and feminist criticism of the natural sciences has, however, revealed that these beliefs are illusory: physical "reality", no less than social "reality", is inherently a social and linguistic construct ...

Perhaps *that* would have been too obvious.

#5 It is at this point in the article that scientist readers begin to suspect a joke (or, alternatively, that the author has gone off his rocker). Is the existence of a real world merely a "dogma imposed by the long post-Enlightenment hegemony over the Western intellectual outlook"? What is striking, by contrast, is that humanist readers — or at least some of them — nowadays find it perfectly commonplace to doubt the existence of an external world and/or the existence of objective physical laws and/or the possibility of obtaining at least tentative knowledge of these laws via experimentation and reasoning. Or perhaps, they have simply become habituated to reading and writing such rhetoric without taking it wholly seriously. As cultural critic Ellen Willis (1996, p. 20) astutely noted, "*ST*'s editors were fooled in part because ... whatever their own views, they belong to an intellectual community in which certain linguistic tics and brands of glib relativism are such a taken-for-granted part of the conversation that they are barely noticed, let alone criticized."

Transgressing the boundaries: Towards a transformative hermeneutics of quantum gravity[#1,#2]

> Transgressing disciplinary boundaries ... [is] a subversive undertaking since it is likely to violate the sanctuaries of accepted ways of perceiving. Among the most fortified boundaries have been those between the natural sciences and the humanities.
>
> — *Valerie Greenberg, Transgressive Readings (1990, p. 1)*

> The struggle for the transformation of ideology into critical science ... proceeds on the foundation that the critique of all presuppositions of science and ideology must be the only absolute principle of science.
>
> — *Stanley Aronowitz, Science as Power (1988b, p. 339)*[#3]

There are many natural scientists, and especially physicists, who continue to reject the notion that the disciplines concerned with social and cultural criticism can have anything to contribute, except perhaps peripherally, to their research. Still less are they receptive to the idea that the very foundations of their worldview must be revised or rebuilt in the light of such criticism. Rather, they cling to the dogma imposed by the long post-Enlightenment hegemony over the Western intellectual outlook, which can be summarized briefly as follows[#4]: that there exists an external world, whose properties are independent of any individual human being and indeed of humanity as a whole; that these properties are encoded in "eternal" physical laws; and that human beings can obtain reliable, albeit imperfect and tentative, knowledge of these laws by hewing to the "objective" procedures and epistemological strictures prescribed by the (so-called) scientific method.[#5]

#6 Quantum mechanics has indeed forced profound (and still imperfectly understood) changes in the way we understand the physical world; but even the most extreme philosophical pronouncements of Heisenberg and Bohr — with which I and many other physicists disagree, by the way — would not deny the existence of an external world, of physical laws, or of the possibility of gaining at least partial knowledge of those laws through science.

#7 These "revisionist studies in the history and philosophy of science" will be examined in more detail (and criticized) in Chapter 6 below. See also Brown (2001).

#8 While feminist critiques have on numerous occasions uncovered sexist biases in biology, psychology and other scientific fields, this is a far cry from "revealing the ideology of domination" that supposedly underlies the *entirety* of modern science. See Chapter 4 below for a brief critical analysis of feminist social-constructivist theorizing about science.

As for poststructuralism, here is how Best (1991, pp. 188, 204) describes the contribution of poststructuralist/postmodernist thought to the philosophy of science:

> Postmodernism stresses the relativity, instability and indeterminacy of meaning; it abandons all attempts to grasp totalities or construct Grand Theory ... Postmodern science draws the conclusion that a new, postmodern paradigm is necessary, one which is more philosophically sophisticated, scientifically complex, ethically sensitive, spiritually aware and ecologically sane. [juxtaposition mine]

As Gross and Levitt (1994, p. 96) sardonically remark, "the reader may be inclined to characterize these dicta as a Very Grand Theory indeed". Luckily, postmodern thought is not constrained by the old-fashioned rules of linear Aristotelian logic, such as non-contradiction.

#9 This statement is, of course, absurd, but it reflects several conceits of "postmodern" theoretical writing. First of all, reality (even *physical* reality) has become in certain circles a no-no concept, which must be placed in scare quotes. Secondly, one may observe the predilection for making radical-sounding affirmations whose meaning is ambiguous: in particular, affirmations that confuse *fact* with *perception of fact*. Thus, the statement that "physical reality is at bottom a social and linguistic construct", interpreted literally, is ridiculous: can even the most ardent social constructionist really believe that there was no physical reality before about 200,000 years ago, when *Homo sapiens* evolved and human language and social life were thus born? (This curious view might be termed "species solipsism".) On the other hand, one may perhaps reinterpret this statement as saying merely that *humans' perceptions* of physical reality are at bottom a social and linguistic construct — a statement that is still far too categorical (these days the Sapir–Whorf thesis, i.e. the idea that our native language radically conditions our view of the world, is viewed with skepticism by many linguists, see e.g. Pinker 1995, pp. 57–67) but at least not completely false.

#10 This assertion is a commonplace (dare I say a cliché?) in radical-social-constructivist writing about science. Like most clichés, it contains a grain of truth but greatly exaggerates the case. Above all, it fails to make the crucial distinction between *actual* knowledge (i.e. rationally justified true belief) and *purported* knowledge. Without a doubt, the dominant groups in any social system will try to pass off their preferred ideology as "scientific knowledge"; that is exactly why critics of the dominant groups need to make a clear conceptual distinction between actual knowledge and purported knowledge. The radical-social-constructivist position is both philosophically and politically suicidal. For further discussion, see Chapter 3 below.

#11 The theory-ladenness of observations goes back at least to physicist-philosopher Pierre Duhem in 1894; it poses problems for the most naive falsifiability theories but by no means undercuts the epistemic claims of science. For further discussion, see Chapter 6 below (pp. 186–189) as well as Brown (2001).

#12 This statement is silly, but it strikes the right emotional chords: against "privilege" (especially *scientists'* privilege) and in favor of the "counter-hegemonic", the "dissident", and the "marginalized".

Note, finally, that the four assertions contained in this sentence are at the very least debatable (if not downright absurd); certainly some argument in their favor ought to be required. But the editors of *Social Text* were happy to publish an article in which these assertions are *taken for granted*. Apparently in certain circles nowadays these assertions *are* taken for granted.

But deep conceptual shifts within twentieth-century science have undermined this Cartesian–Newtonian metaphysics[1,#6]; revisionist studies in the history and philosophy of science have cast further doubt on its credibility[2,#7]; and, most recently, feminist and poststructuralist critiques have demystified the substantive content of mainstream Western scientific practice, revealing the ideology of domination concealed behind the façade of "objectivity".[3,#8] It has thus become increasingly apparent that physical "reality", no less than social "reality", is at bottom a social and linguistic construct[#9]; that scientific "knowledge", far from being objective, reflects and encodes the dominant ideologies and power relations of the culture that produced it[#10]; that the truth claims of science are inherently theory-laden and self-referential[#11]; and consequently, that the discourse of the scientific community, for all its undeniable value, cannot assert a privileged epistemological status with respect to counter-hegemonic narratives emanating from dissident or marginalized communities.[#12] These themes can be traced, despite some differences of emphasis, in Aronowitz's analysis of the cultural fabric that produced quantum mechanics[4,#13]; in Ross' discussion of oppositional discourses in post-quantum science[5,#14]; in Irigaray's and Hayles' exegeses of gender encoding in fluid mechanics[6,#15]; and in Harding's comprehensive critique of the gender ideology underlying the natural sciences in general and physics in particular.[7,#16]

Here my aim is to carry these deep analyses one step farther, by taking account of recent developments in quantum gravity: the emerging branch of physics in which Heisenberg's quantum mechanics and Einstein's general relativity are at once synthesized and superseded. In quantum gravity, as we shall see, the space-time manifold ceases to exist as an objective physical reality[#17]; geometry becomes relational and contextual[#18]; and the foundational conceptual categories of prior science — among them, existence itself — become problematized and relativized.[#19] This conceptual revolution, I will argue, has profound implications for the content of a future postmodern and liberatory science.

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[1] Heisenberg (1958), Bohr (1963).

[2] Kuhn (1970), Feyerabend (1975), Latour (1987), Aronowitz (1988b), Bloor (1991).

[3] Merchant (1980), Keller (1985), Harding (1986, 1991), Haraway (1989, 1991), Best (1991).

[4] Aronowitz (1988b, especially chapters 9 and 12).

[5] Ross (1991, introduction and chapter 1).

[6] Irigaray (1985), Hayles (1992).

[7] Harding (1986, especially chapters 2 and 10); Harding (1991, especially chapter 4).

#13 Quantum mechanics was not produced by a "cultural fabric", but by a small community of physicists (Heisenberg, Schrödinger, Born, Bohr, Pauli, Jordan, Dirac, ...). These physicists were certainly *working within* a cultural fabric. The extent to which this cultural fabric influenced the development of quantum mechanics, as compared to the role played by the internal logic of physics (both theory and experiment), is a question for rational historical investigation. It cannot simply be *assumed* that the physical theory was "produced" by the cultural fabric, nor is it sufficient to "prove" this by flimsy historical evidence.

By the way, the (highly debatable) thesis concerning the cultural origins of quantum physics in the pessimism of Weimar-era Germany is due to historian of science Paul Forman (1971).

#14 Here "oppositional discourses in post-quantum science" is a euphemism for channeling, crystal therapy, "brain expansion machines", morphogenetic fields, and sundry other New Age enthusiasms. Ross' piece is basically a travelogue in which he examines briefly, from a sympathetic but mildly skeptical point of view, a variety of these theories. As journalism or sociology, Ross' treatment is at times insightful; as philosophy of science, it is hopeless. Ross is reasonably acute when it comes to the political implications of New Age ideology, which he finds only partly progressive (he calls it sardonically a "kinder, gentler science"). But, strikingly, he shows not the slightest interest in examining whether the theories in question are *true* or even *plausible*. (No matter: Ross too was an editor of *Social Text* ...)

#15 Irigaray (1985) claims that fluid mechanics is underdeveloped with respect to solid mechanics because solidity is identified with men and fluidity with women. Hayles (1992) asserts a more nuanced version of the same thesis. See Chapter 4 below for a brief critical discussion of both Irigaray and Hayles; and see Sokal and Bricmont (1998, chapter 5) for more details.

#16 See Chapters 2 and 4 below for brief critical analyses of different aspects of Harding's claims.

#17 It is undoubtedly true that, when and if a correct theory of quantum gravity becomes available, our concepts of space and time will have to be radically modified. The space-time manifold, at least as it is currently understood, may well cease to exist as a fundamental ontological entity; it may instead have to be considered as an approximation valid only on length scales much greater than the Planck length (about 10^{-33} centimeters, i.e. a millionth of a billionth of a billionth of the size of an atom!). But this does not mean that there would cease to be an objective physical reality; it means only that the fundamental *elements* of that objective physical reality would be different from those previously thought. Such changes are nothing new in physics: In Newtonian mechanics the fundamental ontological elements were the positions of particles; but with the development of electromagnetic theory in the nineteenth and early twentieth centuries, *fields* came to play a more fundamental role; and the development of quantum mechanics and quantum field theory in the twentieth century has required even more profound ontological shifts (in my opinion still imperfectly understood). See the final section of Chapter 7 below (pp. 252–254) for further discussion of the relationship between successive "levels" of theorization of the same physical object.

#18 It may well be true that an adequate theory of quantum gravity will require a relational understanding of the geometry of physical space-time; that, at any rate, is the view of some eminent physicists such as Lee Smolin (2001, 2006). But statements like "geometry becomes relational and contextual" are too vague to have any useful meaning.

#19 This latter statement is utterly meaningless, but it sounds good in certain circles. One of the many linguistic innovations of contemporary academic humanities-speak is the verb "problematize". (This word in its current sense was first included in the Oxford English Dictionary in 1993, but the intrepid Oxford lexicographers managed to track down an isolated citation from 1910.)

#20 Quantum gravity, when it becomes better understood, will undoubtedly have profound philosophical implications. It is *possible* that these philosophical implications will in turn have cultural implications (although it is more likely that, as with relativity and quantum mechanics, the cultural effects will come from popular *mis*interpretations of the theory). But it is extremely unlikely that quantum gravity will ever have *political* implications!

#21 These last three sentences, with their overwrought modesty, are a gentle parody of the conventions of academic writing (in all fields, physics included).

My approach will be as follows: First I will review very briefly some of the philosophical and ideological issues raised by quantum mechanics and by classical general relativity. Next I will sketch the outlines of the emerging theory of quantum gravity, and discuss some of the conceptual issues it raises. Finally, I will comment on the cultural and political implications of these scientific developments.[#20] It should be emphasized that this article is of necessity tentative and preliminary; I do not pretend to answer all of the questions that I raise. My aim is, rather, to draw the attention of readers to these important developments in physical science, and to sketch as best I can their philosophical and political implications. I have endeavored here to keep mathematics to a bare minimum; but I have taken care to provide references where interested readers can find all requisite details.[#21]

Quantum Mechanics: Uncertainty, Complementarity, Discontinuity and Interconnectedness[#22]

It is not my intention to enter here into the extensive debate on the conceptual foundations of quantum mechanics.[8] Suffice it to say that anyone who has seriously studied the equations of quantum mechanics will assent to Heisenberg's measured (pardon the pun) summary of his celebrated *uncertainty principle*[#24]:

> We can no longer speak of the behaviour of the particle independently of the process of observation. As a final consequence, the natural laws formulated mathematically in quantum theory no longer deal with the elementary particles themselves but with our knowledge of them. Nor is it any longer possible to ask whether or not these particles exist in space and time objectively ...
>
> When we speak of the picture of nature in the exact science of our age, we do not mean a picture of nature so much as a *picture of our relationships with nature*.... Science no longer confronts nature as an objective observer, but sees itself as an actor in this interplay between man [*sic*] and nature. The scientific method of analysing, explaining and classifying has become conscious of its limitations, which arise out of the fact that by its intervention science alters and refashions the object

[8] For a sampling of views, see Jammer (1974), Bell (1987), Albert (1992), Dürr, Goldstein and Zanghí (1992), Weinberg (1992, chapter IV), Coleman (1993), Maudlin (1994), Bricmont (1994).[#23]

#22 Literary critics who study science like to isolate broad "themes" that can be summarized in a few words like "uncertainty", "complementarity", "discontinuity" and "interconnectedness" and then analyzed verbally *ad infinitum*. The trouble is that physical theories are not like novels: rather, they consist of an intricate logical structure in which technical terms have *precise* meanings (which *differ* subtly but crucially from the everyday English senses of the same words); and it is hopeless to try to isolate the philosophical "themes" of a theory that you understand only at the level of metaphor. (For example, one non-scientist friend asked me, quite reasonably: Isn't it contradictory for quantum mechanics to exhibit both discontinuity and interconnectedness? Aren't these opposites? The brief answer is: quantum mechanics exhibits "discontinuity" and "interconnectedness" in *very specific* senses — which require a mathematical understanding of the theory to make precise — and *these* senses are in no way logically contradictory.) For these reasons, this section of the article is hopelessly superficial, even when the statements made are not outright false.

Overall, I have constructed this section to exemplify two aspects of postmodernist musings on quantum mechanics: first, a tendency to confuse the technical meanings of words such as "uncertainty" or "discontinuity" with their everyday meanings; and second, a fondness for the most subjectivist writings of Heisenberg and Bohr, interpreted in a radical way that goes far beyond their own views (which are in turn vigorously disputed by many physicists and philosophers of science). But postmodern philosophy loves the multiplicity of viewpoints, the importance of the observer, holism and indeterminism. For a *serious* discussion of the philosophical problems posed by quantum mechanics, see the references listed in footnote 8.

It should be stressed that physicists — including some of the great physicists of the twentieth century — are partly to blame for inspiring, by example, the later excesses of postmodernist commentary on quantum mechanics. See Beller (1998) for a disturbing trove of quotations that show Niels Bohr, Max Born, Werner Heisenberg and Wolfgang Pauli engaging in absurd extrapolations of ideas from quantum physics to politics, psychology, philosophy and religion.

#23 These are "real" references; I recommend them highly. In particular, the little book of Albert (1992) provides an impressively serious and *intellectually honest* account of quantum mechanics and the philosophical issues it raises — yet it requires no more mathematical background than a modicum of high-school algebra, and does not require any prior knowledge of physics. The main requirement is a willingness to think *slowly* and *clearly*. Weinberg (1992, chapter IV) also provides a good, though much less detailed, semi-popular treatment. The other references are also excellent but more technical.

#24 Of course, this quote does *not* summarize the uncertainty principle; it summarizes *Heisenberg's philosophical interpretation* of the uncertainty principle, which is disputed by many physicists (including myself) and which is in no way contained in the *equations* of quantum mechanics.

#25 These examples of "cross-fertilization of ideas between relativistic quantum theory and literary criticism" are, in my modest opinion, simplistic at best, grossly misguided at worst. The fundamental flaw is that they are based on a purely metaphorical understanding of quantum mechanics (and/or relativity) that is superficial when not simply mistaken.

#26 Of course, this passage is utterly meaningless (despite the promising beginning in the first half-sentence); what it suggests is that Deleuze and Guattari are themselves "amateur philosophers", at least as regards the philosophy of physics. For a much more extensive catalogue of pseudo-scientific nonsense in the work of Deleuze and Guattari, see Sokal and Bricmont (1998, chapter 9).

Note also my characterization of this passage as "lucid". As one of my physicist friends later pointed out, "When you see the word 'lucid', get ready to laugh."

#27 As mentioned in note #13, this (rather dubious) thesis is due to Paul Forman.

#28 This is a joke, intended as an example of the type of error that is committed by vulgar Marxists who don't know what they're talking about. (I have nothing against sophisticated Marxists, or against vulgar Marxists who do know what they're talking about.) In fact, all of contemporary technology depends on semiconductors, and semiconductor physics is utterly based on quantum mechanics.

#29 Physicists use only the term "complementarity"; but I thought it would be fun, in present company, to call it "dialecticism". It doesn't seem so wrong.

> of investigation. In other words, method and object can no longer be separated.[9,10]

Along the same lines, Niels Bohr wrote:

> An independent reality in the ordinary physical sense can ... neither be ascribed to the phenomena nor to the agencies of observation.[11]

Stanley Aronowitz has convincingly traced this worldview to the crisis of liberal hegemony in Central Europe in the years prior and subsequent to World War I.[#27,12,13]

A second important aspect of quantum mechanics is its principle of *complementarity* or *dialecticism.*[#29] Is light a particle or a wave? Complementarity "is the realization that particle and wave behavior are mutually exclusive,

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[9] Heisenberg (1958, pp. 15, 28–29), emphasis in Heisenberg's original. See also Overstreet (1980), Craige (1982), Hayles (1984), Greenberg (1990), Booker (1990) and Porter (1990) for examples of cross-fertilization of ideas between relativistic quantum theory and literary criticism.[#25]

[10] Unfortunately, Heisenberg's uncertainty principle has frequently been misinterpreted by amateur philosophers. As Gilles Deleuze and Félix Guattari (1994, pp. 129–130) lucidly point out,

> in quantum physics, Heisenberg's demon does not express the impossibility of measuring both the speed and the position of a particle on the grounds of a subjective interference of the measure with the measured, but it measures exactly an objective state of affairs that leaves the respective position of two of its particles outside of the field of its actualization, the number of independent variables being reduced and the values of the coordinates having the same probability.... Perspectivism, or scientific relativism, is never relative to a subject: it constitutes not a relativity of truth but, on the contrary, a truth of the relative, that is to say, of variables whose cases it orders according to the values it extracts from them in its system of coordinates ... [#26]

[11] Bohr (1928), cited in Pais (1991, p. 314).

[12] Aronowitz (1988b, pp. 251–256).

[13] See also Porush (1989) for a fascinating account of how a second group of scientists and engineers — cybernetics — contrived, with considerable success, to subvert the most revolutionary implications of quantum physics. The main limitation of Porush's critique is that it remains solely on a cultural and philosophical plane; his conclusions would be immeasurably strengthened by an analysis of economic and political factors. (For example, Porush fails to mention that engineer-cybernetics Claude Shannon worked for the then-telephone monopoly AT&T.) A careful analysis would show, I think, that the victory of cybernetics over quantum physics in the 1940s and 50s can be explained in large part by the centrality of cybernetics to the ongoing capitalist drive for automation of industrial production, compared to the marginal industrial relevance of quantum mechanics.[#28]

#30 In this footnote I am engaging, once again, in a bit of calculated flattery of *Social Text*'s principal "expert" on science. Alas, making a comprehensive catalogue of Aronowitz's confusions about physics would be a thankless chore. Suffice it to say that the search for a unified theory of the fundamental interactions of nature, while still an unfinished task, has made great progress over the last half-century; certainly Aronowitz gives no valid grounds to support his peremptory assertion that it is an "impossibility". Much more could be said about this passage, but it would be exceedingly boring.

#31 The physicist John Bell (1928–1990), who was a major contributor to the study of the conceptual foundations of quantum mechanics, made an interesting observation concerning Bohr's notion of "complementarity" (Bell 1987, pp. 189–190):

> It seems to me that Bohr used this word ["complementary"] with the reverse of its usual meaning. Consider for example the elephant. From the front she is head, trunk, and two legs. From the back she is bottom, tail, and two legs. From the sides she is otherwise, and from top and bottom different again. These various views are complementary in the usual sense of the word. They supplement one another, they are consistent with one another, and they are all entailed by the unifying concept 'elephant'. It is my impression that to suppose Bohr used the word 'complementary' in this ordinary way would have been regarded by him as missing his point and trivializing his thought. He seems to insist rather that we must use in our analysis elements which *contradict* one another, which do not add up to, or derive from, a whole. By 'complementarity' he meant, it seems to me, the reverse: contradictoriness. ... Perhaps he took a subtle satisfaction in the use of a familiar word with the reverse of its familiar meaning.

Note also that the Bohr–Heisenberg interpretation of quantum-mechanical complementarity is by no means universally accepted among physicists concerned with the philosophical foundations of quantum mechanics. As Bell (1987, p. 189) points out:

> The justly immense prestige of Bohr has led to the mention of complementarity in most text books of quantum theory. But usually only in a few lines. One is tempted to suspect that the authors do not understand the Bohr philosophy sufficiently to find it helpful.

#32 Shelly Goldstein (1996, p. 119) amusingly terms this philosophy "multiphysicalism".

yet that both are necessary for a complete description of all phenomena."[14] More generally, notes Heisenberg,

> the different intuitive pictures which we use to describe atomic systems, although fully adequate for given experiments, are nevertheless mutually exclusive. Thus, for instance, the Bohr atom can be described as a small-scale planetary system, having a central atomic nucleus about which the external electrons revolve. For other experiments, however, it might be more convenient to imagine that the atomic nucleus is surrounded by a system of stationary waves whose frequency is characteristic of the radiation emanating from the atom. Finally, we can consider the atom chemically.... Each picture is legitimate when used in the right place, but the different pictures are contradictory and therefore we call them mutually complementary.[15,#31]

And once again Bohr:

> A complete elucidation of one and the same object may require diverse points of view which defy a unique description. Indeed, strictly speaking, the conscious analysis of any concept stands in a relation of exclusion to its immediate application.[16,#32]

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[14] Pais (1991, p. 23). Aronowitz (1981, p. 28) has noted that wave-particle duality renders the "will to totality in modern science" severely problematic:

> The differences within physics between wave and particle theories of matter, the indeterminacy principle discovered by Heisenberg, Einstein's relativity theory, all are accommodations to the impossibility of arriving at a unified field theory, one in which the "anomaly" of difference for a theory which posits identity may be resolved without challenging the presuppositions of science itself.

For further development of these ideas, see Aronowitz (1988a, pp. 524–525, 533).[#30]

[15] Heisenberg (1958, pp. 40–41).

[16] Bohr (1934), cited in Jammer (1974, p. 102). Bohr's analysis of the complementarity principle also led him to a social outlook which was, for its time and place, notably progressive. Consider the following excerpt from a 1938 lecture (Bohr 1958, p. 30):

> I may perhaps here remind you of the extent to which in certain societies the roles of men and women are reversed, not only regarding domestic and social duties but also regarding behaviour and mentality. Even if many of us, in such a situation, might perhaps at first shrink from admitting the possibility that it is entirely a caprice of fate that the people concerned have their specific culture and not ours, and we not theirs instead of our own, it is clear that even the slightest suspicion in this respect implies a betrayal of the national complacency inherent in any human culture resting in itself.

#33 Arkady Plotnitsky is a complicated character. Having obtained a master's degree in mathematics in the Soviet Union before emigrating to the United States and switching to literary theory and cultural studies, he has a fair knowledge of physics; he certainly avoids the gross blunders that are common among his literary colleagues. I can't honestly say that I found his discussion of foundational questions in quantum mechanics terribly enlightening; others may disagree. (It should be stressed that the conceptual foundations of quantum mechanics are an extraordinarily difficult and confusing subject; it is not easy for *anyone*, even a professional physicist or philosopher of physics, to make a genuine contribution to this area.)

#34 The reference to an "eerily exact summary of the complementarity principle" is an ironic joke. Johnson's description of deconstruction is not exactly a masterpiece of clarity and precision; but neither, truth be told, are Bohr's and Heisenberg's descriptions of complementarity.

#35 Here is a brief excerpt from this "thought-provoking analysis":

> This study traces the nature and consequences of the circulation of desire in a postmodern order of things (an order implicitly modelled on a repressed archetype of the new physics' fluid particle flows), and it reveals a complicity between scientism, which underpins the postmodern condition, and the sadism of incessant deconstruction, which heightens the intensity of the pleasure-seeking moment in postmodernism. This complicity raises disturbing questions about the credentials of postmodernism, and it has the dehumanising effect of obscuring the individual and putting an end to praxis. In addition, the unbounded play of difference in this order of things tends to dissolve restraints to sadism and barbarism, giving desire and capital free rein in the fluid play of market signifiers.

The rest of the article is in the same vein.

#36 [A note for physicist readers:] If one wants to stretch the point a bit, this is not really such a bad description of what seems to be going in the φ_4^4 quantum field theory. Who knows? — maybe a few readings of Jacques Derrida's works will inspire someone to prove (or disprove) the triviality of φ_4^4. Anyone who succeeds will deserve, at the very least, the Heinemann Prize for Mathematical Physics.

#37 There are indeed important "homologies" between quantum field theory and the theory of phase transitions, but these have little to do with the "theme" of discontinuity. Rather, they have to do with a precise (but quite technical) mathematical relationship: quantum field theory analytically continued to imaginary time is mathematically *identical* to a model of classical statistical mechanics, and the continuum limit in quantum field theory corresponds to the critical point in the theory of phase transitions.

#38 Merz and Knorr Cetina (1994) is a lengthy — and, when all is said and done, extraordinarily silly — interpretative ethnography of theoretical physicists at the European particle-physics laboratory CERN, in which their mathematical practices are assimilated, by virtue of strained analogies, to Jacques Derrida's notion of "deconstruction" in literary theory. (Even such mainstays of high-school algebra as solving a quadratic equation can, it is claimed, be viewed as an instance of Derridean deconstruction.) Along the way, the authors perpetrate some enormous bloopers, such as the assertion (pp. 77–78) that "an algebraic equation with more than one unknown ... cannot be solved through thinking" (the reader who knows a little algebra is invited to disprove this claim by finding the solution set to $xy = 0$).

I first came across this article as a preprint (generously published by CERN, where the first author was a visiting sociologist). I had no idea that three years later it would be published in the prestigious *Social Studies of Science*.

This foreshadowing of postmodernist epistemology is by no means coincidental. The profound connections between complementarity and deconstruction have recently been elucidated by Froula[17] and Honner[18], and, in great depth, by Plotnitsky.[19,20,21]

A third aspect of quantum physics is *discontinuity* or *rupture*: as Bohr explained,

> [the] essence [of the quantum theory] may be expressed in the so-called quantum postulate, which attributes to any atomic process an essential discontinuity, or rather individuality, completely foreign to the classical theories and symbolized by Planck's quantum of action.[22]

A half-century later, the expression "quantum leap" has so entered our everyday vocabulary that we are likely to use it without any consciousness of its origins in physical theory.

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[17] Froula (1985).

[18] Honner (1994).

[19] Plotnitsky (1994). This impressive work also explains the intimate connections with Gödel's proof of the incompleteness of formal systems and with Skolem's construction of nonstandard models of arithmetic, as well as with Bataille's general economy.[#33] For further discussion of Bataille's physics, see Hochroth (1995).

[20] Numerous other examples could be adduced. For instance, Barbara Johnson (1989, p. 12) makes no specific reference to quantum physics; but her description of deconstruction is an eerily exact summary of the complementarity principle:

> Instead of a simple "either/or" structure, deconstruction attempts to elaborate a discourse that says *neither* "either/or", *nor* "both/and" nor even "neither/nor", while at the same time not totally abandoning these logics either.[#34]

See also McCarthy (1992) for a thought-provoking analysis that raises disturbing questions about the "complicity" between (nonrelativistic) quantum physics and deconstruction.[#35]

[21] Permit me in this regard a personal recollection: Fifteen years ago, when I was a graduate student, my research in relativistic quantum field theory led me to an approach which I called "de[con]structive quantum field theory" (Sokal 1982). Of course, at that time I was completely ignorant of Jacques Derrida's work on deconstruction in philosophy and literary theory. In retrospect, however, there is a striking affinity: my work can be read as an exploration of how the orthodox discourse (e.g. Itzykson and Zuber 1980) on scalar quantum field theory in four-dimensional space-time (in technical terms, "renormalized perturbation theory" for the φ^4_4 theory) can be seen to assert its own unreliability and thereby to undermine its own affirmations.[#36] Since then, my work has shifted to other questions, mostly connected with phase transitions; but subtle homologies between the two fields can be discerned, notably the theme of discontinuity (see footnotes 22 and 81 below).[#37] For further examples of deconstruction in quantum field theory, see Merz and Knorr Cetina (1994).[#38]

[22] Bohr (1928), cited in Jammer (1974, p. 90).

#39 This is not a joke: Maudlin's exposition of Bell's theorem is masterful and clear, and I recommend it highly. See also Mermin (1993) for a more technical account.

#40 Bell's theorem is indeed one of the most profound results in modern physics, and in my opinion its meaning is still incompletely understood. But, contrary to what one might infer from my intentionally overheated summary, Bell's theorem does *not* provide any physical basis for telepathy, psychokinesis, etc. Indeed, it can be proven that the correlations established by Bell's theorem — whatever their correct interpretation — *cannot* be used for the transmission of information or energy. See e.g. Maudlin (1994).

#41 This quote is a hilarious (and depressing) web of confusions. Already the first sentence is a mess: the phrase "linear causality" has no meaning (probably Aronowitz means simply "causality", i.e. the assertion that causes temporally precede their effects); the phrase "can be expressed as a function of temporal succession" is so vague as to be meaningless (probably what he means is that causes temporally precede their effects).

In the second sentence Aronowitz fails to say *which* recent developments he is alluding to; "postulate" is the wrong verb (one has no right to *postulate* anything once one has a complete physical theory, rather one must *deduce* the consequences of that theory); the claim that "it is possible to know the effects of absent causes" is so vague that I haven't the foggiest idea what it is intended to refer to; the "metaphorical speaking" of this sentence gets taken literally in the next sentence; and the claim that in quantum mechanics "effects may anticipate causes" is just balderdash.

In the third sentence, "the hypothesis" is ambiguous (*which* hypothesis?), and moreover "hypothesis" is inappropriate (for the same reason that "postulate" is inappropriate); "asserts the possibility of time's reversal" is also ambiguous (is Aronowitz simply saying again that "[some] effects may anticipate [some] causes", or is he claiming that henceforth *all* effects will precede their causes?); and finally, the question of "time's arrow" and irreversibility is a fundamental one in physics, but quantum mechanics plays only a minor role in it.

In the fourth sentence Aronowitz says "these experiments", without having previously mentioned *any* experiments.

But the fifth sentence is by far the most hilarious, in its juxtaposition of quantum mechanics to matters of human society. The saddest thing is that there *is* an interesting historical and sociological issue here (though Aronowitz is far from the first to notice it): namely, the *human* perception and understanding of time has varied between cultures and between historical epochs; for instance, peasants are likely to be very attuned to the seasons but little interested in the exact time of day, while a modern city-dweller working in an air-conditioned office is apt to feel exactly the reverse. Likewise, Aronowitz's reference to "industrial discipline ... in the early bourgeois epoch" as a cause of time's "segmentation into hours and minutes" is by no means off-base: indeed, prior to the nineteenth century, laborers in Europe were generally paid by the day rather than by the hour. But none of these issues have the slightest thing to do with quantum mechanics.

#42 Of course, all this commentary is pure obfuscation. The cited references contain wonderful physics, but they contain nothing that would support Aronowitz's reveries.

#43 The reference to Goldstein (1983) is a joke. The full title of this book is *The Mind-Body Problem: A Novel*. The narrator, a graduate student in philosophy at Princeton, is writing her doctoral dissertation on the mind-body problem. But she has a mind-body problem of her own: she is attracted to men for their minds, while they are attracted to her for her body. In chapters 7 and 8, the narrator has "intimate relations" with a visiting quantum mechanic from Cornell.

By the way, I recommend this novel highly, even though it fails to solve the philosophical problems of quantum mechanics.

#44 David Bohm (1917–1992) was an American physicist whose intellectual trajectory comprised at least three distinct phases. In 1951, while still an assistant professor at Princeton, he published an excellent textbook on quantum mechanics from the orthodox Bohr–Heisenberg perspective. In 1952, however, he published a pair of articles that proposed a radically new approach to quantum mechanics, now known as Bohmian mechanics. These papers were largely ignored for several decades, and their importance has only gradually become recognized. Simultaneously, Bohm was fired from Princeton because of his refusal to testify before the House Un-American Activities Committee about his alleged Communist associations; he moved to the University of São Paulo and later, after several peregrinations, to Birkbeck College (London), where he taught until his retirement in 1987. In this period he made other contributions to quantum mechanics, such as the discovery of

Finally, Bell's theorem[23] and its recent generalizations[24] show that an act of observation here and now can affect not only the object being observed — as Heisenberg told us — but also an object *arbitrarily far away* (say, on Andromeda galaxy).[#40] This phenomenon — which Einstein termed "spooky" — imposes a radical reevaluation of the traditional mechanistic concepts of space, object and causality[25], and suggests an alternative worldview in which the universe is characterized by interconnectedness and (w)holism: what physicist David Bohm has called "implicate order".[26,#44] New Age interpretations of these insights from quantum physics have often gone overboard in unwarranted speculation, but the general soundness of the argument is undeniable.[27] In Bohr's words, "Planck's discovery of the *elementary quantum of action* ... revealed a feature of *wholeness* inherent

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[23] Bell (1987, especially chapters 10 and 16). See also Maudlin (1994, chapter 1) for a clear account presupposing no specialized knowledge beyond high-school algebra.[#39]

[24] Greenberger *et al.* (1989, 1990), Mermin (1990, 1993).

[25] Aronowitz (1988b, p. 331) has made a provocative observation concerning nonlinear causality in quantum mechanics and its relation to the social construction of time:

> Linear causality assumes that the relation of cause and effect can be expressed as a function of temporal succession. Owing to recent developments in quantum mechanics, we can postulate that it is possible to know the effects of absent causes; that is, speaking metaphorically, effects may anticipate causes so that our perception of them may precede the physical occurrence of a "cause." The hypothesis that challenges our conventional conception of linear time and causality and that asserts the possibility of time's reversal also raises the question of the degree to which the concept of "time's arrow" is inherent in all scientific theory. If these experiments are successful, the conclusions about the way time as "clock-time" has been constituted historically will be open to question. We will have "proved" by means of experiment what has long been suspected by philosophers, literary and social critics: that time is, in part, a conventional construction, its segmentation into hours and minutes a product of the need for industrial discipline, for rational organization of social labor in the early bourgeois epoch.[#41]

The theoretical analyses of Greenberger *et al.* (1989, 1990) and Mermin (1990, 1993) provide a striking example of this phenomenon; see Maudlin (1994) for a detailed analysis of the implications for concepts of causality and temporality. An experimental test, extending the work of Aspect *et al.* (1982), will likely be forthcoming within the next few years.[#42]

[26] Bohm (1980). The intimate relations between quantum mechanics and the mind-body problem are discussed in Goldstein (1983, chapters 7 and 8).[#43]

[27] Among the voluminous literature, the book by Capra (1975) can be recommended for its scientific accuracy and its accessibility to non-specialists. In addition, the book by Sheldrake (1981), while occasionally speculative, is in general sound. For a sympathetic but critical analysis of New Age theories, see Ross (1991, chapter 1). For a critique of Capra's work from a Third World perspective, see Alvares (1992, chapter 6).[#45]

the Aharonov–Bohm effect (1959). Finally, starting in the 1960s, Bohm's philosophical reflections on quantum mechanics — and in particular its nonlocality — led him to speculations on the interconnectedness of the universe, culminating in his 1980 book, *Wholeness and the Implicate Order*.

While Bohm is best known (especially among non-scientists) for his final quasi-New-Age phase, his most important and enduring work is without a doubt the 1952 creation of Bohmian mechanics (also set forth systematically in a posthumously published 1993 textbook co-authored with Basil Hiley). In this work, Bohm *rejects* the Bohr–Heisenberg ideology so beloved of postmodernists, and adopts instead the old-fashioned philosophy of *scientific realism*: the goal of physics is to describe the world as it actually is. Bohmian mechanics is based on an unambiguous ontology (the wave function *and* particle positions) and is governed by a *deterministic* differential equation (just as in *Newtonian* mechanics, though the equation is first-order rather than second-order). It is at present unclear whether the Bohmian approach can be usefully wedded to special and general relativity. For a semi-technical overview of Bohmian mechanics, see Goldstein (2006); and for a detailed history, see Cushing (1994). Bohm's fascinating life and work cry out for a serious and detailed biography by a historian of science.

#45 What Fritjof Capra's best-selling *The Tao of Physics* says about quantum mechanics is not all wrong, but my praise here for its "scientific accuracy" is a bit over the top. Many of Capra's purported "parallels between modern physics and Eastern mysticism" (the subtitle of his book) rest on strained analogies, to say the least.

Rupert Sheldrake's theory of "morphogenetic fields", though popular in New Age circles, hardly qualifies as "in general sound". To call it "occasionally speculative" is a massive understatement. See note #77 below.

Regarding Ross, see note #14 above.

The "Third World perspective" of Claude Alvares will be discussed further in Chapter 8, in connection with postmodernism and Hindu nationalist pseudoscience in India.

#46 The references to physics in this section and the next are, by and large, roughly correct though incredibly shallow; they are written in a deliberately overblown style that parodies some recent popularizations of science. Just for fun, I did introduce a few howlers into the text; but the most absurd passages here are to be found in the footnotes, in the form of quotations from the (mostly French) Masters, whom I shower with mock praise. In any case, the primary purpose of this section is to provide a gentle lead-in to the article's first major gibberish quote, namely Derrida's comment on relativity.

#47 Note the intentionally subjectivist phrasing of this statement. In reality, the Lorentz transformation — the mathematical formula that expresses the transformation of space and time coordinates between two frames of reference in uniform relative motion — enunciates a *perfectly objective* fact about the universe; it would be "perceived" by machines equipped with measuring devices, no less than by human observers.

#48 In reality, Latour's understanding of special relativity is so confused that his article is useless not only as an "introduction to special relativity for non-scientists" — which admittedly it was never intended to be — but also in its intended role as philosophical or sociological commentary on relativity theory. For a brief analysis of Latour's misunderstandings, see Chapter 5 below; and for more details, see Huth (1998) and Sokal and Bricmont (1998, chapter 6).

in atomic physics, going far beyond the ancient idea of the limited divisibility of matter."[28]

Hermeneutics of Classical General Relativity[#46]

In the Newtonian mechanistic worldview, space and time are distinct and absolute.[29] In Einstein's special theory of relativity (1905), the distinction between space and time dissolves: there is only a new unity, four-dimensional space-time, and the observer's perception of "space" and "time" depends on her state of motion.[#47,30] In Hermann Minkowski's famous words (1908):

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[28] Bohr (1963, p. 2), emphasis in Bohr's original.

[29] Newtonian atomism treats particles as hyperseparated in space and time, backgrounding their interconnectedness (Plumwood 1993a, p. 125); indeed, "the only 'force' allowed within the mechanistic framework is that of kinetic energy — the energy of motion by contact — all other purported forces, including action at a distance, being regarded as occult" (Mathews 1991, p. 17). For critical analyses of the Newtonian mechanistic worldview, see Weil (1968, especially chapter 1), Merchant (1980), Berman (1981), Keller (1985, chapters 2 and 3), Mathews (1991, chapter 1) and Plumwood (1993a, chapter 5).

[30] According to the traditional textbook account, special relativity is concerned with the coordinate transformations relating *two* frames of reference in uniform relative motion. But this is a misleading oversimplification, as Latour (1988) has pointed out:

> How can one decide whether an observation made in a train about the behaviour of a falling stone can be made to coincide with the observation made of the same falling stone from the embankment? If there are only one, or even *two*, frames of reference, no solution can be found since the man in the train claims he observes a straight line and the man on the embankment a parabola.... Einstein's solution is to consider *three* actors: one in the train, one on the embankment and a third one, the author [enunciator] or one of its representants, who tries to superimpose the coded observations sent back by the two others.... [W]ithout the enunciator's position (hidden in Einstein's account), and without the notion of centres of calculation, Einstein's own technical argument is ununderstandable... (pp. 10–11 and 35, emphasis in original)

In the end, as Latour wittily but accurately observes, special relativity boils down to the proposition that

> more frames of reference with less privilege can be accessed, reduced, accumulated and combined, observers can be delegated to a few more places in the infinitely large (the cosmos) and the infinitely small (electrons), and the readings they send will be understandable. His [Einstein's] book could well be titled: 'New Instructions for Bringing Back Long-Distance Scientific Travellers'. (pp. 22–23)

Latour's critical analysis of Einstein's logic provides an eminently accessible introduction to special relativity for non-scientists.[#48]

#49 Amusingly, one favorable reviewer of our book *Intellectual Impostures* cited this statement of mathematician Hermann Minkowski (1864–1909) as an example of poststructuralist gobbledygook (see Applebaum 1998). In fact, this sentence is an elegant and scientifically impeccable summary of Einstein's relativity.

#50 This quote from Virilio is hilariously nonsensical. The logistic equation is a differential equation studied in the theory of biological populations (among other areas of science); it is written $dx/dt = \lambda x(1 - x)$ and goes back to the mathematician Verhulst (1845). It has nothing to do with $M \times V$. In Newtonian mechanics $M \times V$ is called the "momentum"; in relativistic mechanics $M \times V$ does not arise at all. The "dromospheric space" is a Virilian invention.

In this quote I have corrected a typographical error in the translation, which rendered "l'espace dromosphérique" as "the dromospheric *sphere*"! For what it's worth, the translation is in general quite bad: "grandeur" is rendered in English as "grandeur" (it should be "quantity"), "physicien" is rendered as "physician" (it should be "physicist"), and so forth.

See Sokal and Bricmont (1998, chapter 10) for many further examples of Virilio's impostures concerning physics.

#51 The reference to "this radical alteration of the Newtonian formula" is an ironic joke: $M \times V$ is the formula for momentum in Newtonian mechanics, but *not* in special-relativistic mechanics. It goes without saying that nothing in the writings of Lorentz, Einstein, Minkowski, Weyl and Weinberg lends any support to Virilio's conceits.

#52 The statements made in this paragraph (but *not* those in the associated footnotes) are basically correct. Note, however, the deliberate use of the buzz-words "mechanistic", "perception" and "absolute".

#53 This was a shameless attempt to curry favor with the editors and readers of *Social Text*, many of whom are likely to have traumatic memories of high-school mathematics classes. (And for good reason: the teaching of mathematics in the United States is, with few exceptions, horrible.) But teaching non-Euclidean geometry in place of Euclidean geometry is hardly likely to make things better!

#54 Einstein's nonlinear equations are indeed difficult to solve, especially for those who do *not* have a "traditional" mathematical training! This reference to "nonlinearity" is the start of a recurrent joke, which imitates the misunderstandings rife in postmodernist writings. A few words of explanation may be in order here, both for non-scientists unfamiliar with the concept of linearity in mathematics and for scientists unfamiliar with the profundities of postmodern thought.

First of all, in mathematics the word "linear" has *two* meanings which must not be confused. On the one hand, one may speak of a linear *function* (or *differential equation*, etc.): for example, the functions $f(x) = 2x$ and $f(x) = -17x$ are linear, while $f(x) = x^2$ and $f(x) = \sin x$ are nonlinear. In terms of mathematical modeling, a linear equation describes a situation in which (here I am oversimplifying a bit) "the effect is strictly proportional to the cause". On the other hand, one may speak of a *linear order* (also called *total order*): this means that one orders a set in such a way that for each pair of elements a and b one has either $a < b$ or $a = b$ or $a > b$. Thus, the real numbers (or points on a line) carry a natural linear order, while the complex numbers (or points in a plane) do not.

Now, various postmodern theorists have given a *third* meaning to the word "linear" — one that is vaguely related to the second sense, but often confused by them with the first — in speaking of *linear thought*. This latter concept is never very precisely defined, but the general idea is clear enough: it designates the logical and rationalist thought of the Enlightenment and of so-called "classical" science (often accused of an extreme reductionism and numericism). This allegedly shallow and outdated mode of thinking has now been superseded, according to the postmodernists, by a much deeper "nonlinear thought". The precise content of this new mode of thought is never explained very clearly — that would, perhaps, be too linear — but the basic idea seems to be to go beyond mere reason by uniting it with intuition and subjective perception (and perhaps also with spirituality). Furthermore, many non-scientist commentators claim that so-called "postmodern science" — and especially chaos theory — justifies and supports this new "nonlinear thought". But, in reality, this argument rests on nothing more than a confusion between two unrelated senses of the same English word.

Lest the reader think this an unfair characterization of the postmodernists' argument, let us examine some examples. Here is what feminist postmodernist Patti Lather (1991, pp. 104–105) says about science:

> ... the intentions of [classical] science to liberate reason from the dictates of kings and priests were inscribed into practices of control and domination. These practices were rooted in a binary logic of hermetic subjects and objects and a *linear, teleological rationality* ... Linearity and teleology

> Henceforth space by itself, and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will preserve an independent reality.[31,#49]

Nevertheless, the underlying geometry of Minkowskian space-time remains absolute.[32,#52]

It is in Einstein's general theory of relativity (1915) that the radical conceptual break occurs: the space-time geometry becomes contingent and dynamical, encoding in itself the gravitational field. Mathematically, Einstein breaks with the tradition dating back to Euclid (and which is inflicted on high-school students even today![#53]), and employs instead the non-Euclidean geometry developed by Riemann. Einstein's equations are highly nonlinear, which is why traditionally-trained mathematicians find them so difficult to solve.[#54,33] Newton's gravitational theory corresponds to the crude (and conceptually misleading) truncation of Einstein's equations in which the nonlinearity is simply ignored. Einstein's general relativity therefore subsumes all the putative successes of Newton's theory, while going beyond Newton to predict radically new phenomena that arise directly from the nonlinearity: the bending of starlight by the sun, the precession of the perihelion of Mercury, and the gravitational collapse of stars into black holes.[#56]

General relativity is so weird that some of its consequences — deduced by impeccable mathematics, and increasingly confirmed by astrophysical observation — read like science fiction. Black holes are by now well known, and wormholes are beginning to make the charts. Perhaps less familiar is Gödel's construction of an Einstein space-time admitting closed timelike curves: that is, a universe in which it is possible to travel *into one's own past*![34,#57]

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[31] Minkowski (1908), translated in Lorentz *et al.* (1952, p. 75).

[32] It goes without saying that special relativity proposes new concepts not only of space and time but also of mechanics. In special relativity, as Virilio (1991, p. 136) has noted, "the dromospheric space, space-speed, is physically described by what is called the 'logistic equation,' the result of the product of the mass displaced by the speed of its displacement, MxV."[#50] This radical alteration of the Newtonian formula has profound consequences, particularly in the quantum theory; see Lorentz *et al.* (1952) and Weinberg (1992) for further discussion.[#51]

[33] Steven Best (1991, p. 225) has put his finger on the crux of the difficulty, which is that "unlike the linear equations used in Newtonian and even quantum mechanics, non-linear equations do [not] have the simple additive property whereby chains of solutions can be constructed out of simple, independent parts". For this reason, the strategies of atomization, reductionism and context-stripping that underlie the Newtonian scientific methodology simply do not work in general relativity.[#55]

[34] Gödel (1949). For a summary of recent work in this area, see 't Hooft (1993).

> are [now] being supplanted by *chaos models of non-linearity* (Gleick, 1987) and an emphasis on historical contingency (Foucault, 1980). [emphasis added]

And here are two (admittedly less well known) postmodernist literary theorists:

> As opposed to more linear (historical and psychoanalytic as well as scientific) determinisms that tend to exclude them as anomalies outside the generally linear course of things, certain older determinisms incorporated chaos, incessant turbulence, sheer chance, in dynamic interactions cognate to modern chaos theory ... (Hawkins 1995, p. 49)

> Unlike teleological linear systems, chaotic models resist closure, breaking off instead into endless "recursive symmetries." This lack of closure privileges uncertainty. A single theory or "meaning" disseminates into infinite possibilities ... What we once considered to be enclosed by linear logic begins to open up to a surprising series of new forms and possibilities. (Rosenberg 1992, p. 210)

Let me stress that I am *not* criticizing these authors for employing the word "linear" in their own sense: mathematics has no monopoly on the word. What I am criticizing is some postmodernists' tendency to *confuse* their sense of the word with the mathematical one, and to draw connections with chaos theory that are not supported by any valid argument.

#55 Best's reference to "the linear equations used in Newtonian and even quantum mechanics" is, as Gross and Levitt (1994, p. 98) point out,

> a howler; for, whereas the fundamental equation of quantum mechanics (the Schrödinger equation) is what is technically known as a linear partial differential equation, the Newtonian laws of celestial mechanics are expressed by a decidedly *nonlinear* system of ordinary differential equations (which is why ... some of the most interesting examples in chaos theory occur in classical celestial mechanics).

The second half of Best's sentence is, by contrast, a basically accurate (though perhaps confusingly phrased) summary of the properties of linear equations.

My final sentence was simply pandering to the intended audience, by invoking the requisite buzzwords. "Atomization", "reductionism", "context-stripping" and the "Newtonian scientific methodology" are (allegedly) *bad*, so they should be attacked (no matter how illogical the argument). For what it's worth, "atomization" and "context-stripping" (whatever precisely they may be) are justified primarily by the *quasilocality* of the laws of physics — namely, the fact that the strength of the force between two objects decreases to zero as the distance between the two objects increases towards infinity — and not so much by their linearity. General relativity modifies but does not eliminate these notions. Finally, reductionism is in no way contradicted by general relativity; indeed, general relativity is a *triumph* of reductionism, explaining a number of phenomena (Newtonian gravity, special relativity, the large-scale evolution of the universe) in a unified framework. For an intelligent and nuanced defense of reductionism, see Weinberg (1992, chapter III; 1995).

#56 The statements made in this paragraph (but *not* those in the associated footnote 33) are basically correct. But note again the emotive buzz-words: "crude", "putative", etc.

#57 It is rather firmly established theoretically that stars of mass greater than about 3 solar masses will, after exhausting their nuclear fuel, collapse into black holes. (For a good non-technical discussion, see e.g. Thorne 1994.) Furthermore, astronomers have in recent years identified more than a dozen convincing candidates for such black holes. It also seems likely that most large galaxies (including our own) have a supermassive black hole at the galactic center (see e.g. Melia 2003a,b for a semi-popular account). Wormholes and Gödel's space-time, by contrast, are highly speculative theoretical ideas. One of the defects of much contemporary scientific popularization is, in fact, to put the best-established and the most speculative aspects of physics on the same footing.

#58 Argyros' understanding of both special and general relativity is, alas, hopelessly confused. See footnote 61 on p. 134 below for further examples of Argyros' confusions about mathematics and physics.

#59 This commentary is pure obfuscation. Note that I've learned the postmodernist lingo ("impermissibly totalizing").

#60 This quote is a tissue of bizarre notions mixed with severe confusions. It is unclear what, if anything, Lyotard means by the curious phrases "elementary memory" and "temporal filter"; certainly they do not belong to any branch of contemporary physics or astrophysics of which I am aware. (And

Thus, general relativity forces upon us radically new and counterintuitive notions of space, time and causality[35,36,37,38]; so it is not surprising that it has had a profound impact not only on the natural sciences but also on philosophy, literary criticism, and the human sciences.[#63] For example, in a celebrated symposium three decades ago on *Les Langages Critiques et les Sciences de l'Homme*[#64], Jean Hyppolite raised an incisive question about Jacques Derrida's theory of structure and sign in scientific discourse:

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[35] These new notions of space, time and causality are *in part* foreshadowed already in special relativity. Thus, Alexander Argyros (1991, p. 137) has noted that

> in a universe dominated by photons, gravitons, and neutrinos, that is, in the very early universe, the theory of special relativity suggests that any distinction between before and after is impossible. For a particle traveling at the speed of light, or one traversing a distance that is in the order of the Planck length, all events are simultaneous.[#58]

However, I cannot agree with Argyros' conclusion that Derridean deconstruction is therefore inapplicable to the hermeneutics of early-universe cosmology: Argyros' argument to this effect is based on an impermissibly totalizing use of special relativity (in technical terms, "light-cone coordinates") in a context where *general* relativity is inescapable. (For a similar but less innocent error, see footnote 40 below.)[#59]

[36] Jean-François Lyotard (1989, pp. 5–6) has pointed out that not only general relativity, but also modern elementary-particle physics, imposes new notions of time:

> In contemporary physics and astrophysics ... a particle has a sort of elementary memory and consequently a temporal filter. This is why contemporary physicists tend to think that time emanates from matter itself, and that it is not an entity outside or inside the universe whose function it would be to gather all different times into universal history. It is only in certain regions that such — only partial — syntheses could be detected. There would on this view be areas of determinism where complexity is increasing.[#60]

Furthermore, Michel Serres (1992, pp. 89–91) has noted that chaos theory (Gleick 1987) and percolation theory (Stauffer 1985) have contested the traditional linear concept of time:

> Time does not always flow along a line ... or a plane, but along an extraordinarily complex manifold, as if it showed stopping points, ruptures, sinks [*puits*], funnels of overwhelming acceleration [*cheminées d'accélération foudroyante*], rips, lacunae, all sown randomly ... Time flows in a turbulent and chaotic manner; it percolates. [Translation mine. Note that in the theory of dynamical systems, "*puits*" is a technical term meaning "sink", i.e. the opposite of "source".][#61]

These multiple insights into the nature of time, provided by different branches of physics, are a further illustration of the complementarity principle.[#62]

[37] General relativity can arguably be read as corroborating the Nietzschean deconstruction of causality (see e.g. Culler 1982, pp. 86–88), although some relativists find this interpretation problematic. In quantum mechanics, by contrast, this phenomenon is rather firmly established (see footnote 25 above).[#65]

[38] General relativity is also, of course, the starting point for contemporary astrophysics and physical cosmology. See Mathews (1991, pp. 59–90, 109–116, 142–163) for a detailed analysis

even if they did, doesn't Lyotard owe his readers a *citation* of at least one contemporary physicist or astrophysicist making these points and perhaps clarifying their meaning?) The first clause of the second sentence seems to be a confused but not-totally-wrong summary of some features of general relativity; but from there on it is all downhill, and the most charitable interpretation is that Lyotard's last two-and-a-half sentences are simply meaningless. In them, he jumbles together in a totally arbitrary fashion the terminology from at least three distinct branches of physics: elementary-particle physics, cosmology, and chaos and complexity theory.

The most striking thing about this passage, it seems to me, is what it reveals about contemporary French intellectual life and its reverence for the acclaimed *maîtres-à-penser*. Here Lyotard, a generalist philosopher whose work touches primarily on ethics and aesthetics and who possesses no special competence in physics or indeed in any natural science, nevertheless feels free to pontificate in a sweeping manner on the nature of time in contemporary physics and astrophysics — something even a professional physicist or philosopher of physics would be reluctant to do — without giving even a single bibliographic reference. For a mordant critique of the intellectual star system in contemporary France, see Bouveresse (1999).

#61 This quote, like much of Serres' work, is (mediocre?) poetry masquerading as philosophy of science. The basic problem here is that Serres confuses the temporal evolution of a particular physical system with the nature of time itself. In chaos theory, and more generally in the theory of dynamical systems, one studies the evolution of a system over the course of time. The state of the system is represented by a point which may evolve in a complicated and unpredictable way. But time itself flows in the usual and straightforward manner ("along a line").

Later in the same discussion, Serres rhapsodizes about another branch of physics:

> I am very fond of the theory of percolation, which says obvious, concrete, decisive and new things about space and time.
>
> In Latin, the verb *colare*, which gives rise to the French *couler*, "to flow", means precisely "to filter". In a filter, one flux passes through while another does not. ...
>
> ... The usual theory assumes time to be everywhere and always laminar — with distances that are measurable and geometrically rigid, or at least constant. One day it will be said that that is a description of eternity! But that is neither true nor possible. No: Time flows in a turbulent and chaotic manner; it percolates. (Serres 1992, pp. 90–91, translation mine; see also Serres and Latour 1995, pp. 58–59 for the official English translation)

In reality, the theory of percolation deals with the flow of liquids in porous media. It says absolutely nothing about space and time.

#62 This last sentence is an ironic joke, stretching the meaning of the vague term "complementarity" well past the breaking point. See also note #31 above.

#63 In reality, general relativity has thus far had a *surprisingly modest* impact on physics and on the philosophy of science (though it may well have a stronger impact in the future). It has had virtually no impact on the other natural sciences — not to speak of literary criticism and the human sciences!

#64 Note my pretentiousness in citing the title of this book — the proceedings of a French–American symposium on structuralism in the human sciences — in French. The book was in fact published in English, with three papers in French.

#65 Here is the "Nietzschean deconstruction of causality", as masterfully expounded by literary theorist Jonathan Culler (1982, pp. 86–88). After observing that the usual principle of causality "asserts the logical and temporal priority of cause to effect", Culler proceeds to show, by means of a concrete example, that this naive "concept of causal structure is not something given as such but rather the product of a precise tropological or chronological reversal":

> Suppose one feels a pain. This causes one to look for a cause and spying, perhaps, a pin, one posits a link and reverses the perceptual or phenomenal order, *pain ... pin*, to produce a causal sequence, *pin ... pain*.... The causal scheme is produced by a metonymy or metalepsis (substitution of cause for effect); it is not an indubitable foundation but the product of a tropological operation.... [T]he experience of pain ... *causes* us to discover the pin and thus causes the production of a cause.
>
> [D]econstruction reverses the hierarchical opposition of the causal scheme. The distinction between cause and effect makes the cause an origin, logically and temporally prior. The effect is derived, secondary, dependent upon the cause.... [T]he deconstruction upsets the hierarchy by producing an exchange of properties. If the effect is what causes the cause to become a cause, then the effect, not the cause, should be treated as the origin. By showing that the argument which elevates cause can be used to favor effect, one uncovers and undoes the rhetorical operation responsi-

> When I take, for example, the structure of certain algebraic constructions [ensembles], where is the center? Is the center the knowledge of general rules which, after a fashion, allow us to understand the interplay of the elements? Or is the center certain elements which enjoy a particular privilege within the ensemble? ... With Einstein, for example, we see the end of a kind of privilege of empiric evidence. And in that connection we see a constant appear, a constant which is a combination of space-time, which does not belong to any of the experimenters who live the experience, but which, in a way, dominates the whole construct; and this notion of the constant — is this the center?[39] #66

Derrida's perceptive reply went to the heart of classical general relativity:

> The Einsteinian constant is not a constant, is not a center. It is the very concept of variability — it is, finally, the concept of the game. In other words, it is not the concept of some*thing* — of a center starting from which an observer could master the field — but the very concept of the game ...[40]

In mathematical terms, Derrida's observation relates to the invariance of the Einstein field equation $G_{\mu\nu} = 8\pi G T_{\mu\nu}$ under nonlinear space-time diffeomorphisms (self-mappings of the space-time manifold which are infinitely differentiable but not necessarily analytic). The key point is that this invariance group "acts transitively": this means that any space-time point, if it exists at all, can be transformed into any other. In this way the infinite-dimensional invariance group erodes the distinction between observer and observed; the π of Euclid and the G of Newton, formerly thought to be constant and universal, are now perceived in their ineluctable historicity; and the putative observer becomes fatally de-centered, disconnected from any epistemic link to a space-time point that can no longer be defined by geometry alone.#68

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of the connections between general relativity (and its generalizations called "geometrodynamics") and an ecological worldview. For an astrophysicist's speculations along similar lines, see Primack and Abrams (1995).

[39] Discussion to Derrida (1970, pp. 265–266).

[40] Derrida (1970, p. 267). Right-wing critics Gross and Levitt (1994, p. 79) have ridiculed this statement, willfully misinterpreting it as an assertion about *special* relativity, in which the Einsteinian constant c (the speed of light in vacuum) is of course constant. No reader even minimally conversant with modern physics — except an ideologically biased one — could fail to understand Derrida's unequivocal reference to *general* relativity.#67

> ble for the hierarchization and one produces a significant displacement. If either cause or effect can occupy the position of origin, then origin is no longer originary; it loses its metaphysical privilege.

One need not be a physicist specializing in general relativity to find this reasoning "problematic", to say the least. For a detailed analysis of Culler's "tissue of confusions", see Searle (1983).

Regarding the alleged deconstruction of causality in quantum mechanics, see note #41 above.

#66 Hyppolite's "incisive question" betrays a profound misunderstanding of Einstein's theory of relativity (though it's nowhere near as bad as Derrida's answer).

First of all, Einstein was a scientist; empirical evidence plays the same role in his theories as in all scientific theories.

As for the "constant", Hyppolite is presumably referring to the speed of light in vacuum. (Here I am being charitable: it is possible that Hyppolite is referring to some "constant" — whatever he may mean by that term — that arises only in his private *mis*understandings of relativity.) Now, one of the bases of the special theory of relativity is that the speed of light in vacuum is constant: that is, if an observer in a stationary laboratory and another observer on a moving rocket ship measure the speed of the same light ray (let's assume for simplicity that the light ray is moving in the same direction as the rocket ship), they will get the same result. This is very curious, as one would expect the rocket observer to obtain a velocity equal to that measured by the laboratory *minus* the speed of the rocket ship relative to the laboratory. Nevertheless, this "counterintuitive" result is well verified experimentally.

Finally, it is true that a speed is, by definition, the distance traveled divided by the time elapsed. But no physicist would say that one has here "a combination of space-time" — much less that it "belongs" or not to the experimenters.

#67 This footnote, aside from serving as useful obfuscation, contains a double joke. Firstly, "no reader even minimally conversant with modern physics" — whatever his or her ideology — could fail to understand that Derrida's statements are utterly meaningless. In particular, they have nothing whatsoever to do with *either* special or general relativity. Secondly, the phrase "Derrida's unequivocal reference to general relativity" is a joke on Derrida's insistence that all texts (except perhaps his own?) are "indeterminate".

For an amusing attempt, by a postmodernist author who does know some physics, to come up with something Derrida's words could conceivably have meant that might make sense, see Plotnitsky (1997). The trouble is that Plotnitsky comes up with at least *two* alternative technical interpretations of Derrida's phrase "the Einsteinian constant", without providing any convincing evidence that Derrida intended (or even understood) either of them.

More fundamentally, exegetical efforts like Plotnitsky's seem, at least to me, to carry a faint whiff of absurdity. After all, Derrida was very much alive at the time of this controversy. Instead of speculating about what his words might have meant, why not just ask him? (True, he might well have been busy with other things. But he apparently had time enough to pen an article for *Le Monde* assailing my book with Bricmont, *Impostures intellectuelles*, in which he defended — but did not explicate — his words from the 1966 conference. See Derrida 1997, and see Bricmont and Sokal 1997 for a gentle response.)

In this footnote I have also engaged in the habit — followed ritually throughout the essay — of tagging Gross and Levitt with the epithet "right-wing". Of course, this epithet is inaccurate: Gross is a curmudgeonly old-fashioned liberal and Levitt is a member of Democratic Socialists of America. But even if Gross and Levitt *were* hard-core right-wingers, how would that affect the validity or invalidity of their arguments? Unfortunately, such argument-by-epithet is by now routine in the leftist (and rightist) literature, even among academics; the editors of *Social Text* raised no objection.

Finally, readers may perhaps be interested in a fuller text of Derrida's remarks. Here it is (Derrida 1970, pp. 265–268):

> JEAN HYPPOLITE: I should simply like to ask Derrida, whose presentation and discussion I have admired, for some explanation of what is, no doubt, the technical point of departure of the presentation. That is, a question of the concept of the center of structure, or what a center might mean. When I take, for example, the structure of certain algebraic constructions [ensembles], where is the center? Is the center the knowledge of general rules which, after a fashion, allow us to understand the interplay of the elements? Or is the center certain elements which enjoy a particular privilege within the ensemble? ... With Einstein, for example, we see the end of a kind of privilege of empiric evidence. And in that connection we see a constant appear, a constant which is a combination of space-time, which does not belong to any of the experimenters who live the experience, but which, in a way, dominates the whole construct; and this notion of the constant — is this the center? ...

Quantum Gravity: String, Weave or Morphogenetic Field?

However, this interpretation, while adequate within classical general relativity, becomes incomplete within the emerging postmodern view of quantum gravity. When even the gravitational field — geometry incarnate — becomes a non-commuting (and hence nonlinear[#69]) operator, how can the classical interpretation of $G_{\mu\nu}$ as a geometric entity be sustained? Now not only the observer, but the very concept of geometry, becomes relational and contextual.[#70]

The synthesis of quantum theory and general relativity is thus the central unsolved problem of theoretical physics[41]; no one today can predict with confidence what will be the language and ontology, much less the content, of this synthesis, when and if it comes.[#71] It is, nevertheless, useful to examine historically the metaphors and imagery that theoretical physicists have employed in their attempts to understand quantum gravity.[#72]

The earliest attempts — dating back to the early 1960s — to visualize geometry on the Planck scale (about 10^{-33} centimeters) portrayed it as "space-time foam": bubbles of space-time curvature, sharing a complex and ever-changing topology of interconnections.[42] But physicists were unable to carry this approach farther, perhaps due to the inadequate development at that time of topology and manifold theory (see below).[#73]

In the 1970s physicists tried an even more conventional approach: simplify the Einstein equations by pretending that they are *almost linear*, and then apply the standard methods of quantum field theory to the thus-oversimplified equations. But this method, too, failed: it turned out that Einstein's general relativity is, in technical language, "perturbatively

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[41] Luce Irigaray (1987, pp. 77–78) has pointed out that the contradictions between quantum theory and field theory are in fact the culmination of a historical process that began with Newtonian mechanics:

> The Newtonian break has ushered scientific enterprise into a world where sense perception is worth little, a world which can lead to the annihilation of the very stakes of physics' object: the matter (whatever the predicates) of the universe and of the bodies that constitute it. In this very science, moreover [*d'ailleurs*], cleavages exist: quantum theory/field theory, mechanics of solids/dynamics of fluids, for example. But the imperceptibility of the matter under study often brings with it the paradoxical privilege of *solidity* in discoveries and a delay, even an abandoning of the analysis of the infinity [*l'in-fini*] of the fields of force.

I have here corrected the translation of "*d'ailleurs*", which means "moreover" or "besides" (not "however").

[42] Wheeler (1964).

> JACQUES DERRIDA: ... Concerning the first part of your question, the Einsteinian constant is not a constant, is not a center. It is the very concept of variability — it is, finally, the concept of the game. In other words, it is not the concept of some*thing* — of a center starting from which an observer could master the field — but the very concept of the game which, after all, I was trying to elaborate.
>
> HYPPOLITE: It is a constant in the game?
>
> DERRIDA: It is *the* constant of the game ...
>
> HYPPOLITE: It is the rule of the game.
>
> DERRIDA: It is a rule of the game which does not govern the game; it is a rule of the game which does not dominate the game. Now, when the rule of the game is displaced by the game itself, we must find something other than the word *rule*. In what concerns algebra, then, I think that it is an example in which a group of significant figures, if you wish, or of signs, is deprived of a center. But we can consider algebra from two points of view. Either as the example or analogue of this absolutely de-centered game of which I have spoken; or we can try to consider algebra as a limited field of ideal objects, products in the Husserlian sense, beginning from a history, from a *Lebenswelt*, from a subject, etc., which constituted, created its ideal objects, and consequently we should always be able to make substitutions, by reactivating in it the origin — that of which the significants, seemingly lost, are the derivations. I think it is in this way that algebra was thought of classically. One could, perhaps, think of it otherwise as an image of the game. Or else one thinks of algebra as a field of ideal objects, produced by the activity of what we call a subject, or man, or history, and thus, we recover the possibility of algebra in the field of classical thought; or else we consider it as a disquieting mirror of a world which is algebraic through and through.

#68 I am very proud of this paragraph, which is truly worthy of the Derrida quote it "explicates". Unfortunately, this was the only instance in which I was inspired enough to produce such a perfectly crafted crescendo of meaninglessness.

The Einstein field equation $G_{\mu\nu} = 8\pi G T_{\mu\nu}$ is indeed invariant under nonlinear space-time diffeomorphisms; and this is a fundamental feature of general relativity, which renders it quite unlike most other theories in physics. But note the intellectual terrorism implicit in inflicting such a sentence on non-scientists. How many *Social Text* readers (or editors) have studied enough differential geometry — a fairly technical branch of mathematics — to know what a diffeomorphism is? (I stress that this observation is in no way intended as a criticism of *Social Text* readers. There is no more reason to expect humanities scholars to know anything about differential geometry than there is to expect me to know anything about Hittite philology or Star Trek fanzines.)

On every connected manifold the diffeomorphism group acts transitively, but so what? (Note also the phrase "if it exists at all", whose only purpose was to confuse matters.)

Finally, the allusion to "observer and observed" is completely out of place (it arises in commentary on quantum mechanics, not general relativity); the reference to the "ineluctable historicity" of π and G is a sop to the conventions of radical-social-constructivist academese; and the best that can be said for the last clause is that it is a grammatically well-formed English sentence.

#69 One of my worries, when I wrote this article, was that some physicist and mathematician readers might conclude that "this time Sokal's really gone mad". To avoid this fate, I sprinkled throughout the article some assertions that are *so* preposterous that no physicist — even one who had already gone mad — could possibly have invented them with a straight face. The phrase "non-commuting (*and hence* nonlinear)" is one of these. In fact, the two properties are completely unrelated. Indeed, quantum mechanics deals with non-commuting operators that are perfectly *linear*.

Stolzenberg (2004, p. 2) also points out, correctly, that the adjectives "non-commuting" and "nonlinear" are of a quite different nature. Linearity/nonlinearity are properties of a single operator, while commutativity/noncommutativity are properties of a *pair* of operators.

#70 Although my phrasing in this paragraph is (by intention) unnecessarily florid and confusing, the issue is a real one: indeed, it is the central conceptual problem of quantum gravity. See e.g. Smolin (2001, 2006) for a careful explanation aimed at the general educated public.

The remainder of this section (*except* for the final paragraph on "morphogenetic fields"!) follows the same pattern: real physics explained more or less correctly but a bit too breathlessly (a mild parody of some semi-popular writing by physicists and science journalists).

#71 The statements are true. (But of course the quote from Irigaray in footnote 41 is nonsense.)

nonrenormalizable".[43] This means that the strong nonlinearities of Einstein's general relativity are intrinsic to the theory; any attempt to pretend that the nonlinearities are weak is simply self-contradictory. (This is not surprising: the almost-linear approach destroys the most characteristic features of general relativity, such as black holes.)[#74]

In the 1980s a very different approach, known as string theory, became popular: here the fundamental constituents of matter are not point-like particles but rather tiny (Planck-scale) closed and open strings.[44] In this theory, the space-time manifold does not exist as an objective physical reality; rather, space-time is a derived concept, an approximation valid only on large length scales (where "large" means "much larger than 10^{-33} centimeters"!). For a while many enthusiasts of string theory thought they were closing in on a Theory of Everything — modesty is not one of their virtues — and some still think so. But the mathematical difficulties in string theory are formidable, and it is far from clear that they will be resolved any time soon.[#75]

More recently, a small group of physicists has returned to the full nonlinearities of Einstein's general relativity, and — using a new mathematical symbolism invented by Abhay Ashtekar — they have attempted to visualize the structure of the corresponding quantum theory.[45] The picture they obtain is intriguing: As in string theory, the space-time manifold is only an approximation valid at large distances, not an objective reality. At small (Planck-scale) distances, the geometry of space-time is a *weave*: a complex interconnection of threads.[#76]

Finally, an exciting proposal has been taking shape over the past few years in the hands of an interdisciplinary collaboration of mathematicians, astrophysicists and biologists: this is the theory of the morphogenetic field.[46,#77] Since the mid-1980s evidence has been accumulating that this field, first conceptualized by developmental biologists[47], is in fact closely linked to

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[43] Isham (1991, sec. 3.1.4).

[44] Green, Schwarz and Witten (1987).

[45] Ashtekar, Rovelli and Smolin (1992), Smolin (1992).

[46] Sheldrake (1981, 1991), Briggs and Peat (1984, chapter 4), Granero-Porati and Porati (1984), Kazarinoff (1985), Schiffmann (1989), Psarev (1990), Brooks and Castor (1990), Heinonen, Kilpeläinen and Martio (1992), Rensing (1993). For an in-depth treatment of the mathematical background to this theory, see Thom (1975, 1990); and for a brief but insightful analysis of the philosophical underpinnings of this and related approaches, see Ross (1991, pp. 40–42, 253n20).

[47] Waddington (1965), Corner (1966), Gierer *et al.* (1978).

#72 Note, once again, the stress on "metaphors and imagery". Cultural-studies-of-science folks love this, but its value for the history and philosophy of science is limited, at best. Theories in physics are *not* primarily about "metaphors and imagery", though physicists do make heavy use of analogies (more often than metaphors) and visual images as an aid to our own understanding. See also note #22 above.

#73 The allegedly "inadequate" development of topology and manifold theory is *not* the principal reason that physicists were unable to carry this approach farther. The problem is simply that no one saw a precise and quantitative way of formulating the vague intuitions about "spacetime foam".

#74 The statements in this paragraph are correct.

#75 The statements in this paragraph are also correct. For a good semi-popular explanation of string theory, see Greene (1999); and for a balanced and thoughtful critique, see Smolin (2006).

#76 The statements in this paragraph are correct as well. For a good semi-popular explanation of loop quantum gravity and a comparison with other approaches to quantum gravity (such as string theory), see Smolin (2001).

#77 Biologist Rupert Sheldrake posits that there exists an as-yet-undiscovered "subquantum" interaction linking "patterns" throughout the universe; he calls these interactions "morphogenetic fields". Thus, for instance, there is a "rat morphogenetic field" through which each rat running a maze can benefit from the prior experience of other rats in that same maze; a "sodium chloride morphogenetic field" through which each sodium chloride (i.e. table salt) solution can crystallize more efficiently when the water evaporates, thanks to the prior experience of other sodium chloride solutions; and so forth. I was made aware of Sheldrake's bizarre theories by the "brief but insightful analysis" provided by Andrew Ross (1991, p. 253n20), one of the editors of *Social Text*.

The other references in footnote 46 are all red herrings: Granero-Porati and Porati (1984), Kazarinoff (1985), Schiffmann (1989) and Rensing (1993) are articles in embryology and developmental biology that use the term "morphogenetic field" in a loose sense, where "field" means roughly "field of action" or "collection of cells by whose interactions a particular organ is formed" (Gilbert 2006) and has nothing whatsoever to do with Sheldrake's notion of a real physical field. Psarev (1990) is a physics article dealing with "morphogenesis of distributions of microparticles", while Brooks and Castor (1990) and Heinonen *et al.* (1992) study *morphisms* (a mathematical concept that has nothing to do with "morphogenesis" in any of its senses). Finally, René Thom is a mathematician who made important contributions to the branch of differential topology popularly known as "catastrophe theory" (see note #136 below) and then tried to apply it in increasingly eccentric ways to the natural and social sciences.

#78 I made this all up. Even Sheldrake does not claim any connection between his purported "morphogenetic fields" and quantum gravity.

The phrase "magnetically charged" is another of those howlers that I inserted in order to reassure my physicist friends that I hadn't (yet) completely lost my marbles (see note #69 above). The adjective "electrically charged" would have been fine; but, as every first-year student of electromagnetism learns, magnetic charges (i.e. magnetic monopoles) have never been observed anywhere in the universe (though they may yet exist). All the magnets we see in our daily life are *dipoles*, i.e. they have both a "north" and a "south" pole.

#79 This is true. But its relevance for "morphogenetic fields" is nil: firstly, because there is no evidence that "morphogenetic fields" (in Sheldrake's sense) actually exist; and secondly, because the alleged relationship (a)–(c) is a pure invention on my part.

#80 But I haven't mentioned *any* evidence for (a), (b) and (c)! I have simply *asserted* them.

#81 This sentence was intended to pander to the guild feelings of the *Social Text* editors and readers. But see note #82.

#82 This reference to Chomsky was intended as ironic. If the editors of *Social Text* had bothered to look it up, they would have found that it *praises* natural scientists — and particularly mathematicians and physicists — for their *indifference* to credentials and "turf":

> In my own professional work I have touched on a variety of different fields. I've done work in mathematical linguistics, for example, without any professional credentials in mathematics; in this subject I am completely self-taught, and not very well taught. But I've often been invited by universities to speak on mathematical linguistics at mathematics seminars and colloquia. No one has ever

the quantum *gravitational* field[48]: (a) it pervades all space; (b) it interacts with all matter and energy, irrespective of whether or not that matter/energy is magnetically charged; and, most significantly, (c) it is what is known mathematically as a "symmetric second-rank tensor".[#78] All three properties are characteristic of gravity; and it was proven some years ago that the only self-consistent *nonlinear* theory of a symmetric second-rank tensor field is, at least at low energies, precisely Einstein's general relativity.[49,#79] Thus, if the evidence for (a), (b) and (c) holds up[#80], we can infer that the morphogenetic field is the quantum counterpart of Einstein's gravitational field. Until recently this theory has been ignored or even scorned by the high-energy-physics establishment, who have traditionally resented the encroachment of biologists (not to mention humanists) on their "turf".[#81,50] However, some theoretical physicists have recently begun to give this theory a second look, and there are good prospects for progress in the near future.[51]

It is still too soon to say whether string theory, the space-time weave or morphogenetic fields will be confirmed in the laboratory: the experiments are not easy to perform.[#84] But it is intriguing that all three theories have similar conceptual characteristics: strong nonlinearity, subjective space-time[#85], inexorable flux, and a stress on the topology of interconnectedness.

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[48] Some early workers thought that the morphogenetic field might be related to the electromagnetic field, but it is now understood that this is merely a suggestive analogy: see Sheldrake (1981, pp. 77, 90) for a clear exposition. Note also point (b) below.

[49] Boulware and Deser (1975).

[50] For another example of the "turf" effect, see Chomsky (1979, pp. 6–7).[#82]

[51] To be fair to the high-energy-physics establishment, I should mention that there is also an honest intellectual reason for their opposition to this theory: inasmuch as it posits a subquantum interaction linking patterns throughout the universe, it is, in physicists' terminology, a "non-local field theory". Now, the history of classical theoretical physics since the early 1800s, from Maxwell's electrodynamics to Einstein's general relativity, can be read in a very deep sense as a trend away from action-at-a-distance theories and towards *local field theories*: in technical terms, theories expressible by partial differential equations (Einstein and Infeld 1961, Hayles 1984). So a non-local field theory definitely goes against the grain. On the other hand, as Bell (1987) and others have convincingly argued, the key property of quantum mechanics is precisely its *non-locality*, as expressed in Bell's theorem and its generalizations (see footnotes 23 and 24 above). Therefore, a non-local field theory, although jarring to physicists' classical intuition, is not only natural but in fact *preferred* (and possibly even *mandatory*?) in the quantum context. This is why classical general relativity is a local field theory, while quantum gravity (whether string, weave or morphogenetic field) is inherently non-local.[#83]

> asked me whether I have the appropriate credentials to speak on these subjects; the mathematicians couldn't care less. What they want to know is what I have to say. No one has ever objected to my right to speak, asking whether I have a doctor's degree in mathematics, or whether I have taken advanced courses in this subject. That would never have entered their minds. They want to know whether I am right or wrong, whether the subject is interesting or not, whether better approaches are possible — the discussion dealt with the subject, not with my right to discuss it.
>
> But on the other hand, in discussion or debate concerning social issues or American foreign policy, Vietnam or the Middle East, for example, the issue is constantly raised, often with considerable venom. I've repeatedly been challenged on grounds of credentials, or asked, what special training do you have that entitles you to speak of these matters. The assumption is that people like me, who are outsiders from a professional viewpoint, are not entitled to speak on such things.
>
> Compare mathematics and the political sciences — it's quite striking. In mathematics, in physics, people are concerned with what you say, not with your certification. But in order to speak about social reality, you must have the proper credentials, particularly if you depart from the accepted framework of thinking. Generally speaking, it seems fair to say that the richer the intellectual substance of a field, the less there is a concern for credentials, and the greater is the concern for content.

#83 The statements about the history of physics from 1800 to 1915 are correct (but Einstein and Infeld is a better source for this than Hayles). And it is also correct that Bell's theorem indicates some extremely strange non-local features of quantum mechanics (their exact nature is less clear). But we simply do not yet know what a correct theory of quantum gravity will look like. It may turn out to be a local field theory, or a non-local field theory, or a string theory — or it may very likely be something even stranger, which no one has yet conceived.

#84 This is an understatement, to put it mildly! A *direct* experimental test of theories of quantum gravity would require energies approximately a million billion times larger than those planned for the Large Hadron Collider scheduled to come on-line at CERN in 2008. Clearly, insight into the correct theory of quantum gravity will have to come from *indirect* experimental tests; a key problem for elementary-particle physicists in the coming decades will be to devise such tests (if indeed this is possible).

#85 One doesn't have to be a professional physicist to realize that it is an incredible (and grossly illogical) leap from "the space-time manifold does not exist as an objective physical reality" to "subjective space-time"! Just because the space-time manifold is not a fundamental ontological entity in quantum gravity does not mean that it is somehow an artifact of human minds (i.e. "subjective"). Rather, its status is exactly what was explained in the foregoing text: it is "a derived concept, an approximation valid only on large length scales (where 'large' means 'much larger than 10^{-33} centimeters'!)". The validity of this approximation (in a suitable precise sense) is an *objective* fact about the world.

#86 The principal purpose of this section is to provide a lead-in to the article's second major gibberish quote, namely Lacan's pontifications on psychoanalysis and topology.

#87 The statement that "its methods are holistic rather than Cartesian" is meaningless (but it sounds good!); the rest is correct.

By the way, the reader may be amused to know that "right-wing scientist" Norman Levitt (the co-author of Gross and Levitt 1994) is a topologist.

#88 This last sentence is a joke: "anomaly" is here a technical term in quantum field theory, which has nothing whatsoever to do with the Kuhnian notion of "anomalies" in the history of science.

#89 An assertion like this is music to cult-stud ears: Isn't it flattering to think that even the most abstrusely technical theories in physics "reflect an increased emphasis on [put here your favorite notion] in the wider culture"? Some assertions of this type are undoubtedly true — that is one of the things that makes the history of science so fascinating — but I know of no evidence that this particular one is.

#90 The statements in this paragraph (though *not* those in the associated footnotes) are all correct.

Differential Topology and Homology[#86]

Unbeknownst to most outsiders, theoretical physics underwent a significant transformation — albeit not yet a true Kuhnian paradigm shift — in the 1970s and 80s: the traditional tools of mathematical physics (real and complex analysis), which deal with the space-time manifold only locally, were supplemented by topological approaches (more precisely, methods from differential topology[52]) that account for the global (holistic) structure of the universe. This trend was seen in the analysis of anomalies in gauge theories[53]; in the theory of vortex-mediated phase transitions[54]; and in string and superstring theories.[55] Numerous books and review articles on "topology for physicists" were published during these years.[56,#90]

At about the same time, in the social and psychological sciences Jacques Lacan pointed out the key role played by differential topology:

> This diagram [the Möbius strip] can be considered the basis of a sort of essential inscription at the origin, in the knot which constitutes the subject. This goes much further than you may think at first, because you can search for the sort of surface able to receive such inscriptions. You can perhaps see that the sphere, that old symbol for totality, is unsuitable. A torus, a Klein bottle, a cross-cut surface, are able to receive such a cut. And this diversity is very important as it explains many things about the structure of mental disease. If one can symbolize the subject by this fundamental cut, in the same way one can show that a cut on a torus

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[52] Differential topology is the branch of mathematics concerned with those properties of surfaces (and higher-dimensional manifolds) that are unaffected by smooth deformations. The properties it studies are therefore primarily qualitative rather than quantitative, and its methods are holistic rather than Cartesian.[#87]

[53] Alvarez-Gaumé (1985). The alert reader will notice that anomalies in "normal science" are the usual harbinger of a *future* paradigm shift (Kuhn 1970).[#88]

[54] Kosterlitz and Thouless (1973). The flowering of the theory of phase transitions in the 1970s probably reflects an increased emphasis on discontinuity and rupture in the wider culture: see footnote 81 below.[#89]

[55] Green, Schwarz and Witten (1987).

[56] A typical such book is Nash and Sen (1983).

#91 I nearly fell off my chair when I came across this passage in Lacan's paper. The idea that the topology of surfaces "explains many things about the structure of mental disease" is so bizarre as to hardly merit comment. Suffice it to say that Lacan gives no *argument* supporting the relevance of mathematical topology to human psychology; he merely *asserts* it.

A charitable reader might suppose that Lacan is here speaking metaphorically. One member of the audience at Lacan's oral presentation thought so too, and he asked:

> May I ask if this fundamental arithmetic and this topology are not in themselves a myth or merely at best an analogy for an explanation of the life of the mind?

Lacan answered indignantly:

> Analogy to what? "S" designates something which can be written exactly as this S. And I have said that the "S" which designates the subject is instrument, matter, to symbolize a loss. A loss that you experience as a subject (and myself also). In other words, this gap between one thing which has marked meanings and this other thing which is my actual discourse that I try to put in the place where you are, you as not another subject but as people that are able to understand me. Where is the analogon? Either this loss exists or it doesn't exist. If it exists it is only possible to designate the loss by a system of symbols. In any case, the loss does not exist before this symbolization indicates its place. It is not an analogy. It is really in some part of the realities, this sort of torus. This torus really exists and it is exactly the structure of the neurotic. It is not an analogon; it is not even an abstraction, because an abstraction is some sort of diminution of reality, and I think it is reality itself. (Lacan 1970, pp. 195–196)

Once again, Lacan gives no argument to support his peremptory assertion that the torus "is exactly the structure of the neurotic" (whatever this may mean). Moreover, when asked explicitly whether it is simply an analogy, he denies it.

Only some months later did I learn that this passage was not a one-time folly. For the last two decades of his life, Lacan became obsessed with mathematical topology as the alleged key to the human psyche, and his seminars became increasingly bizarre. Perhaps it is not surprising that an old man became demented in the final years of his life; what is more surprising is the extent to which Lacan's disciples followed their guru into madness (see note #92 below). For a more detailed discussion of Lacan's (mis)uses of topology and other branches of mathematics, see Sokal and Bricmont (1998, chapter 2).

#92 Lacan's followers have elaborated extensively on the Master's psychoanalytic topology; the cited books and articles form part (but by no means the whole) of this oeuvre.

#93 In an early draft, I wrote "Lacan's topologico-psychosocial theory"; but one of my friends, Montse Domínguez, raised the very sensible question: "What is that? And what does mathematical topology have to do with psychoanalysis, anyway?" And I began to worry that this passage might betray the hoax. But then I hit upon the perfect solution: to obfuscate the question and divert the reader from thinking, use French! (Well, use *any* foreign language — but Lacan is French.)

#94 This last sentence is a joke: Bourbaki (1970) is not exactly a "gentle introduction" to set theory. A charming alternative is Vilenkin (1968).

#95 The reader may be wondering what, precisely, mathematical topology has to do with film criticism and "the psychoanalysis of AIDS". Well, so am I, even after reading the cited articles.

#96 The reference to Eilenberg and Steenrod (1952) is an in-joke: this book is in fact a highly technical monograph, with a well-deserved reputation for incomprehensibility. (A topologist friend informs me that Eilenberg–Steenrod is actually rather straightforward reading, provided that you're familiar with the concept of a covariant functor from the category of pairs of topological spaces to the category of graded R-modules. Unfortunately, that excludes yours truly.) Munkres (1984) is a standard (and very well-written) text on algebraic topology for doctoral students in mathematics.

#97 These last three sentences are also jokes. "Relative homology theory" in mathematics has nothing to do with "relativity" in physics (much less with "relativism" in philosophy). If some nostalgic Marxists (or Hegelians) wish to see the relationship between homology theory and cohomology theory as "dialectical", they are welcome to do so; the mathematical content remains unaltered. Finally, "cybernetic" is just a fancy way of saying that computers are involved.

#98 This last word is a joke: "trivial" is here a technical term in mathematics (meaning "the group consisting only of the identity element"); its correct antonym is "nontrivial", not "profound".

> corresponds to the neurotic subject, and on a cross-cut surface to another sort of mental disease.[#91,57,58]

As Althusser rightly commented, "Lacan finally gives Freud's thinking the scientific concepts that it requires".[59] More recently, Lacan's *topologie du sujet*[#93] has been applied fruitfully to cinema criticism[60] and to the psychoanalysis of AIDS.[61,#95] In mathematical terms, Lacan is here pointing out that the first homology group[62] of the sphere is trivial, while those of the other surfaces are profound[#98]; and this homology is linked with the connectedness or disconnectedness of the surface after one or more cuts.[63] Furthermore, as Lacan suspected, there is an intimate connection between

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[57] Lacan (1970, pp. 192–193), lecture given in 1966. For an in-depth analysis of Lacan's use of ideas from mathematical topology, see Juranville (1984, chapter VII), Granon-Lafont (1985, 1990), Vappereau (1985) and Nasio (1987, 1992); a brief summary is given by Leupin (1991). See Hayles (1990, p. 80) for an intriguing connection between Lacanian topology and chaos theory; unfortunately she does not pursue it. See also Žižek (1991, pp. 38–39, 45–47) for some further homologies between Lacanian theory and contemporary physics. Lacan also made extensive use of concepts from set-theoretic number theory: see e.g. Miller (1977/78) and Ragland-Sullivan (1990).[#92]

[58] In bourgeois social psychology, topological ideas had been employed by Kurt Lewin as early as the 1930s, but this work foundered for two reasons: first, because of its individualist ideological preconceptions; and second, because it relied on old-fashioned point-set topology rather than modern differential topology and catastrophe theory. Regarding the second point, see Back (1992).

[59] Althusser (1993, p. 50): "Il suffit, à cette fin, de reconnaître que Lacan confère enfin à la pensée de Freud, les concepts scientifiques qu'elle exige". This famous essay on "Freud and Lacan" was first published in 1964, before Lacan's work had reached its highest level of mathematical rigor. It was reprinted in English translation in 1969 (*New Left Review*).

[60] Miller (1977/78, especially pp. 24–25). This article has become quite influential in film theory: see e.g. Jameson (1982, pp. 27–28) and the references cited there. As Strathausen (1994, p. 69) indicates, Miller's article is tough going for the reader not well versed in the mathematics of set theory. But it is well worth the effort. For a gentle introduction to set theory, see Bourbaki (1970).[#94]

[61] Dean (1993, especially pp. 107–108).

[62] Homology theory is one of the two main branches of the mathematical field called *algebraic topology*. For an excellent introduction to homology theory, see Munkres (1984); or for a more popular account, see Eilenberg and Steenrod (1952).[#96] A fully relativistic homology theory is discussed e.g. in Eilenberg and Moore (1965). For a dialectical approach to homology theory and its dual, cohomology theory, see Massey (1978). For a cybernetic approach to homology, see Saludes i Closa (1984).[#97]

[63] For the relation of homology to cuts, see Hirsch (1976, pp. 205–208); and for an application to collective movements in quantum field theory, see Caracciolo *et al.* (1993, especially app. A.1).

#99 Please note that this phrase ("its inner psychological representation *qua* knot theory") *presumes* the validity of Lacan's bizarre idea that psychological states are specified in terms of knots.

#100 I am very proud of this sentence, which makes utter nonsense sound plausible. It goes without saying that Witten's wonderful work on the relationship between Chern–Simons quantum field theory and knot invariants has nothing to do with psychoanalysis.

#101 The mathematical statements about the projective space RP^3 are correct, but the rest is all hot air.

#102 In this sentence I have played on the postmodern fondness for "multidimensionality" and "nonlinearity" by inventing a nonexistent mathematical field: "multidimensional (nonlinear) logic". Oh, well, it *sounds* good.

#103 I am indebted to Luce Irigaray's translator for *mis*translating the French term *théorie des ensembles* as "theory of wholes" (it should be "set theory"), thereby allowing me to make a pun on "wholes" and "holes". Postmodernists love such puns.

#104 Of course I cited this passage as a joke: Irigaray doesn't have the slightest idea about topology, manifold theory or any other branch of mathematics. (See Sokal and Bricmont 1998, chapter 5 for documentation on this point.) A rather shocking use of this passage from Irigaray can be found on p. 130 below.

the external structure of the physical world and its inner psychological representation *qua* knot theory[#99]: this hypothesis has recently been confirmed by Witten's derivation of knot invariants (in particular the Jones polynomial[64]) from three-dimensional Chern–Simons quantum field theory.[65,#100]

Analogous topological structures arise in quantum gravity, but inasmuch as the manifolds involved are multidimensional rather than two-dimensional, higher homology groups play a role as well. These multidimensional manifolds are no longer amenable to visualization in conventional three-dimensional Cartesian space: for example, the projective space RP^3, which arises from the ordinary 3-sphere by identification of antipodes, would require a Euclidean embedding space of dimension at least 5.[66] Nevertheless, the higher homology groups can be perceived, at least approximately, via a suitable multidimensional (nonlinear) logic.[67,68,#102]

Manifold Theory: (W)holes and Boundaries[#103]

Luce Irigaray, in her famous article "Is the Subject of Science Sexed?", pointed out that

> the mathematical sciences, in the theory of wholes [*théorie des ensembles*], concern themselves with closed and open spaces ... They concern themselves very little with the question of the partially open, with wholes that are not clearly delineated [*ensembles flous*], with any analysis of the problem of borders [*bords*] ...[69,#104]

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[64] Jones (1985).

[65] Witten (1989).

[66] James (1971, pp. 271–272). It is, however, worth noting that the space RP^3 is homeomorphic to the group $SO(3)$ of rotational symmetries of conventional three-dimensional Euclidean space. Thus, some aspects of three-dimensional Euclidicity are preserved (albeit in modified form) in the postmodern physics, just as some aspects of Newtonian mechanics were preserved in modified form in Einsteinian physics.[#101]

[67] Kosko (1993). See also Johnson (1977, pp. 481–482) for an analysis of Derrida's and Lacan's efforts toward transcending the Euclidean spatial logic.

[68] Along related lines, Eve Seguin (1994, p. 61) has noted that "logic says nothing about the world and attributes to the world properties that are but constructs of theoretical thought. This explains why physics since Einstein has relied on alternative logics, such as trivalent logic which rejects the principle of the excluded middle." A pioneering (and unjustly forgotten) work in this direction, likewise inspired by quantum mechanics, is Lupasco (1951). See also Plumwood (1993b, pp. 453–459) for a specifically feminist perspective on nonclassical logics. For a critical analysis of one nonclassical logic ("boundary logic") and its relation to the ideology of cyberspace, see Markley (1994).

[69] Irigaray (1987, pp. 76–77), essay originally appeared in French in 1982. Irigaray's phrase "*théorie des ensembles*" can also be rendered as "theory of sets", and "*bords*" is usually

#105 This is a contrivance on my part, allowing me to praise Irigaray's "incisive criticism" of masculinist "privileging". In truth, manifolds both with and without boundary have been a classic topic of differential geometry and differential topology for over a century. ("Manifold" is a geometrical concept that generalizes the notion of surface to spaces of more than two dimensions.)

#106 This is true.

#107 *Perhaps* this will turn out to be true; we won't know until we have in hand a full-fledged theory of quantum gravity.

#108 In this sentence I have managed to pack an incredible number of confusions typical of postmodern literary theorists' ruminations on mathematics. I suggest here that "conventional" science has an aversion to anything that is "multidimensional"; but the truth is that *all* interesting manifolds are multidimensional, and they have been intensively studied by mathematicians for well over a century. See note #54 above for a deconstruction of the meaningless phrase "linear mathematical thought".

#109 In this footnote I have parodied an extreme form of a view that I myself hold in a more nuanced form. It *is* true that the direction of development of technology — and, to a considerably lesser extent, that of pure science — has been driven *in part* by the commercial and military needs of the most powerful groups in society. But the reference to number theory is a joke: for although number theory has *very recently* (over the past few decades) come to have important applications in cryptography — now employed every time we make a credit-card transaction — it was for millennia the exemplar of pure mathematics (going back at least to Euclid's proof that there are infinitely many prime numbers).

The reference to Hardy was "dangerous": in this very accessible autobiography, Hardy prides himself on working in mathematical fields that have *no applications whatsoever*:

> I have never done anything 'useful'. No discovery of mine has made, or is likely to make, directly or indirectly, for good or ill, the least difference to the amenity of the world. (Hardy 1967, p. 150)

A man of left-wing political views, Hardy went so far as to give, during the carnage of World War I, the following sarcastic definition: "a science is said to be useful if its development tends to accentuate the existing inequalities in the distribution of wealth, or more directly promotes the destruction of human life" (Hardy 1967, p. 120n).

There is an additional irony in this reference. Writing in 1940, Hardy listed two branches of science that, in his view, will never have military applications: number theory and Einstein's relativity. Futurology is a risky enterprise, indeed!

In 1982, when Irigaray's essay first appeared, this was an incisive criticism: differential topology has traditionally privileged the study of what are known technically as "manifolds without boundary".[#105] However, in the past decade, under the impetus of the feminist critique, some mathematicians have given renewed attention to the theory of "manifolds with boundary" [Fr. *variétés à bord*].[70] Perhaps not coincidentally, it is precisely these manifolds that arise in the new physics of conformal field theory, superstring theory and quantum gravity.

In string theory, the quantum-mechanical amplitude for the interaction of n closed or open strings is represented by a functional integral (basically, a sum) over fields living on a two-dimensional manifold with boundary.[71,#106] In quantum gravity, we may expect that a similar representation will hold, except that the two-dimensional manifold with boundary will be replaced by a multidimensional one.[#107] Unfortunately, multidimensionality goes against the grain of conventional linear mathematical thought, and despite a recent broadening of attitudes (notably associated with the study of multidimensional nonlinear phenomena in chaos theory), the theory of multidimensional manifolds with boundary remains somewhat underdeveloped.[#108] Nevertheless, physicists' work on the functional-integral approach to quantum gravity continues apace[72], and this work is likely to stimulate the attention of mathematicians.[73]

As Irigaray anticipated, an important question in all of these theories is: Can the boundary be transgressed (crossed), and if so, what happens then? Technically this is known as the problem of "boundary conditions". At a purely mathematical level, the most salient aspect of boundary conditions is the great diversity of possibilities: for example, "free b.c." (no obstacle to crossing), "reflecting b.c." (specular reflection as in a mirror), "periodic b.c." (re-entrance in another part of the manifold), and "antiperiodic b.c." (re-entrance with 180° twist). The question posed by physicists is: Of all

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translated in the mathematical context as "boundaries". Her phrase "*ensembles flous*" may refer to the new mathematical field of "fuzzy sets" (Kaufmann 1973, Kosko 1993).

[70] See e.g. Hamza (1990), McAvity and Osborn (1991), Alexander, Berg and Bishop (1993) and the references cited therein.

[71] Green, Schwarz and Witten (1987).

[72] Hamber (1992), Nabutosky and Ben-Av (1993), Kontsevich (1994).

[73] In the history of mathematics there has been a long-standing dialectic between the development of its "pure" and "applied" branches (Struik 1987). Of course, the "applications" traditionally privileged in this context have been those profitable to capitalists or useful to their military forces: for example, number theory has been developed largely for its applications in cryptography (Loxton 1990). See also Hardy (1967, pp. 120–121, 131–132).[#109]

#110 This paragraph is all fluff. The problem of boundary conditions is indeed an important technical issue in many areas of mathematical physics (not just quantum gravity). But its philosophical relevance is minimal to nil; and it has, in any case, nothing at all to do with the quantum-mechanical complementary principle. See also note #31 above.

#111 Much of the history of physics over the past 200 years has been concerned with the search for the fundamental (or "elementary") constituents of matter. Thus, in the nineteenth century the smallest building-blocks of matter were believed to be the atoms of Dalton and Mendeleev, which form the fundamental units of chemistry. But in the early twentieth century it was learned that atoms consist of a dense nucleus surrounded by a diffuse cloud of electrons. In the 1930s it was learned that the nucleus is itself comprised of protons and neutrons. Over the subsequent three decades, hundreds of additional species of subatomic particles were discovered — muons, pions, kaons, hyperons and many others — and physicists wondered whether these particles, too, might be composed of some more fundamental constituents (analogously to the atoms of Mendeleev). One promising idea for such a reduction was the "quark model" of Gell-Mann, Ne'eman and others, introduced in the early 1960s.

Chew's bootstrap theory — the idea that, by contrast, there are *no* truly fundamental particles, but rather, each type of particle can be viewed somehow as a composite of all other types — was popular among some high-energy physicists in the 1960s, largely as a result of despair about how to deal mathematically with strongly-interacting quantum field theories. The bootstrap philosophy was popularized among non-scientists by Fritjof Capra's *The Tao of Physics* (1975), which aimed to find parallels between modern physics and Eastern mysticism. Alas, the early 1970s saw rapid progress in quantum field theory, notably the development of the Weinberg–Salam–Glashow unified theory of the electromagnetic and weak interactions together with quantum chromodynamics (QCD), which provided a precise quantum-field-theoretic formulation of the quark model. Together these theories form what is now known as the "standard model" of elementary-particle interactions and is experimentally confirmed to quite high precision. As a result, the bootstrap theory fell into justified oblivion at almost exactly the moment that Capra and his followers began to hype it. See e.g. Kane 1995 for a non-mathematical account of these exciting developments in elementary-particle physics.

#112 I wrote this essay in sonata form; the recurrence of the title theme "Transgressing the Boundaries" signals the beginning of the recapitulation.

This section combines gross confusions about science with exceedingly sloppy thinking about philosophy and politics. Nevertheless, it also contains some ideas — on the link between scientists and the military, on ideological bias in science, on the pedagogy of science — with which I partly agree, at least when these ideas are formulated more carefully. I do not want the parody to provoke unqualified derision toward these ideas, and I refer the reader to Chapters 2 and 3 for my real views on some of them.

I begin this section by claiming that "postmodern" science has freed itself from objective truth. But, whatever opinions scientists may have on chaos theory or quantum mechanics, they clearly do not consider themselves "liberated" from the goal of objectivity; were that the case, they would simply have ceased to do science. Nevertheless, a whole book would be needed to disentangle the confusions concerning chaos, quantum physics and self-organization that underlie this sort of idea; see Sokal and Bricmont (1998, chapter 7) for a brief analysis and for further references.

Having freed science from the goal of objectivity, the article then proposes to politicize science in the worst sense: judging scientific theories not by their correspondence to reality but by their compatibility with one's ideological preconceptions. See again Chapters 2 and 3 for my real views concerning this disastrous idea.

#113 This quote from Markley neatly summarizes the postmodernist ideas that I am fighting *against*. Indeed, I was so upset when I saw it — upset that my politically progressive comrades could fall for such pernicious stuff — that I did something "dangerous": I added the citation to Hobsbawm (1993). If the *Social Text* editors had bothered to check this reference, they would have found that Hobsbawm provides an eloquent *refutation* of Markley's ideas. See pp. 95–96 below.

#114 This is nonsense. If quantum gravity is to be a science at all, its goal must be to give an objectively true — or at least, objectively *approximately* true — account of the phenomena it purports to describe. See Chapters 6 and 7 below for further discussion of my views on the philosophy of science.

these conceivable boundary conditions, which ones actually occur in the representation of quantum gravity? Or perhaps, do *all* of them occur simultaneously and on an equal footing, as suggested by the complementarity principle?[#110,74]

At this point my summary of developments in physics must stop, for the simple reason that the answers to these questions — if indeed they have univocal answers — are not yet known. In the remainder of this essay, I propose to take as my starting point those features of the theory of quantum gravity which *are* relatively well established (at least by the standards of conventional science), and attempt to draw out their philosophical and political implications.

Transgressing the Boundaries: Towards a Liberatory Science[#112]

Over the past two decades there has been extensive discussion among critical theorists with regard to the characteristics of modernist versus postmodernist culture; and in recent years these dialogues have begun to devote detailed attention to the specific problems posed by the natural sciences.[75] In particular, Madsen and Madsen have recently given a very clear summary of the characteristics of modernist versus postmodernist science. They posit two criteria for a postmodern science:

> A simple criterion for science to qualify as postmodern is that it be free from any dependence on the concept of objective truth. By this criterion, for example, the complementarity interpretation of quantum physics due to Niels Bohr and the Copenhagen school is seen as postmodernist.[76]

Clearly, quantum gravity is in this respect an archetypal postmodernist science.[#114] Secondly,

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[74] The equal representation of all boundary conditions is also suggested by Chew's bootstrap theory of "subatomic democracy": see Chew (1977) for an introduction, and see Morris (1988) and Markley (1992) for philosophical analysis.[#111]

[75] Among the large body of works from a diversity of politically progressive perspectives, the books by Merchant (1980), Keller (1985), Harding (1986), Aronowitz (1988b), Haraway (1991) and Ross (1991) have been especially influential. See also the references cited below.

[76] Madsen and Madsen (1990, p. 471). The main limitation of the Madsen–Madsen analysis is that it is essentially apolitical; and it hardly needs to be pointed out that disputes over what is *true* can have a profound effect on, and are in turn profoundly affected by, disputes over *political projects*. Thus, Markley (1992, p. 270) makes a point similar to that of Madsen–Madsen, but rightly situates it in its political context:

> Radical critiques of science that seek to escape the constraints of deterministic dialectics must also give over narrowly conceived debates about realism and truth to investigate what kind of realities — political realities — might be engendered by a dialogical bootstrapping. Within a dialogically agitated environment, debates about

#115 The idea that theories should refer only to observable quantities is called *operationalism*; far from being postmodernist, it was popular among physicists and philosophers of physics in the first half of the twentieth century. But it has severe flaws: see Chapter 7 below (pp. 240–245) as well as Weinberg (1992, pp. 174–184).

#116 Aronowitz's alleged dichotomy between "particle" and "field" theories is, alas, an artifact of his own misunderstandings (as is, therefore, his sociological "explanation" of this nonexistent "fact"). In reality, quantum chromodynamics is a quantum *field* theory that describes the interactions of the *particles* known as quarks. (There are, to be sure, deep and unresolved foundational questions concerning *how* quantum theories, and in particular quantum field theories, manage to describe particles; but these issues are in no way illuminated by Aronowitz's misconceptions. See e.g. Teller 1995 for these issues.)

It should be stressed that Pickering, who trained as an elementary-particle physicist before turning to the sociology of science, does *not* make these silly errors. Indeed, his book provides a fascinating and rich historical account of the development of elementary-particle physics in the 1960s and early 1970s. (My only complaint is with his first and last chapters, which wed his excellent historical work to some extraordinarily sloppy philosophy.)

#117 Regarding Chew's bootstrap theory, see note #111 above.

> The other concept which can be taken as being fundamental to postmodern science is that of *essentiality*. Postmodern scientific theories are constructed from those theoretical elements which are essential for the consistency and utility of the theory.[77]

Thus, quantities or objects which are in principle unobservable — such as space-time points, exact particle positions, or quarks and gluons — ought not to be introduced into the theory.[#115,78] While much of modern physics

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> reality become, in practical terms, irrelevant. "Reality," finally, is a historical construct.

See Markley (1992, pp. 266–272) and Hobsbawm (1993, pp. 63–64) for further discussion of the political implications.[#113]

[77] Madsen and Madsen (1990, pp. 471–472).

[78] Aronowitz (1988b, pp. 292–293) makes a slightly different, but equally cogent, criticism of quantum chromodynamics (the currently hegemonic theory representing nucleons as permanently bound states of quarks and gluons): drawing on the work of Pickering (1984), he notes that

> in his [Pickering's] account, quarks are the name assigned to (absent) phenomena that cohere with particle rather than field theories, which, in each case, offer different, although equally plausible, explanations for the same (inferred) observation. That the majority of the scientific community chose one over another is a function of scientists' preference for the tradition rather than the validity of explanation.
>
> However, Pickering does not reach back far enough into the history of physics to find the basis of the research tradition from which the quark explanation emanates. It may not be found inside the tradition but in the ideology of science, in the differences behind field versus particle theories, simple versus complex explanations, the bias toward certainty rather than indeterminateness.[#116]

Along very similar lines, Markley (1992, p. 269) observes that physicists' preference for quantum chromodynamics over Chew's bootstrap theory of "subatomic democracy" (Chew 1977) is a result of ideology rather than data:

> It is not surprising, in this regard, that bootstrap theory has fallen into relative disfavor among physicists seeking a GUT (Grand Unified Theory) or TOE (Theory of Everything) to explain the structure of the universe. Comprehensive theories that explain "everything" are products of the privileging of coherence and order in western science. The choice between bootstrap theory and theories of everything that confronts physicists does *not* have to do primarily with the truth-value offered by these accounts of available data but with the narrative structures — indeterminate or deterministic — into which these data are placed and by which they are interpreted.[#117]

Unfortunately, the vast majority of physicists are not yet aware of these incisive critiques of one of their most fervently-held dogmas.

For another critique of the hidden ideology of contemporary particle physics, see Kroker *et al.* (1989, pp. 158–162, 204–207). The style of this critique is rather too Baudrillardian for my staid taste, but the content is (except for a few minor inaccuracies) right on target.

#118 This quote from Kelly Oliver raises the perennial problem of self-refutation: How can one know whether or not a theory is "strategic", except by asking whether it is *truly, objectively* efficacious in promoting one's declared political goals? The problems of truth and objectivity cannot be evaded so easily.

#119 Regarding "general themes and attitudes", see note #22 above.

is excluded by this criterion, quantum gravity again qualifies: in the passage from classical general relativity to the quantized theory, space-time points (and indeed the space-time manifold itself) have disappeared from the theory.

However, these criteria, admirable as they are, are insufficient for a *liberatory* postmodern science: they liberate human beings from the tyranny of "absolute truth" and "objective reality", but not necessarily from the tyranny of other human beings. In Andrew Ross' words, we need a science "that will be publicly answerable and of some service to progressive interests".[79] From a feminist standpoint, Kelly Oliver makes a similar argument:

> ... in order to be revolutionary, feminist theory cannot claim to describe what exists, or, "natural facts." Rather, feminist theories should be political tools, strategies for overcoming oppression in specific concrete situations. The goal, then, of feminist theory, should be to develop *strategic* theories — not true theories, not false theories, but strategic theories.[80] #118

How, then, is this to be done?

In what follows, I would like to discuss the outlines of a liberatory postmodern science on two levels: first, with regard to general themes and attitudes; and second, with regard to political goals and strategies.#119

One characteristic of the emerging postmodern science is its stress on nonlinearity and discontinuity: this is evident, for example, in chaos theory and the theory of phase transitions as well as in quantum gravity.[81] At the same time, feminist thinkers have pointed out the need for an adequate analysis of fluidity, in particular turbulent fluidity.[82] These two themes

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[79] Ross (1991, p. 29). For an amusing example of how this modest demand has driven right-wing scientists into fits of apoplexy ("frighteningly Stalinist" is the chosen epithet), see Gross and Levitt (1994, p. 91).

[80] Oliver (1989, p. 146).

[81] While chaos theory has been deeply studied by cultural analysts — see e.g. Hayles (1990, 1991), Argyros (1991), Best (1991), Young (1991, 1992), Assad (1993) among many others — the theory of phase transitions has passed largely unremarked. (One exception is the discussion of the renormalization group in Hayles (1990, pp. 154–158).) This is a pity, because discontinuity and the emergence of multiple scales are central features in this theory; and it would be interesting to know how the development of these themes in the 1970s and afterwards is connected to trends in the wider culture. I therefore suggest this theory as a fruitful field for future research by cultural analysts. Some theorems on discontinuity which may be relevant to this analysis can be found in Van Enter, Fernández and Sokal (1993).

[82] Irigaray (1985), Hayles (1992). See, however, Schor (1989) for a critique of Irigaray's undue deference toward conventional (male) science, particularly physics.

#120 I am very proud of this paragraph: it is eloquent bunkum.

are not as contradictory as it might at first appear: turbulence connects with strong nonlinearity, and smoothness/fluidity is sometimes associated with discontinuity (e.g. in catastrophe theory[83]); so a synthesis is by no means out of the question.

Secondly, the postmodern sciences deconstruct and transcend the Cartesian metaphysical distinctions between humankind and Nature, observer and observed, Subject and Object. Already quantum mechanics, earlier in this century, shattered the ingenuous Newtonian faith in an objective, prelinguistic world of material objects "out there"; no longer could we ask, as Heisenberg put it, whether "particles exist in space and time objectively". But Heisenberg's formulation still presupposes the objective existence of space and time as the neutral, unproblematic arena in which quantized particle-waves interact (albeit indeterministically); and it is precisely this would-be arena that quantum gravity problematizes. Just as quantum mechanics informs us that the position and momentum of a particle are brought into being only by the act of observation, so quantum gravity informs us that space and time themselves are contextual, their meaning defined only relative to the mode of observation.[#120,84]

Thirdly, the postmodern sciences overthrow the static ontological categories and hierarchies characteristic of modernist science. In place of atomism and reductionism, the new sciences stress the dynamic web of relationships between the whole and the part; in place of fixed individual essences (e.g. Newtonian particles), they conceptualize interactions and flows (e.g. quantum fields). Intriguingly, these homologous features arise in numerous seemingly disparate areas of science, from quantum gravity to chaos theory to the biophysics of self-organizing systems. In this way, the postmodern sciences appear to be converging on a new epistemological

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[83] Thom (1975, 1990), Arnol'd (1992).

[84] Concerning the Cartesian/Baconian metaphysics, Robert Markley (1991, p. 6) has observed that

> Narratives of scientific progress depend upon imposing binary oppositions — true/false, right/wrong — on theoretical and experimental knowledge, privileging meaning over noise, metonymy over metaphor, monological authority over dialogical contention.... [T]hese attempts to fix nature are ideologically coercive as well as descriptively limited. They focus attention only on the small range of phenomena — say, linear dynamics — which seem to offer easy, often idealized ways of modeling and interpreting humankind's relationship to the universe.

While this observation is informed primarily by chaos theory — and secondarily by nonrelativistic quantum mechanics — it in fact summarizes beautifully the radical challenge to modernist metaphysics posed by quantum gravity.

#121 The preceding three paragraphs are closely modelled on some rather ubiquitous clichés in postmodernist commentary on science. These paragraphs hit all the right buzz-words, with the right emotional tonalities ("nonlinearity" and "fluidity" are good, "Cartesian" is bad). Moreover, they *seem* to be saying something concrete and even profound (as long as one does not examine too carefully). But when one tries to make the meaning and argument more precise, it dissolves into dust.

#122 On the basis of a hopelessly confused and distorted conception of modern physics, combined with an uncritical acceptance of physicist Ilya Prigogine's philosophical pronouncements, the renowned sociologist and economic historian Immanuel Wallerstein (1993, p. 20) concludes that

> The reversal by the new science of the premises of classical modern science has led to a reversal of the relationship of the physical sciences and the social sciences.... all of a sudden, the physical scientists seem to be looking towards the historical social sciences for models.

As Gross and Levitt (1994, p. 269n45) dryly remark: "We, on the other hand, have noticed no such thing; but it's understandable that a social scientist would wish it to be so."

A more detailed but equally flawed exposition of these ideas can be found in Santos (1992).

#123 In this quote, Markley puts complex number theory — which, in fact, goes back at least to the early nineteenth century and belongs to mathematics, not physics — in the same bag as quantum mechanics, chaos theory and the now-largely-defunct hadron bootstrap theory. He has probably confused it with the recent, and very speculative, theories on *complexity*. My commentary in footnote 86 is an ironic joke at his expense.

More fundamentally, Markley is simply wrong when he claims that quantum mechanics and chaos theory "foreground themselves [!] as metaphors rather than as 'accurate' descriptions of reality". Like all theories in physics, quantum mechanics and chaos theory aim to provide a *precise quantitative* (and not merely metaphorical) description of the class of phenomena under study. Regarding hadron bootstrap theory, see note #111 above.

paradigm, one that may be termed an *ecological* perspective, broadly understood as "recogniz[ing] the fundamental interdependence of all phenomena and the embeddedness of individuals and societies in the cyclical patterns of nature".[85,#121]

A fourth aspect of postmodern science is its self-conscious stress on symbolism and representation. As Robert Markley points out, the postmodern sciences are increasingly transgressing disciplinary boundaries, taking on characteristics that had heretofore been the province of the humanities:

> Quantum physics, hadron bootstrap theory, complex number theory, and chaos theory share the basic assumption that reality cannot be described in linear terms, that nonlinear — and unsolvable — equations are the only means possible to describe a complex, chaotic, and non-deterministic reality. These postmodern theories are — significantly — all metacritical in the sense that they foreground themselves as metaphors rather than as "accurate" descriptions of reality. In terms that are more familiar to literary theorists than to theoretical physicists, we might say that these attempts by scientists to develop new strategies of description represent notes towards a theory of theories, of how representation — mathematical, experimental, and verbal — is inherently complex and problematizing, not a solution but part of the semiotics of investigating the universe.[86,87,#123]

From a different starting point, Aronowitz likewise suggests that a liberatory science may arise from interdisciplinary sharing of epistemologies:

> ... natural objects are also socially constructed. It is not a question of whether these natural objects, or, to be more precise, the objects of natural scientific knowledge, exist independently of the act of knowing.

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[85] Capra (1988, p. 145). One caveat: I have strong reservations about Capra's use here of the word "cyclical", which if interpreted too literally could promote a politically regressive quietism. For further analyses of these issues, see Bohm (1980), Merchant (1980, 1992), Berman (1981), Prigogine and Stengers (1984), Bowen (1985), Griffin (1988), Kitchener (1988), Callicott (1989, chapters 6 and 9), Shiva (1990), Best (1991), Haraway (1991, 1994), Mathews (1991), Morin (1992), Santos (1992) and Wright (1992).

[86] Markley (1992, p. 264). A minor quibble: It is not clear to me that complex number theory, which is a new and still quite speculative branch of mathematical physics, ought to be accorded the same epistemological status as the three firmly established sciences cited by Markley.

[87] See Wallerstein (1993, pp. 17–20) for an incisive and closely analogous account of how the postmodern physics is beginning to borrow ideas from the historical social sciences; and see Santos (1989, 1992) for a more detailed development.[#122]

#124 This passage is so clumsily written that it is hard to know what, if anything, its author is arguing (how in heavens' name did we get from "science" to "performance art"?). The real surprise is that Aronowitz, an editor of *Social Text*, did not realize that I was quoting this passage in order to make him look (justly) foolish; evidently he felt proud of his work and considered it fully deserving of my praise.

A cynical reader might suspect that I intentionally truncated Aronowitz's paragraph — deleting his explanation of *why* "performance art may be such an attempt" (an attempt to do *what* exactly, anyway?) — in order to exaggerate its absurdity. In fact the opposite is true. Here is the full paragraph, which comes after an observation that "technology as discourse defines social construction":

> In turn, natural objects are also socially constructed. It is not a question of whether these natural objects, or, to be more precise, the objects of natural scientific knowledge, exist independently of the act of knowing. This question is answered by the assumption of "real" time as opposed to the presupposition, common among neo-Kantians, that time always has a referent, that temporality is therefore a relative, not an unconditioned, category. Surely, the earth evolved long before life on earth. The question is whether objects of natural scientific knowledge are constituted outside the social field. If this is possible, we can assume that science or art may develop procedures that effectively neutralize the effects emanating from the means by which we produce knowledge/art. Performance art may be such an attempt. The artist foregoes the use of tools — brushes, chisels, cameras, as well as raw materials (paper, stone, film) upon which are inscribed shapes, colors, lines. Performance art, like more conventional theater, attempts to restore to the body its autonomous space. Communication is no longer mediated by things. This might satisfy the antitechnological impulse were it not for the body itself, which is already incorporated into the technological sensorium. Movement is never natural; it is enframed in technology. (Aronowitz 1988b, p. 344)

#125 This is a complete *non sequitur*. Even if Bohr's ideas on complementarity were to constitute the correct philosophical framework for understanding subatomic physics — and this is far from clear — why would that imply anything about the sociology of science?

#126 For what it's worth, irrational numbers (such as $\sqrt{2}$ and π) and imaginary numbers (such as $\sqrt{-1}$) are very different beasts. More importantly, there is no relation (except an etymological one) between "irrational numbers" in mathematics and "irrationality" in its everyday or philosophical sense.

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Finally, postmodern science provides a powerful refutation of the authoritarianism and elitism inherent in traditional science, as well as an empirical basis for a democratic approach to scientific work. For, as Bohr noted, "a complete elucidation of one and the same object may require diverse points of view which defy a unique description" — this is quite simply a fact about the world, much as the self-proclaimed empiricists of modernist science might prefer to deny it. In such a situation, how can a self-perpetuating secular priesthood of credentialed "scientists" purport to maintain a monopoly on the production of scientific knowledge?[#125] (Let me emphasize that I am in no way opposed to specialized scientific training; I object only when an elite caste seeks to impose its canon of "high science", with the aim of excluding *a priori* alternative forms of scientific production by non-members.[89])

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[88] Aronowitz (1988b, p. 344).

[89] At this point, the traditional scientist's response is that work not conforming to the evidentiary standards of conventional science is fundamentally *irrational*, i.e. logically flawed and therefore not worthy of credence. But this refutation is insufficient: for, as Porush (1993) has lucidly observed, modern mathematics and physics have *themselves* admitted a powerful "intrusion of the irrational" in quantum mechanics and Gödel's theorem — although, understandably, like the Pythagoreans 24 centuries ago, modernist scientists have attempted to exorcise this unwanted irrational element as best they could. Porush makes a powerful plea for a "post-rational epistemology" that would retain the best of conventional Western science while validating alternative ways of knowing.

Note also that Jacques Lacan, from a quite different starting point, came long ago to a similar appreciation of the inevitable role of irrationality in modern mathematics:

> If you'll permit me to use one of those formulas which come to me as I write my notes, human life could be defined as a calculus in which zero was irrational. This formula is just an image, a mathematical metaphor. When I say "irrational," I'm referring not to some unfathomable emotional state but precisely to what is called an imaginary number. The square root of minus one doesn't correspond to anything that is subject to our intuition, anything real — in the mathematical sense of the term — and yet, it must be conserved, along with its full function.

[Lacan (1977, pp. 28–29), seminar originally given in 1959.]

For further reflections on irrationality in modern mathematics, see Solomon (1988, p. 76) and Bloor (1991, pp. 122–125).[#126]

#127 The repetition of the theme from the exposition signals that the end is near (see note #112 above).

#128 I can't resist quoting Gary Kamiya's astute comment on this passage:

> Yo! Comrades! Let's go out and transgress some boundaries! And while we're at it, let's break down barriers! Meet me at noon to radically democratize all aspects of social, economic, political and cultural life! Right after the faculty luncheon at the Regency! (Kamiya 1996)

#129 In these two quotes, Markley raises some genuine and important issues and then proceeds to address them in an extraordinarily superficial way. Why, for instance, should "the state of the biosphere" — even assuming it to be as dire as Markley's litany of troubles suggests — have any consequences for or against the philosophical view known as "realism"? (See Chapter 7 for a defense of a nuanced form of realism.)

The content and methodology of postmodern science thus provide powerful intellectual support for the progressive political project, understood in its broadest sense: the transgressing of boundaries[#127], the breaking down of barriers, the radical democratization of all aspects of social, economic, political and cultural life.[#128,90] Conversely, one part of this project must involve the construction of a new and truly progressive science that can serve the needs of such a democratized society-to-be. As Markley observes, there seem to be two more-or-less mutually exclusive choices available to the progressive community:

> On the one hand, politically progressive scientists can try to recuperate existing practices for moral values they uphold, arguing that their right-wing enemies are defacing nature and that they, the counter-movement, have access to the truth. [But] the state of the biosphere — air pollution, water pollution, disappearing rain forests, thousands of species on the verge of extinction, large areas of land burdened far beyond their carrying capacity, nuclear power plants, nuclear weapons, clearcuts where there used to be forests, starvation, malnutrition, disappearing wetlands, nonexistent grass lands, and a rash of environmentally caused diseases — suggests that the realist dream of scientific progress, of recapturing rather than revolutionizing existing methodologies and technologies, is, at worst, irrelevant to a political struggle that seeks something more than a reenactment of state socialism.[91]

The alternative is a profound reconception of science as well as politics:

> [T]he dialogical move towards redefining systems, of seeing the world not only as an ecological whole but as a set of competing systems — a world held together by the tensions among various natural and human interests — offers the possibility of redefining what science is and what it does, of restructuring deterministic schemes of scientific education in favor of ongoing dialogues about how we intervene in our environment.[92,#129]

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[90] See e.g. Aronowitz (1994) and the discussion following it.

[91] Markley (1992, p. 271).

[92] Markley (1992, p. 271). Along parallel lines, Donna Haraway (1991, pp. 191–192) has argued eloquently for a democratic science comprising "partial, locatable, critical knowledges sustaining the possibility of webs of connections called solidarity in politics and shared conversations in epistemology" and founded on "a doctrine and practice of objectivity that privileges contestation, deconstruction, passionate construction, webbed connections, and

#130 I *agree* with all of this sentence except the first clause.

#131 Graduate students in solid-state physics would be overjoyed if this latter statement were true!

#132 Unfortunately, the teaching of mathematics and science *is* often authoritarian; and this is antithetical not only to the principles of radical/democratic pedagogy but to the principles of science itself. See Chapter 2 below for a brief discussion.

#133 This is a grave charge; it ought not be made lightly. Yet the *Social Text* editors never challenged me to produce any evidence that this charge is even plausible, much less true, vis-à-vis the cited authors. Nor, apparently, did they bother to check for themselves any of the cited references. If they had done so, they would have discovered that none of the cited authors are by any stretch of the imagination racist; indeed, their condemnation of the silliest excesses of Afrocentrism is done from an explicitly stated position of respect for genuine multiculturalist scholarship. For a comprehensive and balanced analysis of Afrocentric ideas as well as their historical precursors, see Howe (1998).

It goes without saying that postmodernist science unequivocally favors the latter, deeper approach.

In addition to redefining the content of science, it is imperative to restructure and redefine the institutional loci in which scientific labor takes place — universities, government labs, and corporations — and reframe the reward system that pushes scientists to become, often against their own better instincts, the hired guns of capitalists and the military.[#130] As Aronowitz has noted, "One third of the 11,000 physics graduate students in the United States are in the single subfield of solid state physics, and all of them will be able to get jobs in that subfield."[93,#131] By contrast, there are few jobs available in either quantum gravity or environmental physics.

But all this is only a first step: the fundamental goal of any emancipatory movement must be to demystify and democratize the production of scientific knowledge, to break down the artificial barriers that separate "scientists" from "the public". Realistically, this task must start with the younger generation, through a profound reform of the educational system.[94] The teaching of science and mathematics must be purged of its authoritarian and elitist characteristics[95,#132], and the content of these subjects enriched by incorporating the insights of the feminist[96], queer[97], multiculturalist[98] and ecological[99] critiques.

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hope for transformation of systems of knowledge and ways of seeing". These ideas are further developed in Haraway (1994) and Doyle (1994).

[93] Aronowitz (1988b, p. 351). Although this observation appeared in 1988, it is all the more true today.

[94] Freire (1970), Aronowitz and Giroux (1991, 1993).

[95] For an example in the context of the Sandinista revolution, see Sokal (1987).

[96] Merchant (1980), Easlea (1981), Keller (1985, 1992), Harding (1986, 1991), Haraway (1989, 1991), Plumwood (1993a). See Wylie *et al.* (1990) for an extensive bibliography. The feminist critique of science has, not surprisingly, been the object of a bitter right-wing counterattack. For a sampling, see Levin (1988), Haack (1992, 1993), Sommers (1994), Gross and Levitt (1994, chapter 5) and Patai and Koertge (1994).

[97] Trebilcot (1988), Hamill (1994).

[98] Ezeabasili (1977), Van Sertima (1983), Frye (1987), Sardar (1988), Adams (1990), Nandy (1990), Alvares (1992), Harding (1994). As with the feminist critique, the multiculturalist perspective has been ridiculed by right-wing critics, with a condescension that in some cases borders on racism.[#133] See e.g. Ortiz de Montellano (1991), Martel (1991/92), Hughes (1993, chapter 2) and Gross and Levitt (1994, pp. 203–214).

[99] Merchant (1980, 1992), Berman (1981), Callicott (1989, chapters 6 and 9), Mathews (1991), Wright (1992), Plumwood (1993a), Ross (1994).

Finally, the content of any science is profoundly constrained by the language within which its discourses are formulated; and mainstream Western physical science has, since Galileo, been formulated in the language of mathematics.[100,101] But *whose* mathematics? The question is a fundamental one, for, as Aronowitz has observed, "neither logic nor mathematics escapes

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[100] See Wojciehowski (1991) for a deconstruction of Galileo's rhetoric, in particular his claim that the mathematico-scientific method can lead to direct and reliable knowledge of "reality".

[101] A very recent but important contribution to the philosophy of mathematics can be found in the work of Deleuze and Guattari (1994, chapter 5). Here they introduce the philosophically fruitful notion of a "functive" [Fr. *fonctif*], which is neither a function [Fr. *fonction*] nor a functional [Fr. *fonctionnelle*] but rather a more basic conceptual entity:

> The object of science is not concepts but rather functions that are presented as propositions in discursive systems. The elements of functions are called *functives*. (p. 117)

This apparently simple idea has surprisingly subtle and far-reaching consequences; its elucidation requires a detour into chaos theory (see also Rosenberg 1993 and Canning 1994):

> ... the first difference between science and philosophy is their respective attitudes toward chaos. Chaos is defined not so much by its disorder as by the infinite speed with which every form taking shape in it vanishes. It is a void that is not a nothingness but a *virtual*, containing all possible particles and drawing out all possible forms, which spring up only to disappear immediately, without consistency or reference, without consequence. Chaos is an infinite speed of birth and disappearance. (pp. 117–118)

But science, unlike philosophy, cannot cope with infinite speeds:

> ... it is by slowing down that matter, as well as the scientific thought able to penetrate it [*sic*] with propositions, is actualized. A function is a Slow-motion. Of course, science constantly advances accelerations, not only in catalysis but in particle accelerators and expansions that move galaxies apart. However, the primordial slowing down is not for these phenomena a zero-instant with which they break but rather a condition coextensive with their whole development. To slow down is to set a limit in chaos to which all speeds are subject, so that they form a variable determined as abscissa, at the same time as the limit forms a universal constant that cannot be gone beyond (for example, a maximum degree of contraction). *The first functives are therefore the limit and the variable*, and reference is a relationship between values of the variable or, more profoundly, the relationship of the variable, as abscissa of speeds, with the limit. (pp. 118–119, emphasis mine)

A rather intricate further analysis (too lengthy to quote here) leads to a conclusion of profound methodological importance for those sciences based on mathematical modelling:

> The respective independence of variables appears in mathematics when one of them is at a higher power than the first. That is why Hegel shows that variability in the function is not confined to values that can be changed ($\frac{2}{3}$ and $\frac{4}{6}$) or are left

#134 I included these lengthy quotes from the book of Deleuze and Guattari — which was indeed a best-seller in France in 1991 — because they are so hilariously meaningless. See Sokal and Bricmont (1998, chapter 9) for a more detailed compendium and analysis of Deleuze and Guattari's charlatanry concerning physics and mathematics.

#135 As Gross and Levitt (1994, p. 115) acerbically comment: "This strange notion of mathematics as the willing victim of date rape is, we must admit, a new one on us — and one of us has been earning a (marginal) living at it for thirty-five years!" They add, uncharitably but perhaps not unjustly, that "language like this makes it difficult to forget that one of the authors is in an English department."

#136 Of course, the classism, social-Darwinism and sexism in this passage *are* obvious. That does not detract in any way from the mathematical importance of this paper, which founded the theory of branching processes.

the 'contamination' of the social."[102] And as feminist thinkers have repeatedly pointed out, in the present culture this contamination is overwhelmingly capitalist, patriarchal and militaristic: "mathematics is portrayed as a woman whose nature desires to be the conquered Other."#135, 103, 104 Thus, a

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undetermined ($a = 2b$) but requires one of the variables to be at a higher power ($y^2/x = P$). (p. 122)

(Note that the English translation inadvertently writes $y^{2/x} = P$, an amusing error that thoroughly mangles the logic of the argument.)

Surprisingly for a technical philosophical work, this book (*Qu'est-ce que la philosophie?*) was a best-seller in France in 1991. It has recently appeared in English translation, but is, alas, unlikely to compete successfully with Rush Limbaugh and Howard Stern for the best-seller lists in this country.#134

[102] Aronowitz (1988b, p. 346). For a vicious right-wing attack on this proposition, see Gross and Levitt (1994, pp. 52–54). See Ginzberg (1989), Cope-Kasten (1989), Nye (1990) and Plumwood (1993b) for lucid feminist critiques of conventional (masculinist) mathematical logic, in particular the *modus ponens* and the syllogism. Concerning the *modus ponens*, see also Woolgar (1988, pp. 45–46) and Bloor (1991, p. 182); and concerning the syllogism, see also Woolgar (1988, pp. 47–48) and Bloor (1991, pp. 131–135). For an analysis of the social images underlying mathematical conceptions of infinity, see Harding (1986, p. 50). For a demonstration of the social contextuality of mathematical statements, see Woolgar (1988, p. 43) and Bloor (1991, pp. 107–130).

[103] Campbell and Campbell-Wright (1993, p. 11). See Merchant (1980) for a detailed analysis of the themes of control and domination in Western mathematics and science.

[104] Let me mention in passing two other examples of sexism and militarism in mathematics that to my knowledge have not been noticed previously:

The first concerns the theory of branching processes, which arose in Victorian England from the "problem of the extinction of families", and which now plays a key role *inter alia* in the analysis of nuclear chain reactions (Harris 1963). In the seminal (and this sexist word is apt) paper on the subject, Francis Galton and the Reverend H.W. Watson wrote (1874):

> The decay of the families of men who occupied conspicuous positions in past times has been a subject of frequent research, and has given rise to various conjectures ... The instances are very numerous in which surnames that were once common have since become scarce or have wholly disappeared. The tendency is universal, and, in explanation of it, the conclusion has hastily been drawn that a rise in physical comfort and intellectual capacity is necessarily accompanied by a diminution in 'fertility' ...
>
> Let $p_0, p_1, p_2, \ldots$ be the respective probabilities that a man has $0, 1, 2, \ldots$ sons, let each son have the same probability of sons of his own, and so on. What is the probability that the male line is extinct after r generations, and more generally what is the probability for any given number of descendants in the male line in any given generation?

One cannot fail to be charmed by the quaint implication that human males reproduce asexually; nevertheless, the classism, social-Darwinism and sexism in this passage are obvious.#136

The second example is Laurent Schwartz's 1973 book on *Radon Measures*. While technically quite interesting, this work is imbued, as its title makes plain, with the pro-nuclear-energy

#137 This is one of my favorite in-jokes in the article. "Radon measures" are a fairly abstruse technical concept in mathematical analysis, named after the mathematician Johann Radon (1887–1956). They have nothing whatsoever to do with the radioactive gas radon!

Laurent Schwartz (1915–2002) was an important twentieth-century French mathematician: he created, among other things, the *theory of distributions*, which has important applications in many areas of mathematics and mathematical physics, including quantum field theory. Schwartz was also a human-rights activist and a tireless opponent of the imperialist wars in Algeria, Vietnam, Central America and Afghanistan. See Schwartz (2001) for a fascinating autobiography.

#138 But this is my favorite of them all: it is nothing but an absurd play on two completely unrelated meanings of the word "choice" (and likewise of "equality"). The axiom of choice is an important but rather technical assertion in mathematical set theory: it says that if we have a collection of disjoint sets, each of which contains at least one element, then there exists a set containing exactly one element "chosen" from each of the original sets. Obviously this has nothing to do with abortion! Likewise, the axiom of equality says that two sets are equal if and only if they have the same elements. Clearly this has nothing to do with nineteenth-century liberalism!

#139 Catastrophe theory is a branch of mathematics that, very roughly speaking, classifies the possible types of bifurcations that can occur in a system as the parameters are varied. It has many potential applications to the natural and social sciences, but these applications were unfortunately vastly oversold in some popular books published in the 1970s and 1980s; indeed, catastrophe theory was, in many ways, a precursor fad to the more recent enthusiasms for chaos and complexity. For skeptical comments on the applications of catastrophe theory, see Zahler and Sussmann (1977), Sussmann and Zahler (1978), Kadanoff (1986) and Arnol'd (1992).

#140 In this final sentence I have endeavored to be as exaggeratedly florid as possible.

#141 A private joke: these are four dear friends of mine ranging in age from 2 to 6 at the time the article was written. (Two are my nieces; the others are the son of one of my physicist colleagues and the daughter of another.) Amusingly, one commentator speculated that "this list of names is either farcical or chosen for its blatant political correctness" (Shusterman 1998, p. 22).

This is a good place to thank those other friends who read and commented on this article, either before or after its submission to *Social Text*: the late Bob Alford, Jean Bricmont, Sergio Caracciolo, Montse Domínguez, Barbara Epstein, Roberto Fernández, Sabino Ferreira, Shelly Goldstein, Noretta Koertge, Antti Kupiainen, Norm Levitt, Marko Loparic, Don Meade, Marion Nestle, Bonnie Oglensky, Marina Papa, Thea Pignataro, Ruth Rosen, David Ruelle, Mary Beth Ruskai, Dick Sacksteder, Jesús Salas, Maria Elisa Marchini Sayeg, Lee Smolin and Dan Zwanziger. It goes without saying that these people should not be assumed to agree with any of my views, whether parodic or real.

liberatory science cannot be complete without a profound revision of the canon of mathematics.[105] As yet no such emancipatory mathematics exists, and we can only speculate upon its eventual content. We can see hints of it in the multidimensional and nonlinear logic of fuzzy systems theory[106]; but this approach is still heavily marked by its origins in the crisis of late-capitalist production relations.[107] Catastrophe theory[108,#139], with its dialectical emphases on smoothness/discontinuity and metamorphosis/unfolding, will indubitably play a major role in the future mathematics; but much theoretical work remains to be done before this approach can become a concrete tool of progressive political praxis.[109] Finally, chaos theory — which provides our deepest insights into the ubiquitous yet mysterious phenomenon of nonlinearity — will be central to all future mathematics. And yet, these images of the future mathematics must remain but the haziest glimmer: for, alongside these three young branches in the tree of science, there will arise new trunks and branches — entire new theoretical frameworks — of which we, with our present ideological blinders, cannot yet even conceive.[#140]

I wish to thank Giacomo Caracciolo, Lucía Fernández-Santoro, Lia Gutiérrez and Elizabeth Meiklejohn for enjoyable discussions which have contributed greatly to this article. Needless to say, these people should not be assumed to be in total agreement with the scientific and political views expressed here, nor are they responsible for any errors or obscurities which may inadvertently remain.[#141]

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worldview that has been characteristic of French science since the early 1960s.[#137] Sadly, the French left — especially but by no means solely the PCF — has traditionally been as enthusiastic for nuclear energy as the right (see Touraine *et al.* 1980).

[105] Just as liberal feminists are frequently content with a minimal agenda of legal and social equality for women and "pro-choice", so liberal (and even some socialist) mathematicians are often content to work within the hegemonic Zermelo–Fraenkel framework (which, reflecting its nineteenth-century liberal origins, already incorporates the axiom of equality) supplemented only by the axiom of choice. But this framework is grossly insufficient for a liberatory mathematics, as was proven long ago by Cohen (1966).[#138]

[106] Kosko (1993).

[107] Fuzzy systems theory has been heavily developed by transnational corporations — first in Japan and later elsewhere — to solve practical problems of efficiency in labor-displacing automation.

[108] Thom (1975, 1990), Arnol'd (1992).

[109] An interesting start is made by Schubert (1989).

#142 Two little jokes are hidden in the bibliography: namely, a wink at former French minister of culture Jacques Toubon (also known to French wags as Jack Allgood), who tried to impose the use of French in scientific conferences sponsored by the French government (see Kontsevitch 1994), and at Catalan nationalism (see Smolin 1992).

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2

Transgressing the boundaries: An afterword*

> Les grandes personnes sont décidément bien bizarres, se dit le petit prince.
>
> — *Antoine de Saint Exupéry, Le Petit Prince*

Alas, the truth is out: my article, "Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity", which appeared in the Spring/Summer 1996 issue of the cultural-studies journal *Social Text*, is a parody. Clearly I owe the editors and readers of *Social Text*, as well as the wider intellectual community, a non-parodic explanation of my motives and my true views.[1] One of my goals here is to make a small contribution toward a dialogue on the Left between humanists and natural scientists — "two cultures" which, contrary to some optimistic pronouncements (mostly by the former group), are probably farther apart in mentality than at any time in the past fifty years.

Like the genre it is meant to satirize — myriad exemplars of which can be found in my reference list — my article is a mélange of truths, half-truths, quarter-truths, falsehoods, non sequiturs, and syntactically correct sentences that have no meaning whatsoever. (Sadly, there are only a handful of the

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* This article was submitted to *Social Text* following the publication of the parody, but was rejected on the grounds that it did not meet their intellectual standards. It was published in *Dissent* **43**(4), pp. 93–99 (Fall 1996) and, in slightly different form, in *Philosophy and Literature* **20**(2), pp. 338–346 (October 1996). See also the critical comment by *Social Text* co-founder Stanley Aronowitz in *Dissent* **44**(1), pp. 107–110 (Winter 1997) and my reply in the same issue, pp. 110–111.

[1] Readers are cautioned not to infer my views on any subject except insofar as they are set forth in this Afterword. In particular, the fact that I have parodied an extreme or ambiguously stated version of an idea does not exclude that I may agree with a more nuanced or precisely stated version of the same idea.

latter: I tried hard to produce them, but I found that, save for rare bursts of inspiration, I just didn't have the knack.) I also employed some other strategies that are well-established (albeit sometimes inadvertently) in the genre: appeals to authority in lieu of logic; speculative theories passed off as established science; strained and even absurd analogies; rhetoric that sounds good but whose meaning is ambiguous; and confusion between the technical and everyday senses of English words.[2] (N.B. All works cited in my article are real, and all quotations are rigorously accurate; none are invented.)

But why did I do it? I confess that I'm an unabashed Old Leftist who never quite understood how deconstruction was supposed to help the working class.[3] And I'm a stodgy old scientist who believes, naively, that there exists an external world, that there exist objective truths about that world, and that my job is to discover some of them. (If science were merely a negotiation of social conventions about what is agreed to be "true", why would I bother devoting a large fraction of my all-too-short life to it? I don't aspire to be the Emily Post of quantum field theory.[4,5])

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[2] For example: "linear", "nonlinear", "local", "global", "multidimensional", "relative", "frame of reference", "field", "anomaly", "chaos", "catastrophe", "logic", "irrational", "imaginary", "complex", "real", "equality", "choice".

[3] **Note added for this edition:** Many commentators have been misled by this sentence, having missed its sardonic tone. For instance, Gita Chadha (1997, 1998) has characterized me as an "orthodox Marxist" who is opposed to "new leftist discourses" such as feminism and cultural analysis; at one point she even attributes to me "a belief in ... the ethical supremacy of scientific communism"! For what it's worth, let me say for the record that I'm not a Marxist of any kind, orthodox or otherwise. I have respect for Marxist tools such as class analysis, but it seems to me that Marxists have radically underestimated the difficulty of developing an empirically validated "scientific" theory of any significant part of human behavior — not to mention a theory of the "inevitable" global sweep of human history. Moreover, far from being opposed to non-Marxist progressive currents such as feminism, I have specifically characterised myself as a leftist *and* a feminist (Sokal 1996). *Of course* I recognize non-class oppressions such as those based on race, gender, sexuality, caste and religion — who nowadays could fail to do so? My point was simply that Derridean deconstruction and kindred sophistries won't do much for the working class *or* for women *or* for African-Americans *or* for gays and lesbians *or* for dalits ("untouchables") *or* for any other oppressed group. See also Sokal (2000) for a more detailed response to Chadha.

[4] **Note added for this edition:** Emily Post (1873–1960) was the author of a classic American manual of social etiquette.

[5] By the way, anyone who believes that the laws of physics are mere social conventions is invited to try transgressing those conventions from the windows of my apartment. I live on the twenty-first floor. (P.S. I am aware that this wisecrack is unfair to the more sophisticated relativist philosophers of science, who will concede that *empirical statements* can be objectively true — e.g. the fall from my window to the pavement will take approximately 2.5 seconds — but claim that the *theoretical explanations* of those empirical statements are more-or-less

But my main concern isn't to defend science from the barbarian hordes of lit crit (we'll survive just fine, thank you). Rather, my concern is explicitly *political*: to combat a currently fashionable postmodernist/poststructuralist/social-constructivist discourse — and more generally a penchant for subjectivism — which is, I believe, inimical to the values and future of the Left.[6] Alan Ryan said it well:

> It is, for instance, pretty suicidal for embattled minorities to embrace Michel Foucault, let alone Jacques Derrida. The minority view was always that power could be undermined by truth ... Once you read Foucault as saying that truth is simply an effect of power, you've had it.... But American departments of literature, history and sociology contain large numbers of self-described leftists who have confused radical doubts about objectivity with political radicalism, and are in a mess.[7]

Likewise, Eric Hobsbawm has decried

> the rise of "postmodernist" intellectual fashions in Western universities, particularly in departments of literature and anthropology, which imply

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arbitrary social constructions. I think that also this view is largely wrong, but that is a much longer discussion.)

Note added for this edition: Many hostile commentators (e.g. Krige 1998 and Lynch 2001, pp. 54–55) seem to think (or at least to want their readers to think) that my entire philosophy of science is contained in this wisecrack. And this despite the fact that far more detailed expositions of my philosophical ideas — for instance, the remainder of the present essay, as well as Chapters 3, 5 and especially 6 of the present book — were available in print at the time of their writing. I leave the reader to judge for herself the justice of their criticisms.

[6] The natural sciences have little to fear, at least in the short run, from postmodernist silliness; it is, above all, history and the social sciences — and leftist politics — that suffer when verbal game-playing displaces the rigorous analysis of social realities. Nevertheless, because of the limitations of my own expertise, my analysis here will be restricted to the natural sciences (and indeed primarily to the physical sciences). While the basic epistemology of inquiry ought to be roughly the same for the natural and social sciences, I am of course perfectly aware that many special (and very difficult) methodological issues arise in the social sciences from the fact that the objects of inquiry are human beings (including their subjective states of mind); that these objects of inquiry have intentions (including in some cases the concealment of evidence or the placement of deliberately self-serving evidence); that the evidence is expressed (usually) in human language whose meaning may be ambiguous; that the meaning of conceptual categories (e.g. childhood, masculinity, femininity, family, economics, etc.) changes over time; that the goal of historical inquiry is not just facts but interpretation, etc. So by no means do I claim that my comments about physics should apply directly to history and the social sciences — that would be absurd. To say that "physical reality is a social and linguistic construct" is just plain silly, but to say that "social reality is a social and linguistic construct" is virtually a tautology.

[7] Ryan (1992).

> that all "facts" claiming objective existence are simply intellectual constructions. In short, that there is no clear difference between fact and fiction. But there is, and for historians, even for the most militantly antipositivist ones among us, the ability to distinguish between the two is absolutely fundamental.[8]

(Hobsbawm goes on to show how rigorous historical work can refute the fictions propounded by reactionary nationalists in India, Israel, the Balkans and elsewhere.) And finally Stanislav Andreski:

> So long as authority inspires awe, confusion and absurdity enhance conservative tendencies in society. Firstly, because clear and logical thinking leads to a cumulation of knowledge (of which the progress of the natural sciences provides the best example) and the advance of knowledge sooner or later undermines the traditional order. Confused thinking, on the other hand, leads nowhere in particular and can be indulged indefinitely without producing any impact upon the world.[9]

As an example of "confused thinking", I would like to consider a chapter from Harding (1991) entitled "Why 'Physics' Is a Bad Model for Physics". I select this example both because of Harding's prestige in certain (but by no means all) feminist circles, and because her essay is (unlike much of this genre) very clearly written. Harding wishes to answer the question, "Are feminist criticisms of Western thought relevant to the natural sciences?" She does so by raising, and then rebutting, six "false beliefs" about the nature of science. Some of her rebuttals are perfectly well-taken; but they don't prove anything like what she claims they do. That is because she conflates five quite distinct issues:

1) *Ontology.* What objects *exist* in the world? What statements about these objects are *true*?
2) *Epistemology.* How can human beings obtain *knowledge* of truths about the world? How can they assess the *reliability* of that knowledge?
3) *Sociology of knowledge.* To what extent are the truths *known* (or *knowable*) by humans in any given society influenced (or determined) by social, economic, political, cultural and ideological factors? Same question for the false statements erroneously believed to be true.

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[8] Hobsbawm (1993, p. 63).

[9] Andreski (1972, p. 90).

4) *Individual ethics.* What types of research *ought* a scientist (or technologist) to undertake (or refuse to undertake)?

5) *Social ethics.* What types of research *ought* society to encourage, subsidize or publicly fund (or alternatively to discourage, tax or forbid)?

These questions are obviously related — e.g. if there are no objective truths about the world, then there isn't much point in asking how one can know those (nonexistent) truths — but they are conceptually distinct.

For example, Harding (citing Forman 1987) points out that American research in the 1940s and 50s on quantum electronics was motivated in large part by potential military applications. True enough. Now, quantum mechanics made possible solid-state physics, which in turn made possible quantum electronics (e.g. the transistor), which made possible nearly all of modern technology (e.g. the computer).[10] And the computer has had applications that are beneficial to society (e.g. in allowing the postmodern cultural critic to produce her articles more efficiently) as well as applications that are harmful (e.g. in allowing the U.S. military to kill human beings more efficiently). This raises a host of social and individual ethical questions: Ought society to forbid (or discourage) certain applications of computers? Forbid (or discourage) research on computers *per se*? Forbid (or discourage) research on quantum electronics? On solid-state physics? On quantum mechanics? And likewise for individual scientists and technologists. (Clearly, an affirmative answer to these questions becomes harder to justify as one goes down the list; but I do not want to declare any of these questions *a priori* illegitimate.) Likewise, sociological questions arise, for example: To what extent is our (true) knowledge of computer science, quantum electronics, solid-state physics and quantum mechanics — and our lack of knowledge about other scientific subjects, e.g. the global climate — a result of public-policy choices favoring militarism? To what extent have the erroneous theories (if any) in computer science, quantum electronics, solid-state physics and quantum mechanics been the result (in whole or in part) of social, economic, political, cultural and ideological factors, in particular the culture of militarism?[11] These are all serious questions, which deserve careful

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[10] Computers existed prior to solid-state technology, but they were unwieldy and slow. The 486 PC sitting today on the literary theorist's desk is roughly 1000 times more powerful than the room-sized vacuum-tube computer IBM 704 from 1954 (see e.g. Williams 1985).

[11] I certainly don't exclude the possibility that *present* theories in any of these subjects might be erroneous. But critics wishing to make such a case would have to provide not only historical evidence of the claimed cultural influence, but also *scientific* evidence that the theory in

investigation adhering to the highest standards of scientific and historical evidence. *But they have no effect whatsoever on the underlying scientific questions*: whether atoms (and silicon crystals, transistors and computers) really do behave according to the laws of quantum mechanics (and solid-state physics, quantum electronics and computer science). The militaristic orientation of American science has quite simply no bearing whatsoever on the ontological question, and only under a wildly implausible scenario could it have any bearing on the epistemological question. (E.g. if the worldwide community of solid-state physicists, following what they believe to be the conventional standards of scientific evidence, were to hastily accept an erroneous theory of semiconductor behavior because of their enthusiasm for the breakthrough in military technology that this theory would make possible.)

Andrew Ross has drawn an analogy between the hierarchical taste cultures (high, middlebrow and popular) familiar to cultural critics, and the demarcation between science and pseudoscience.[12] At a sociological level this is an incisive observation; but at an ontological and epistemological level it is simply mad. Ross seems to recognize this, because he immediately says:

> I do not want to insist on a literal interpretation of this analogy ... A more exhaustive treatment would take account of the local, qualifying differences between the realm of cultural taste and that of science [!], but it would run up, finally, against the stand-off between the empiricist's claim that non-context-dependent beliefs exist and that they can be true, and the culturalist's claim that beliefs are only socially accepted as true.[13]

But such epistemological agnosticism simply won't suffice, at least not for people who aspire to make social change. Deny that non-context-dependent assertions can be true, and you don't just throw out quantum mechanics and molecular biology: you also throw out the Nazi gas chambers, the American

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question is in fact erroneous. (The same evidentiary standards of course apply to *past* erroneous theories; but in this case the scientists may have already performed the second task, relieving the cultural critic of the need to do so from scratch.)

[12] Ross (1991, pp. 25–26); also in Ross (1992, pp. 535–536).

[13] Ross (1991, p. 26); also in Ross (1992, p. 535). In the discussion following this paper, Ross (1992, p. 549) expressed further (and quite justified) misgivings:

> I'm quite skeptical of the "anything goes" spirit that is often the prevailing climate of relativism around postmodernism.... Much of the postmodernist debate has been devoted to grappling with the philosophical or cultural limits to the grand narratives of the Enlightenment. If you think about ecological questions in this light, however, then you are talking about "real" physical, or material, limits to our resources for encouraging social growth. And postmodernism, as we know, has been loath to address the "real," except to announce its banishment.

enslavement of Africans, and the fact that today in New York it's raining. Hobsbawm is right: facts do matter, and some facts (like the first two cited here) matter a great deal.

Still, Ross is correct that, at a sociological level, maintaining the demarcation line between science and pseudoscience serves — *among other things* — to maintain the social power of those who, whether or not they have formal scientific credentials, stand on science's side of the line. (It has *also* served to increase the mean life expectancy in the United States from 47 years to 76 years in less than a century.[14]) Ross notes that

> Cultural critics have, for some time now, been faced with the task of exposing similar vested institutional interests in the debates about class, gender, race, and sexual preference that touch upon the demarcations between taste cultures, and I see no ultimate reason for us to abandon our hard-earned skepticism when we confront science.[15]

Fair enough: scientists are in fact the *first* to advise skepticism in the face of other people's (and one's own) truth claims. But a sophomoric skepticism, a bland (or blind) agnosticism, won't get you anywhere. Cultural critics, like historians or scientists, need an *informed* skepticism: one that can evaluate evidence and logic, and come to reasoned (albeit tentative) judgments *based on that evidence and logic.*

At this point Ross may object that I am rigging the power game in my own favor: how is he, a professor of American Studies, to compete with me, a physicist, in a discussion of quantum mechanics?[16] (Or even of nuclear

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[14] U.S. Bureau of the Census (1975, pp. 47, 55; 1994, p. 87). In 1900 the mean life expectancy at birth was 47.3 years (47.6 years for whites, and a shocking 33.0 years for "Negro and other"). In 1995 it is 76.3 years (77.0 years for whites, 70.3 years for blacks).

I am aware that this assertion is likely to be misinterpreted, so let me engage in some preemptive clarification. I am *not* claiming that all of the increase in life expectancy is due to advances in scientific *medicine*. A large fraction (possibly the dominant part) of the increase — especially in the first three decades of the twentieth century — is due to the general improvement in the standards of housing, nutrition and public sanitation (the latter two informed by improved scientific understanding of the etiology of infectious and dietary-deficiency diseases). [For reviews of the evidence, see e.g. Holland *et al.* (1991).] But — without discounting the role of social struggles in these improvements, particularly as concerns the narrowing of the racial gap — the underlying and overwhelming cause of these improvements is quite obviously the vast increase in the material standard of living over the past century, by more than a factor of five (U.S. Bureau of the Census 1975, pp. 224–225; 1994, p. 451). And this increase is quite obviously the direct result of science, as embodied in technology.

[15] Ross (1991, p. 26); also in Ross (1992, p. 536).

[16] By the way, intelligent non-scientists seriously interested in the conceptual problems raised by quantum mechanics need no longer rely on the vulgarizations (in both senses) published by Heisenberg, Bohr and sundry physicists and New Age authors. The little book

power — a subject on which I have no expertise whatsoever.) But it is equally true that I would be unlikely to win a debate with a professional historian on the causes of World War I. Nevertheless, as an intelligent lay person with a modest knowledge of history, I am capable of evaluating the evidence and logic offered by competing historians, and of coming to some sort of reasoned (albeit tentative) judgment. (Without that ability, how could any thoughtful person justify being politically active?)

The trouble is that few non-scientists in our society feel this self-confidence when dealing with scientific matters. As C.P. Snow observed in his famous "Two Cultures" lecture 35 years ago:

> A good many times I have been present at gatherings of people who, by the standards of the traditional culture, are thought highly educated and who have with considerable gusto been expressing their incredulity at the illiteracy of scientists. Once or twice I have been provoked and have asked the company how many of them could describe the Second Law of Thermodynamics. The response was cold: it was also negative. Yet I was asking something which is about the scientific equivalent of: *Have you read a work of Shakespeare's?*
>
> I now believe that if I had asked an even simpler question — such as, What do you mean by mass, or acceleration, which is the scientific equivalent of saying, *Can you read?* — not more than one in ten of the highly educated would have felt that I was speaking the same language. So the great edifice of modern physics goes up, and the majority of the cleverest people in the western world have about as much insight into it as their neolithic ancestors would have had.[17]

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of Albert (1992) provides an impressively serious and *intellectually honest* account of quantum mechanics and the philosophical issues it raises — yet it requires no more mathematical background than a modicum of high-school algebra, and does not require any prior knowledge of physics. The main requirement is a willingness to think *slowly* and *clearly*.

[17] Snow (1963, pp. 20–21). One significant change has taken place since C.P. Snow's time: while humanist intellectuals' ignorance about (for example) mass and acceleration remains substantially unchanged, nowadays a significant minority of humanist intellectuals feels entitled to pontificate on these subjects in spite of their ignorance (perhaps trusting that their readers will be equally ignorant). Consider, for example, the following excerpt from a recent book on *Rethinking Technologies*, edited by the Miami Theory Collective and published by the University of Minnesota Press: "it now seems appropriate to reconsider the notions of acceleration and deceleration (what physicists call positive and negative speeds)" (Virilio 1993, p. 5). The reader who does not find this uproariously funny (as well as depressing) is invited to sit in on the first two weeks of Physics I.

Note added for this edition: For many further examples of Virilio's pseudo-scientific charlatanry — and proof that this strong characterization is amply justified — see Sokal and Bricmont (1998, chapter 10).

A lot of the blame for this state of affairs rests, I think, with the scientists. The teaching of mathematics and science *is* often authoritarian[18]; and this is antithetical not only to the principles of radical/democratic pedagogy but to the principles of science itself. No wonder most Americans can't distinguish between science and pseudoscience: their science teachers have never given them any rational grounds for doing so. (Ask an average undergraduate: Is matter composed of atoms? Yes. Why do you think so? The reader can fill in the response.) Is it then any surprise that 36% of Americans believe in telepathy, and that 47% believe in the creation account of Genesis?[19]

As Ross has noted[20], many of the central political issues of the coming decades — from health care to global warming to Third World development — depend in part on subtle (and hotly debated) questions of scientific fact. But they don't depend only on scientific fact: they depend also on ethical values and — in this journal it hardly needs to be added — on naked economic interests. No Left can be effective unless it takes seriously questions of scientific fact *and* of ethical values *and* of economic interests. The issues at stake are too important to be left to the capitalists or to the scientists — or to the postmodernists.

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[18] I wasn't joking about that. For anyone who is interested in my views, I would be glad to provide a copy of Sokal (1987). For another sharp critique of the poor teaching of mathematics and science, see (irony of ironies) Gross and Levitt (1994, pp. 23–28).

[19] Telepathy: Hastings and Hastings (1992, p. 518), American Institute of Public Opinion poll from June 1990. Concerning "telepathy, or communication between minds without using the traditional five senses", 36% "believe in", 25% are "not sure", and 39% "do not believe in". For "people on this earth are sometimes possessed by the devil", it is 49–16–35 (!). For "astrology, or that the position of the stars and planets can affect people's lives", it is 25–22–53. Mercifully, only 11% believe in channeling (22% are not sure), and 7% in the healing power of pyramids (26% not sure).

Creationism: Gallup (1993, pp. 157–159), Gallup poll from June 1993. The exact question was: "Which of the following statements comes closest to your views on the origin and development of human beings: 1) human beings have developed over millions of years from less advanced forms of life, but God guided this process; 2) human beings have developed over millions of years from less advanced forms of life, but God had no part in this process; 3) God created human beings pretty much in their present form at one time within the last 10,000 years or so?" The results were 35% developed with God, 11% developed without God, 47% God created in present form, 7% no opinion. A poll from July 1982 (Gallup 1982, pp. 208–214) found almost identical figures, but gave breakdowns by sex, race, education, region, age, income, religion, and community size. Differences by sex, race, region, income and (surprisingly) religion were rather small. By far the largest difference was by education: only 24% of college graduates supported creationism, compared to 49% of high-school graduates and 52% of those with a grade-school education. So maybe the worst science teaching is at the elementary and secondary levels.

[20] See footnote 13 above.

A quarter-century ago, at the height of the U.S. invasion of Vietnam, Noam Chomsky observed that

> George Orwell once remarked that political thought, especially on the left, is a sort of masturbation fantasy in which the world of fact hardly matters. That's true, unfortunately, and it's part of the reason that our society lacks a genuine, responsible, serious left-wing movement.[21]

Perhaps that's unduly harsh, but there's unfortunately a significant kernel of truth in it. Nowadays the erotic text tends to be written in (broken) French rather than Chinese, but the real-life consequences remain the same. Here's Alan Ryan in 1992, concluding his wry analysis of American intellectual fashions with a lament that

> the number of people who combine intellectual toughness with even a modest political radicalism is pitifully small. Which, in a country that has George Bush as President and Danforth Quayle lined up for 1996, is not very funny.[22]

Four years later, with Bill Clinton installed as our supposedly "progressive" president and Newt Gingrich already preparing for the new millennium, it still isn't funny.[23]

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[21] Chomsky (1984, p. 200), lecture delivered in 1969.

[22] Ryan (1992).

[23] **Note added for this edition:** The weak comedy of 1996 has now turned to tragedy: life under George W. Bush and his aspiring successors is enough to make one pine for the good old days of *conservatives* like Bush father, Quayle and Gingrich.

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3

Truth, reason, objectivity, and the Left*

> I am by no means alone in viewing social trends in the contemporary world with dismay and alarm. The gulf between rich and poor and between developed and underdeveloped countries widens, the environment is destroyed and the threat of annihilation looms. The social and political problems facing us are urgent and vital. I do not think this cause is helped by construals of science as a capitalist male conspiracy or as indistinguishable from black magic or voodoo.
>
> — *Alan Chalmers, Science and Its Fabrication (1990, p. 125)*

The *Social Text* affair has brought up an incredible number of issues, and I can't dream of addressing them all in 20 minutes. So let me start by circumscribing my talk, listing some issues that I *won't* address now, but which we might want to discuss later.

First of all, I don't want to belabor *Social Text*'s failings either before or after the publication of my parody: *Social Text* is not my enemy, nor is it my main intellectual target. (In fact, I strongly recommend two recent issues of *Social Text*, dealing with the crisis of academic labor.[1]) Secondly, I won't go into the ethical issues related to the propriety of hoaxing (although in the question period I'd be glad to defend my ethics).[2] I won't address the

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* Based on a talk presented at a forum at New York University on October 30, 1996 and, in slightly expanded form, at the Socialist Scholars Conference in New York on March 30, 1997. Versions of this essay were published in *New Politics* **6**(2), pp. 126–129 (Winter 1997); in the *Economic and Political Weekly* [Bombay] **33**(16), pp. 913–914 (April 18–24, 1998); and in *Mistaken Identities: The Second Wave of Controversy over "Political Correctness"*, edited by Cyril Levitt *et al.* (Peter Lang Publishing, New York, 1999), pp. 285–294. I have retained here the informal style from the oral presentation.

[1] *Social Text* **49** (Winter 1996) and **51** (Summer 1997).

[2] This issue is discussed in Sokal (1996, p. 64).

obscurantist prose and the uncritical celebrity-worship that have infected certain trendy sectors of the American academic humanities; nor will I try to analyze the media fallout from this affair and what it may indicate both about academia and about the larger society (though these are all important issues that I hope we'll discuss later).[3] I won't enter into technical issues of the philosophy of science (though again I'd be glad to do that in the question period).[4] I won't discuss the social role of science and technology, nor the problem of reconciling technical expertise with democratic control — these are very important issues for the Left, but they would take me too far afield. Indeed, I want to emphasize that this affair is in my view *not* primarily about science — though that was the excuse that I used in constructing my parody — nor is it a disciplinary conflict between scientists and humanists, who are in fact represented on all sides of the debate. What I believe this debate *is* principally about — and what I want to focus on this afternoon — is the nature of truth, reason and objectivity, and its implications for progressive political action.

Let me make one clarification from the beginning. A lot of the discussion this afternoon may come to revolve around the word "relativism", and it's important to understand that this word is used commonly to refer to three very different things: *cognitive* relativism (that is, relativism about truth and knowledge); *ethical* or *moral* relativism (about what is good); and *aesthetic* relativism (about what is beautiful artistically). I think it's very important to keep these three issues separate. My remarks in this talk will concern *only* cognitive relativism. Obviously that's not the end of the story: in our political work we have to make assertions *both* about facts and about values. But I'm going to have to stick to what I feel competent to discuss.

Now, perhaps I should begin by explaining what led me to write the parody, because it's not what you might at first think. My aim isn't to defend science from the barbarian hordes of lit crit or sociology. I know perfectly well that the main threats to science nowadays come from budget-cutting politicians and from corporate executives more concerned with profit than with truth, not from a handful of postmodernist academics. Rather, my goal is to defend what one might call a scientific *worldview* — defined broadly as a respect for evidence and logic, and for the incessant confrontation of theories with the real world; in short, for reasoned argument over wishful thinking, superstition and demagoguery. And my motives for trying to defend

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[3] For some incisive comments on these issues, see Frank (1996), Pollitt (1996) and Willis (1996).

[4] For a detailed discussion, see Chapters 6 and 7 below.

these old-fashioned ideas are basically *political*. I identify politically — as I think all of us here today do — with the Left, understood broadly as the political current that denounces the injustices and inequalities of capitalist society and that seeks more egalitarian and democratic social and economic arrangements. And I'm worried about trends in the American Left — particularly in academia — that at a minimum divert us from the task of formulating a progressive social critique, by leading smart and committed people into trendy but ultimately empty intellectual fashions, and that can in fact undermine the prospects for such a critique, by promoting subjectivist and relativist philosophies that in my view are inconsistent with producing a realistic analysis of society that we and our fellow citizens will find compelling. It seems to me that truth, reason and objectivity are values worth defending no matter what one's political views; but for those of us on the Left, they are crucial — without them, our critique loses all its force.

David Whiteis, in a recent article, said it well:

> Too many academics, secure in their ivory towers and insulated from the real-world consequences of the ideas they espouse, seem blind to the fact that non-rationality has historically been among the most powerful weapons in the ideological arsenals of oppressors. The hypersubjectivity that characterizes postmodernism is a perfect case in point: far from being a legacy of leftist iconoclasm, as some of its advocates so disingenuously claim, it in fact ... plays perfectly into the anti-rationalist — really, anti-*thinking* — bias that currently infects "mainstream" U.S. culture.[5]

Along similar lines, the philosopher of science Larry Laudan observed caustically that

> the displacement of the idea that facts and evidence matter by the idea that everything boils down to subjective interests and perspectives is — second only to American political campaigns — the most prominent and pernicious manifestation of anti-intellectualism in our time.[6]

(And these days, being nearly as anti-intellectual as American political campaigns is really quite a feat.)

Now of course, no one will admit to being against reason, evidence and logic — that's like being against Motherhood and Apple Pie. Rather, our postmodernist and poststructuralist friends will claim to be in favor of some new and *deeper* kind of reason: such as the celebration of "local knowledges"

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[5] Whiteis (1997).

[6] Laudan (1990, p. x).

and "alternative ways of knowing" as an antidote to the so-called "Eurocentric scientific methodology" (you know, things like systematic experiment, controls, replication, and so forth). You find this magic phrase "local knowledges" in, for example, the articles of Andrew Ross and Sandra Harding in the "Science Wars" issue of *Social Text*.[7] But are "local knowledges" all that great? And when local knowledges conflict, *which* local knowledges should we believe? In many parts of the Midwest, the "local knowledges" say that you should spray more herbicides to get bigger crops. It's old-fashioned objective science that can tell us which herbicides are poisonous to farm workers and to people downstream. Here in New York City, lots of "local knowledges" hold that there's a wave of teenage motherhood that's destroying our moral fiber. It's those boring *data* that show that the birth rate to teenage mothers has risen only slightly since 1975, and is about two-thirds of what it was in the good old 1950s.[8] Another word for "local knowledges" is *prejudice*.[9]

I'm sorry to say it, but under the influence of postmodernism some very smart people can fall into some incredibly sloppy thinking, and I want to give two examples. The first comes from a recent front-page article in the *New York Times* about the conflict between archaeologists and some Native American creationists.[10] I don't want to address here the ethical and legal aspects of this controversy — who should control the use of 10,000-year-old human remains — but only the epistemic issue. There are at least two competing views on where Native American populations come from. The scientific consensus, based on extensive archaeological evidence, is that humans first entered the Americas from Asia about 10–20,000 years ago, crossing the Bering Strait. Many Native American creation accounts hold, on the other hand, that native peoples have always lived in the Americas, ever since their ancestors emerged onto the surface of the earth from a subterranean world of spirits. And the *Times* article observed that many archaeologists, "pulled between their scientific temperaments and their appreciation for native culture ... have been driven close to a postmodern relativism in which science is just one more belief system". For example, Roger Anyon, a British archaeologist who has worked for the Zuni people, was quoted as saying that "Science is just one of many ways of knowing the world.... [The Zunis'

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[7] Ross (1996), Harding (1996).

[8] U.S. Bureau of the Census (1975, Series B11–B19; 1980, Table 87; 1990, Table 82; 1997, Tables 90 and 91).

[9] For an example of the pernicious effects of "local knowledges" in a Third World context, see Nanda (1997).

[10] Johnson (1996).

world view is] just as valid as the archeological viewpoint of what prehistory is about."

Now, perhaps Dr. Anyon was misquoted[11], but one does hear this type of assertion rather frequently nowadays, and I'd like to analyze it. Note, first of all, that the word "valid" is ambiguous: Is it intended in a cognitive sense, or in some other sense (for example, as describing the psychological or social role of a system of beliefs)? If the latter, I have no objection; but the reference to "knowing the world" suggests the former. Now, both in philosophy and in everyday language, there is a distinction between *knowledge* (understood, roughly, as justified true belief) and mere *belief*; that's why the word "knowledge" has a positive connotation, while "belief" is neutral. What, then, does Anyon mean by "knowing the world"? If he intends the word "knowing" in its traditional sense, then his assertion is quite simply false: the two theories in question are mutually incompatible, and so cannot both be true (or even approximately true). If, on the other hand, he is simply noting that different people have different beliefs, then his assertion is true (and banal), but it is misleading to employ the success-word "knowledge".[12]

It seems to me that Anyon has quite simply allowed his political and cultural sympathies to cloud his reasoning. And there's no justification for that: we can perfectly well remember the victims of a horrible genocide, and support their descendants' valid political goals, without endorsing uncritically (or hypocritically) their societies' traditional creation myths. After all, if you want to support Native American land claims, does it *really* matter whether Native Americans have been here "forever" or *merely* for 10,000 years? Moreover — and to me this is a key point — the relativists' stance is extremely condescending: it treats a complex society as a monolith, obscures the conflicts within it, and takes its most obscurantist factions as spokespeople for the whole. In a way, it's a late-twentieth-century postmodern analogue of the nineteenth-century imperialist romanticization of the "exotic". Are all Native Americans literal creationists? Are most of them? Has anyone bothered to ask them?

This example landed me in a lot of hot water when I used it in a forum at New York University a few months ago: people wanted to know "by what

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[11] But probably not, because essentially identical views are expressed in Anyon *et al.* (1996).

[12] When challenged, relativist anthropologists sometimes *deny* that there is a distinction between knowledge (i.e. justified true belief) and mere belief, by denying that beliefs — even cognitive beliefs about the external world — can be objectively (trans-culturally) true or false. But it is hard to take such a claim seriously. Didn't millions of Native Americans *really* die in the period following the European invasion? Is this merely a belief held to be true within some cultures?

authority" I was forcing them to decide between those two theories of Native American history; they wanted to know why I was "putting Native Americans on trial"; and so forth. Well, what can I say? By "what authority" do I speak? — obviously none. I'm not an archaeologist. I'm just a lay person who happens to be interested in questions of human history. If you're *not* interested in those questions, that's your business; no one is forcing you to decide anything. Nor am I making a substantive claim about the facts of human history. I'm merely making a simple point of logic: that two mutually contradictory theories can't both be true. And quite honestly, if we on the Left have to spend several hours debating such an elementary point, then god knows how we're going to make radical social change. As for "putting Native Americans on trial", I want to emphasize that the purpose of my story isn't to criticize the Native Americans; it's to criticize the archaeologist who couldn't get his thinking straight.[13]

(By the way, this particular example has been analyzed in more detail by the philosopher Paul Boghossian.[14] He notes that the phrase "just as valid" can be read in at least three different ways: as a claim about truth, as a claim about evidence, or as a claim about purpose. Boghossian argues persuasively that on *none* of the three readings does the relativist view hold water.)

My second example of sloppy thinking comes from a recent article by *Social Text* co-editor Bruce Robbins.[15] Now I'm loath to bring up this example, because I have nothing personal against Robbins — in fact, he's been the most publicly candid and self-critical of the *Social Text* editors since the scandal broke.[16] But I think there *is* a serious intellectual issue here, and I think Robbins' confusions are symptomatic of the confusions of a significant fraction of the academic Left; and it's those confusions that I want to discuss.

In this article Robbins tries to defend — albeit half-heartedly — the postmodernist/poststructuralist subversion of conventional notions of truth. He asks: "Is it in the interests of women, African Americans, and other superexploited people to insist that truth and identity are social constructions? Yes and no," he asserts. "No, you can't talk about exploitation without respect

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[13] **Note added for this edition:** See also Brumble (1998) for an incisive critique of Vine Deloria, Jr.'s Native American creationism and the favorable reception it has garnered in certain intellectual circles.

[14] Boghossian (1996).

[15] Robbins (1996).

[16] **Note added for this edition:** More recently, Robbins has become a personal friend, as a result of our work together on the Open Letter from American Jews to Our Government on peace in the Middle East (`www.peacemideast.org`).

for empirical evidence" — exactly my point. "But yes," Robbins continues, "truth can be another source of oppression." Huh? What could he mean by that? Is he simply observing that sometimes the truth is bitter? Apparently not, because his very next sentence explains what he means: "It was not so long ago," he says, "that scientists gave their full authority to explanations of why women and African Americans ... were inherently inferior." But is Robbins claiming that *that* is truth? I should hope not! Sure, lots of people say things about women and African-Americans that are not true; and yes, those falsehoods have sometimes been asserted in the name of "science", "reason" and all the rest. But claiming something doesn't make it true, and the fact that people — including scientists — sometimes make false claims doesn't mean that we should reject or revise the concept of truth. Quite the contrary: it means that we should examine with the utmost care the *evidence* underlying people's truth claims, and we should reject assertions that in our best rational judgment are false.

This error is, unfortunately, repeated throughout Robbins' essay: he systematically confuses truth with *claims* of truth, fact with *assertions* of fact, and knowledge with *pretensions* to knowledge. These elisions underlie much of the sloppy thinking about "social construction" that is prevalent nowadays in the academy, and it's something that progressives ought to resist. Sure, let's show which economic, political and ideological interests are served by our opponents' accounts of "reality"; but first let's demonstrate, by marshalling evidence and logic, why those accounts are objectively *false* (or in some cases true but incomplete).

Now let me be clear: I'm not saying that it's *easy* to determine, in any specific instance, which claims of truth are in fact truths. Trying to make that distinction is, after all, what all of our intellectual work is about; and if it were so easy, then we'd be out of a job. (Of course, we may be out of a job anyway, but that's another story.) What I'm saying is that it's crucial to distinguish between the *concept* of "truth" and the *concept* of "claim of truth"; if we don't do that, we give away the game before it starts. Unfortunately, some people, starting from the undoubted fact that it's *difficult* to determine the truth — especially in the social sciences — have leapt to the conclusion that there is no objective truth at all. The result is an extreme epistemological skepticism: so that even when postmodernists and their friends concede the existence of an external world — as they pretty much have to — they hobble themselves with a self-imposed inability to make any coherent assertions about that world. How such an extreme skepticism could be a philosophical foundation for *political* radicalism beats me.

On the contrary, political radicalism means speaking truth in the face of power. Against the mystifications promoted by the economic and political elites, we have to offer to our fellow citizens a coherent and persuasive account of how the existing society really works; we have to criticize that society on the basis of a coherent set of ethical values; and finally, we have to make coherent proposals for how to change that society so as to bring it more in accord with our ethical values.

There's a lot more that can be said along these lines:

- about the use of trendy but ambiguous phraseology, like "the social construction of facts", that intentionally elides the distinction between the external world and our knowledge of it;
- about how Cultural Studies has vulgarized valid philosophy of science, drawing wildly exaggerated conclusions from doctrines such as the underdetermination of theory by evidence and the theory-dependence of observation;
- about the distinction between facts and values, which many in Cultural Studies have questioned but which I believe is important (for both intellectual and political reasons) to uphold;
- and more generally, about the importance of distinguishing properly between issues of ontology, epistemology, sociology of knowledge, politics, and ethics, and the failure of much trendy work to do so.

But all this is a big agenda, so instead of my going on for another two hours, let's save those issues for the discussion period.[17]

I want to emphasize that my plea in favor of truth, reason and objectivity in no way implies that the exact meaning of these concepts is self-evident; certainly I don't purport to have resolved centuries-old problems of epistemology. But it does seem to me that these deep and difficult epistemological problems should be treated with the utmost intellectual rigor — as indeed serious philosophers of science have been doing for years. And it's this intellectual rigor, as I've tried to show and would be glad to show in more detail, that has unfortunately been lacking in some of the trendier segments of the American academy. And it's even more unfortunate — at least to my mind — that this sloppy thinking has proliferated among academics who identify with the political Left.

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[17] **Note added for this edition:** Some of these issues are discussed in detail in Chapters 5 and 6 below. See also Sokal and Bricmont (1998, chapter 12).

Let me close by observing that nothing much that I've said this afternoon is new; dozens of people in the humanities, social sciences and natural sciences — many of whom are on the Left — have been saying the same thing for years.[18] But if my parody in *Social Text* has helped just a little bit to amplify their voices and to provoke a much-needed debate in our universities and on the American Left, then it will have served its purpose.

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[18] See, for example, Noam Chomsky's comments in Raskin and Bernstein (1987, pp. 104–156); and see also Albert (1992–93), Chomsky (1992–93), Ehrenreich (1992–93), Albert (1996) and Epstein (1997).

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4

Science studies: Less than meets the eye*

For some years I've been troubled by an apparent decline in the standards of intellectual rigor in the trendier precincts of the American academic humanities. But I'm a mere physicist: if I find myself unable to make head or tail of *jouissance* and *différance*, perhaps that just reflects my own inadequacy.

So, to test the prevailing intellectual standards, I decided to try a modest (though admittedly uncontrolled) experiment: Would the leading North American journal of cultural studies — whose editorial collective includes such luminaries as Fredric Jameson and Andrew Ross — publish an article consisting of utter nonsense if (a) it sounded good and (b) it flattered the editors' ideological preconceptions?

The answer, unfortunately, is yes. Interested readers can find my article, "Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity" (!), in the Spring/Summer 1996 issue of *Social Text*, devoted to the "Science Wars".[1]

What's going on here? Could the editors *really* not have realized that my article was a parody? And what, in heavens' name, are the "science wars"?

According to Andrew Ross, "the Science Wars [are] a second front opened up by conservatives cheered by the successes of their legions in the holy Culture Wars. Seeking explanations for their loss of standing in the public eye and the decline in funding from the public purse, conservatives in science have joined the backlash against the (new) usual suspects — pinkos,

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* This essay was mostly written in 1996 but remained unfinished. I have now completed it, and it is being published for the first time here.

[1] Sokal (1996), reprinted here with annotations as Chapter 1.

feminists and multiculturalists".[2] But, just as in the wearisome "culture wars", the story is rather more complex than a simple left-right confrontation. These disputes are driven by an odd melange of real politics, academic politics, and honest intellectual disagreement. And so — as a pinko and feminist myself, I can personally testify — the participants often find themselves with unusual bedfellows.

The opening shot in the "science wars" — if we must follow Ross' unfortunate military metaphor — was the 1994 publication of Paul Gross and Norman Levitt's *Higher Superstition: The Academic Left and Its Quarrels With Science*.[3] The focus of the Gross–Levitt book is the analysis of a curious historical *volte-face*. For most of the past two centuries, the Left has been identified with science and against obscurantism; we have believed that rational thought and the fearless analysis of objective reality (both natural and social) are incisive tools for combating the mystifications promoted by the powerful — not to mention being desirable human ends in their own right. And yet, over the past two decades, a large number of "progressive" or "leftist" academic humanists and social scientists (though virtually no natural scientists, whatever their political views) have turned away from this Enlightenment legacy and — bolstered by French imports such as deconstruction as well as by home-grown doctrines like feminist standpoint epistemology — have embraced one or another version of epistemic relativism. Moreover, a small but growing subset of these scholars have turned their critique on the natural sciences, questioning not only the political and economic organization of scientific research but also the alleged "cultural prejudices inscribed in the very epistemology of scientific inquiry", as Ross put it.[4] Gross and Levitt contend that these latter scholars, combining an inadequate philosophy of science with an utter ignorance of the science they purport to criticize, have made fools of themselves and subverted the standards of scholarship. What's more, they have harmed the Left: in Levitt's words,

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[2] Ross (1995b, p. 346). An almost identical quotation can be found in Ross (1996, p. 6).

[3] Gross and Levitt (1994a). British readers might place the opening shot two years earlier, with the publication of Lewis Wolpert's *The Unnatural Nature of Science* (1992). In fact, these same questions were being debated in India more than a decade before that, as discussed in Chapter 8 below.

[4] Ross (1995a). This same phrase recurs in Andrew Ross and Stanley Aronowitz, unpublished letter to the author (and to other contributors to the "Science Wars" issue of *Social Text*), March 8, 1995, cited in Traweek (1996, p. 129).

they have served up hanging curve balls to the cultural Right, who have proceeded, alas, to hit them out of the park.[5]

In Ross' estimation, "*Higher Superstition* belongs fair and square to the tradition of Allan Bloom, William Bennett, Roger Kimball, Hilton Kramer and Dinesh D'Souza."[6] Now, this claim is not even guilt by association, but guilt by invented association: in fact Gross is a centrist (by American standards) and Levitt a socialist.[7] But even if they *were* notorious right-wingers, how would that affect the validity or invalidity of their arguments?

So let's put politics aside for a moment, and look at the substance of the debate.

Science is a human endeavor, and like any other human endeavor it merits being subjected to rigorous social analysis. Which research problems count as important; how research funds are distributed; who gets prestige and power; what role scientific expertise plays in public-policy debates; in what form scientific knowledge becomes embodied in technology, and for whose benefit — all these issues are strongly affected by political, economic and to some extent ideological considerations, as well as by the internal logic of scientific inquiry. At a more subtle level, even the content of scientific debate — what types of theories can be conceived and entertained, what criteria are to be used for deciding between competing theories — is constrained in part by the prevailing attitudes of mind, which in turn arise in part from deep-seated historical factors. It is the task of historians and

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[5] Levitt (1995, p. 15). I apologize to non-American readers who may not share my and Levitt's fondness for baseball metaphors. Gross and Levitt (1994a, p. 88) observe that the embrace of postmodernism by some segments of the academic left has presented the ideological right "with welcome opportunities for polemical sallies, counterblows that avoid the necessity for justifying the illogical or evil practices of their own heroes".

[6] Ross (1995b, p. 346), repeated in Ross (1996, p. 7).

[7] Elsewhere, Levitt (1999, p. 29) describes himself as "a socialist in economics, a liberal in politics, and a conservative in culture". Gross has recently co-authored an important book-length critique of creationism a.k.a. Intelligent Design (Forrest and Gross 2004). Gross and Levitt explicitly state at the beginning of their book — and I have no reason to question their sincerity — that

> in the last analysis, the subjects of our rancor are not enemies but friends. There is inescapable irony in that, but, we trust, no hypocrisy. Our chief hope in writing this is to convert friends (whose asseverations are for the moment our subject), or at least to persuade them to reflect. If we succeed only in gratifying their traditional foes, providing one more shaft to be launched against them, we shall have failed utterly. (p. 2)

sociologists of science to sort out, in each specific instance, the roles played by "external" and "internal" factors in determining the course of scientific development. Not surprisingly, scientists tend to stress the "internal" factors while sociologists tend to stress the "external", if only because each group tends to have a poor grasp on the other group's concepts. But these problems are perfectly amenable to rational debate.

Nor is there anything wrong, in principle, with research informed by a political commitment, as long as that commitment does not blind the researcher to inconvenient facts. Thus, there is a long and honorable tradition of socio-political critique of science and technology, often quite scathing: the leftist critique of military and industrial technologies; the ecological critique of the same; the antiracist critique of anthropological pseudo-science and eugenics; and feminist critiques of psychology and parts of medicine and biology. It goes without saying that good politics does not guarantee good science, sociology or history; each analysis has to stand or fall on its own merits.

But over the past three decades there has emerged a new and more radical breed of critique, which aims at the scientific *method* itself. Even more surprisingly, it is claimed that the long-accepted *content* of the natural sciences — biology, chemistry, physics, and even mathematics[8] — is contaminated by bourgeois and/or sexist and/or Eurocentric prejudices. It is these philosophically radical critiques (and *only* these) that I wish to analyze in this essay; for convenience I will refer to them all as belonging to "Science Studies".

Of course, Science Studies has no canonical doctrine; there are significant differences of opinion and of emphasis, both within and between "schools". Still, one may identify a confluence of several related intellectual trends: sociology of scientific knowledge (SSK) along the lines of the Edinburgh and Bath schools of social constructivism; feminist and multiculturalist standpoint epistemologies, and the associated critiques of traditional science as misogynist and imperialist; poststructuralist and postmodernist philosophy applied to science and scientific discourse; and the free-floating analysis carried out by the cultural-studies crowd. What all these critiques have in common is a deep suspicion toward the epistemic claims of modern science, and a commitment (explicit or implicit) to one or another version of epistemic relativism.

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[8] Of course, mathematics is not really a natural science: it deals with truths of pure logic and does not purport to make assertions about the nature of the real world. Nevertheless, because of its close sociological and methodological connections with the natural sciences, I will include it in the discussion here.

Rather than attempting a comprehensive overview of all these schools of thought[9], I would like to focus here on one particularly inventive variety — the feminist wing of social constructivism — and then reconsider the Gross–Levitt book in the light of that analysis.

Feminist science-criticism is a growth industry.[10] Carolyn Merchant's *The Death of Nature*, Sandra Harding's *The Science Question in Feminism*, and Evelyn Fox Keller's *Reflections on Gender and Science* have by now attained the status of canonical texts in Women's Studies courses; they are widely cited by feminist non-scientists seeking the "authoritative" feminist analysis of science.[11] It is therefore urgent to ask whether the content of these works is (a) valid, and (b) feminist. I shall argue that both claims are dubious.[12]

One favorite tactic of feminist science-critics is to mine the works of early-modern philosophers of science, notably Francis Bacon (1561–1626), for allegedly sexist metaphors: in this way the critics aim to reveal the fundamentally misogynist nature of the modern scientific method. Thus, Bacon stands accused of analogizing systematic experimentation to the rape (Harding) and torture (Merchant) of Nature, viewed as female. Harding claims that "Francis Bacon appealed to rape metaphors to persuade

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[9] See Chapter 6 for discussion of several schools in the "new" sociology of science; and see also Murphy (1994) and Brown (2001, chapters 4 and 6).

[10] Or at least it was in 1996 when this essay was first written. In recent years the growth seems to have tapered off somewhat.

[11] Merchant (1980), Harding (1986), Keller (1985). Merchant's book has been cited 702 times in the academic literature since its publication, Harding's 1033 times, and Keller's 927 times. These are quite large numbers: though they pale in comparison with Chomsky's *Aspects of the Theory of Syntax* (4753 citations) or Derrida's *Of Grammatology* (4502 citations), they far outrun, for instance, my own book *Intellectual Impostures/Fashionable Nonsense* (1998), which has been cited only 299 times. Data from Science, Social Science and Arts & Humanities Citation Indexes combined, as of October 26, 2006.

[12] In particular, it is important to protest against the appropriation of the label "feminist epistemology" to denote the views of *certain* feminist theorists of a generally social-constructivist bent (Sandra Harding, Carolyn Merchant, Evelyn Fox Keller, Helen Longino, Donna Haraway, Ruth Bleier, Ruth Hubbard) to the exclusion of others whose politics are equally feminist but whose epistemological views are closer to the mainstream of analytic philosophy of science (Noretta Koertge, Susan Haack, Janet Radcliffe Richards, Meera Nanda). In point of fact, there is no canonical feminist "line" on epistemology, and no feminist has the right to dictate to another what her (or his) philosophical views must be. For simplicity, I shall refrain from placing the phrase "feminist critiques of science" always in quotation marks, but emphasize that I use this phrase solely as a shorthand to designate the former group of theorists.

his audience that experimental method is a good thing" and that these sexual meanings "are central to the ways scientists conceptualize both the methods of inquiry and models of nature" and thus form "a substantive part of science".[13] Similarly, Merchant claims that Bacon's philosophy "treats nature as a female to be tortured through mechanical inventions" along the lines of "the mechanical devices used to torture witches."[14]

Noretta Koertge, Alan Soble, Sarah Hutton, Iddo Landau and others have taken issue with these critics' readings of Bacon, accusing them of seeing sexual innuendos where none exist and of grossly exaggerating when they assimilate laboratory experimentation on nonliving entities to violence against nature.[15] In particular, Soble and Landau dissect both Harding's and Merchant's claims and reveal them to rest in part on artful omissions of words or sentences in their quotations from Bacon.[16]

In a now-famous (or should I say infamous?) passage — which, however, is rarely quoted in full[17] — Harding avers that

> Traditional historians and philosophers have said that these [rape and torture] metaphors are irrelevant to the *real* meanings and referents of scientific concepts ... But when it comes to regarding nature as a machine, they have a quite different analysis: here, we are told, the metaphor provides the interpretations of Newton's mathematical laws: it directs inquirers to fruitful ways to apply his theory ... But if we are to believe that mechanistic metaphors were a fundamental component of the explanations the new science provided, why should we believe that the gender metaphors were not? A consistent analysis would lead to the conclusion that understanding nature as a woman indifferent to or even welcoming rape was equally fundamental to the interpretations of these new

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[13] Harding (1991, pp. 43–44).

[14] Merchant (1980, p. 168).

[15] Koertge (1980, pp. 353–354), Soble (1995), Hutton (1997), Landau (1998), Pesic (1999), Waterhouse (1999). The phrase "violence toward nature" is explicitly used by Merchant (2006, p. 529) to characterize Bacon's experimental method.

[16] Soble (1995): see pp. 196–203 re Harding, and pp. 203–207 re Merchant. Landau (1998): see pp. 48–51 re Merchant, pp. 51–53 re Harding, and p. 53 re Keller.

See Merchant (2006) for a detailed reply to Soble, which to my mind is convincing on some issues (e.g. the enthusiasm of James I for torturing suspected witches) but dubious on others (e.g. the claim that "the very essence of the experimental method arose out of techniques of human torture transferred onto nature", p. 532).

[17] A quick search on Google Scholar and Google Book Search for the keywords "Newton" and "rape manual" found 13 articles and 25 books that cite Harding (not always by name) using these words. However, only four of these quote more than the shock-phrase.

> conceptions of nature and inquiry. Presumably these metaphors, too, had fruitful pragmatic, methodological, and metaphysical consequences for science. In that case, why is it not as illuminating and honest to refer to Newton's laws as "Newton's rape manual" as it is to call them "Newton's mechanics"?[18]

Many commentators have mocked Harding's inflammatory description of the notoriously unreadable *Philosophiæ Naturalis Principia Mathematica* as a "rape manual", and I do not propose to heap on one more reproach. Instead, I would like to draw attention to the astounding (for a self-proclaimed feminist!) assertion contained in her two penultimate sentences. According to Harding, rape and torture metaphors *had fruitful pragmatic, methodological, and metaphysical consequences for science.* Does Harding realize what she is saying? If her claim were true, it would be disastrous news for feminism. After all, Harding does not reject the scientific revolution that began with Galileo and Newton: she, like most feminists, fully acknowledges that "Newton's physics permitted a far more useful understanding of many kinds of phenomena than did the Aristotelian physics it replaced"[19], and she (once again like most feminists) composes her articles on a computer designed in accordance with the laws of electromagnetism that were elucidated by Newton's successors. Does Harding *really* contend that rape and torture metaphors *helped* to bring about this cognitive and material progress? God help us if she were right.

Thankfully, the danger is averted: Harding does not provide a single example of rape and torture metaphors — or, for that matter, sexist metaphors of any kind — having *fruitful* consequences for physics or any of the other natural sciences; and that is most likely because no such examples exist. As Margarita Levin points out,

> The machine metaphor is fruitful; the rape metaphor is not. Consider the lesson that machines teach: what at first glance seems a complex jumble of parts can be analyzed into repetitions and rearrangements of simpler machines, such as levers, pulleys, and gears.[20]

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[18] Harding (1986, p. 113), emphasis in the original. Landau (1998, p. 60) observes that "Harding's last sentence is baffling, since it is Bacon, not Newton, who is claimed to have used the rape metaphor". Perhaps Harding means to assert that Newton's scientific work is conceptually dependent on the ideas of his predecessor Bacon, hence infected with the latter's sins.

[19] Harding (1986, p. 43).

[20] Levin (1988, p. 102).

No such methodological lesson is taught by rape and torture metaphors, even assuming for the sake of argument that such metaphors really were present in Francis Bacon's writings.

When all is said and done, the fundamental flaw in Merchant and Harding's metaphor-hermeneutics is not exegetical but logical. Let us grant for the sake of argument that some of the founders of modern science consciously used sexist metaphors to promote their epistemological and methodological views (this much is probably true, even if Merchant and Harding have exaggerated the case). But what would that entail for the *philosophy* (as opposed to the *history*) of science? Apparently the critics wish to claim that sexism *could* have passed from metaphor into the substantive content of scientific methods and/or theories. But if modern science *does* in fact contain sexist assumptions, then surely the feminist theorists ought to be able to locate and criticize those biased assumptions, *independently* of any argument from history. Indeed, to do otherwise is to commit the "genetic fallacy": evaluating an idea on the basis of its origin rather than its content.

Putting aside the florid accusations of rape and torture, the argument of Merchant and Harding boils down to the assertion that the scientific revolution of the seventeenth century displaced a female-centered (spiritual, hermetic, organic, geocentric) universe in favor of a male-centered (rationalist, scientific, mechanical, heliocentric) one.[21] How should we evaluate this argument?

To begin with, one might wonder whether the gender associations claimed for these two cosmologies are really as univocal as the feminist critics claim.[22] (After all, the main defender of the geocentric worldview — the

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[21] "The female earth was central to the organic cosmology that was undermined by the Scientific Revolution and the rise of a market-oriented culture in early modern Europe." (Merchant 1980, p. xvi)

"In the seventeenth century ... that female world-soul died — or more precisely, was *murdered* — by the mechanist re-visioning of nature." (Bordo 1987, p. 102, emphasis in the original)

"[W]hen Copernican theory replaced the earth-centered universe with a sun-centered universe, it also replaced a woman-centered universe with a man-centered one.... In the new Copernican theory, the womanly earth, which had been God's special creation for man's nurturance, became just one tiny, externally moved planet circling in an insignificant orbit around the masculine sun." (Harding 1986, p. 114)

"Copernican theory replaced the female (earth)-centered universe with a male (sun)-centered universe." (Jaggar 1983, p. 372)

[22] For instance, historian of science William Newman (1998) argues that the pseudo-Paracelsian treatise *De natura rerum* is at least as misogynist as anything to be found in the writings of Bacon and his successors, and that the hermetic-alchemical tradition is at least as explicit (if not more so) in recommending the "torture" of nature as is the later mechanistic science.

Catholic Church — was not exactly a female-centered enterprise, its adoration of the Virgin Mary notwithstanding.) But let us put aside this objection and grant these gender associations for the sake of argument; for the principal flaw in the Merchant–Harding thesis is, once again, not historical but logical. Margarita Levin puts it bluntly: Do Merchant and Harding really "think we have a *choice* about which theory is correct? Masculine or feminine, the solar system is the way it is."[23]

The same point applies not only to astronomy but to scientific theories quite generally; and the bottom line is that there is ample evidence, *independent* of any allegedly sexist imagery, for the epistemic value of modern science. Therefore, as Koertge remarks, "if it really could be shown that patriarchal thinking not only played a crucial role in the Scientific Revolution but is also necessary for carrying out scientific inquiry as we know it, that would constitute the strongest argument for patriarchy that I can think of!"[24]

Of course, the feminist science-critics are not only archaeologists of 300-year-old science; some of their critique is resolutely modern, even postmodern. Here, for instance, is what Donna Haraway, professor of the history of consciousness (!) at the University of California–Santa Cruz and one of the most acclaimed feminist theorists of science, says about her research:

> For the complex or boundary objects in which I am interested, the mythic, textual, technical, political, organic, and economic dimensions implode. That is, they collapse into each other in a knot of extraordinary density that constitutes the objects themselves. In my sense, story telling is in no way an 'art practice' — it is, rather, a fraught practice for narrating complexity in such a field of knots or black holes. In no way is story telling opposed to materiality. But materiality itself is tropic; it makes us swerve, it trips us; it is a knot of the textual, technical, mythic/oneiric, organic, political, and economic.[25]

As right-wing critic Roger Kimball acidly comments: "Remember that this woman is not some crank but a professor at a prestigious university and one of the leading lights of contemporary 'women's studies.'"[26] The saddest thing, for us pinkos and feminists, is that Kimball is dead on target.

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[23] Levin (1988, pp. 105–106), emphasis in the original.

[24] Koertge (1980, p. 354).

[25] Haraway (1994, p. 63).

[26] Kimball (1994, p. 17).

N. Katherine Hayles is professor of English at the University of California–Los Angeles and former president of the Society for Literature and Science. Best known for her book *Chaos Bound* (1990), in which she attempts to relate the mathematical theory of nonlinear dynamics to deconstructive literary theory, Hayles has also achieved some notoriety (in both senses of the word) with her article "Gender Encoding in Fluid Mechanics: Masculine Channels and Feminine Flows", published in *Differences: A Journal of Feminist Cultural Studies*.[27] As Gross and Levitt note, "merely reading Hayles's title aloud to a mathematician triggers, in sequence, a stare of disbelief, an emphatic wince, and an uncontrollable case of the giggles."[28]

In truth, Hayles' paper is not quite so ridiculous as its title. Her point of departure is French feminist Luce Irigaray's contention that fluid mechanics is underdeveloped with respect to solid mechanics because solidity is identified with men and fluidity with women. (But Irigaray was born in Belgium: doesn't she know the symbol of the city of Brussels?) Hayles *rejects* this reasoning, on the grounds that it "ignore[s] virtually all of the specific formalisms that the mathematics of fluid mechanics comprises ... [and] implies that these formalisms arose from gender considerations rather than from experimentally informed decisions about the best way to model reality". She notes that "Irigaray airily advises the reader 'to consult some texts on solid and fluid mechanics' without bothering to mention any. The lack of mathematical detail in her argument forces one to wonder whether she has followed this advice herself."[29] So far so good.[30]

But then Hayles tries to reach similar conclusions by a different path. Her argument begins with an explanation of the important conceptual differences between linear and nonlinear differential equations. It's a respectable attempt at scientific journalism, albeit marred by a few serious errors (e.g. she confuses feedback with nonlinearity, and she asserts that Euler's equation of fluid mechanics is linear) and one hideous metaphor ("suppose that the dancers have halitosis"). From this point on, however, her argument deteriorates into a caricature of postmodern lit-crit. Seeking to trace the historical development of fluid mechanics in the period 1650–1750, she claims to identify "a pair of hierarchical dichotomies [what else?!] in which the first term is privileged at the expense of the second: continuity versus rupture,

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[27] Hayles (1992).

[28] Gross and Levitt (1994b, p. 29).

[29] Hayles (1992, p. 17).

[30] See Sokal and Bricmont (1998, chapter 5) for a more detailed analysis and critique of Irigaray's writings on fluid mechanics and other scientific subjects.

and conservation versus dissipation".[31] There follows a rather confused discussion of the conceptual foundations of differential calculus, an imaginative (to say the least) exegesis of the "subliminal gender identifications" in early hydraulics, and a Freudian analysis of thermodynamics "from heat death to *jouissance*".[32] Hayles claims that

> Despite their names, conservation laws are not inevitable facts of nature but constructions that foreground some experiences and marginalize others.... Almost without exception, conservation laws were formulated, developed, and experimentally tested by men. If conservation laws represent particular emphases and not inevitable facts, then people living in different kinds of bodies and identifying with different gender constructions might well have arrived at different models for flow.[33]

What an interesting idea: perhaps "people living in different kinds of bodies" will learn to see beyond those masculinist laws of conservation of energy and momentum. Ah, what wonders await us in feminist fluid mechanics!

Evelyn Fox Keller is a different can of worms entirely. She is scientifically competent, having studied physics and mathematical biology and published several papers in each area before turning to the history and philosophy of science.[34] Her recollections of life as a woman physics student in the 1950s and 60s, published as a dialogue with Italian physicist Elisabetta Donini[35], make fascinating reading; without a doubt Keller was treated unfairly. But victimization does not confer any particular epistemic privilege (as I believe Keller would agree, contrary to Harding); her philosophical contributions have to stand or fall on their own merits. And it seems to me that they (mostly) fall.

Keller's seminal work, *Reflections on Gender and Science*, is a loosely connected set of essays with a common theme but surprisingly little sustained philosophical or scientific argument. The first essay discusses "love and sex in Plato's epistemology", while the next two discuss the alleged

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[31] Hayles (1992, p. 22).

[32] Sullivan (1998, pp. 76–84) provides a detailed analysis of Hayles' errors in fluid mechanics and explains how they "vitiate her subtle and elaborate attempts to reveal gender encodings" (p. 76).

[33] Hayles (1992, pp. 31–32).

[34] Three of her papers from 1970–71 in mathematical biology — on slime mold aggregation and on chemotaxis — seem to have been quite influential, with 311, 202 and 171 citations, respectively. Data from Science Citation Index, as of October 26, 2006.

[35] Donini (1991).

gender metaphors in seventeenth-century science. Keller's reading of Bacon is much more nuanced than that of Harding and Merchant: she sees a "complex sexual dialectic" between aggression ("bind her [Nature] to your service and make her your slave") and responsiveness ("man is but the servant and interpreter of nature").[36,37] Furthermore, Keller demonstrates that some seventeenth-century English advocates of the scientific method also believed in the reality of spirits and witchcraft (for what that's worth). But, in contrast to this relatively detailed textual and historical exegesis, her argument suddenly goes thin when it addresses the "implications for science":

> The subsequent history of science provides abundant evidence that the values articulated by early modern scientists were in fact effective in promoting those kinds of knowledge that would lead to the mastery, control, and domination of nature. If these are the goals that define success in science, we might generally agree that different values — such as those expressed in hermetic philosophy — could not have been as conducive to success. What is much more difficult (if not impossible) to assess is how successful different values might have been in achieving other goals, more consonant with those values, and what those goals would have been.[38]

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[36] Keller (1985, pp. 35–36).

[37] More recently, Waterhouse (1999) has argued that the sentence "I am come in very truth leading to you Nature with all her children to bind her to your service and make her your slave", frequently quoted by feminists using the published English translation of Bacon's *The Masculine Birth of Time* (Farrington 1964, p. 62) — see e.g. Merchant (1980, pp. 169, 170), Jordanova (1980, p. 46), Easlea (1981, p. 84), Keller (1985, pp. 36, 39, 48), Midgley (1992, p. 77), Lloyd (1993, p. 12) and Spanier (1995, p. 17), among many others — is in fact a *mis*translation from Bacon's Latin original, "Ego ... revera naturam cum fetibus suis tibi addicturus et mancipaturus", and that a more accurate translation would be: "In fact, I am about to assign and transfer to you nature with her offspring", without any reference to slavery or servitude. Indeed, the published French translation reads simply "c'est véritablement la nature et ses œuvres que je vais t'adjuger et te donner en toute propriété" (Bacon 1987, p. 53). The published Italian translation, by the renowned Bacon scholar Paolo Rossi, is even more austere, stressing knowledge rather than control: "ti mostrerò e ti farò quasi toccare con mano la natura e le sue opere" (Bacon 1954, p. 56).

Waterhouse comments (p. 771) that

> Having done some translation myself, I shall not criticize Farrington [the translator]. Texts in different languages can never be identical in the impression they make, and all translators focus on getting certain things right while necessarily neglecting others. The main point is that scholars interested in particular metaphors or turns of phrase must consult original texts, as their special concerns may not have been in the minds of the translators.

[38] Keller (1985, p. 64).

Firstly, Keller's repeated references to "values" are misleading: she implies that the issue is one of ethics, rather than of epistemology. Early modern scientists articulated the *methods* that have proven to be effective in obtaining reliable knowledge of nature. *Why* it is considered *good* to obtain such knowledge; what this knowledge is to be used *for* — these are questions of ethics. But the effectiveness of the methods themselves is a question purely of epistemology. To give a brutal example: modern nuclear physics has been employed for numerous immoral ends (as judged by my own ethics, at least); but the very fact that these immoral applications were successful (e.g. the bombs at Hiroshima and Nagasaki did explode) is good evidence that the theories of nuclear physics on which the applications were based are, at least to a reasonable degree of approximation, *true*.[39]

Secondly, Keller's identification of science with "the mastery, control, and domination of nature" is a gross exaggeration. The earliest and most spectacular successes of Newtonian mechanics were in astronomy, a field concerned with the observation and description of phenomena over which we have *no control whatsoever*. (It is true that *prediction* plays a key role in astronomy, as a test of the correctness of theories; but successful prediction involves "mastery" over nature only in the ironic sense that the king in *Le Petit Prince* was able to "order" a sunset.) Obviously, modern science and modern technology were developed simultaneously and often by the same people; the dialectic between the twin goals of knowledge and control is a subtle one, which has for years engaged the attention of historians and philosophers of science. But Keller, like Merchant, simply vulgarizes the situation.[40]

Finally, in this passage, Keller (like Harding) raises the image of a "different" (e.g. feminist) science. The natural question would then be: what would (might) such a science consist of, and how would (might) it be different in methods or content from science as we now know it? But rather than

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[39] This point was also made by Levin (1988, p. 104).

[40] This particular vulgarization is exceedingly common among social-constructivist critics of science in general, not only feminists. For instance, Stanley Aronowitz (1997, p. 109) claims that "the ideal of domination [of what or whom?] informs all scientific inquiry". Oh, really? Superstring theory and Cambrian paleontology? Quantum chemistry and lepidopterology? Even in areas of science more closely linked to technological applications — say, solid-state physics — to collapse all of science's social effects into the single category of "domination" is simplistic, to say the least.

answering this question — even with vague speculations — Keller proceeds to evade it:

> Although it may be idle to ask what science would have looked like had it developed in conjunction with a different gender ideology or, even better, independent of any gender ideology, we *can* begin to examine the ways in which a commitment to a particular ideology has influenced the course of scientific development.[41]

Quite the contrary: the claim that "a particular ideology has influenced the course of scientific development" has no *meaning* except insofar as one can imagine that a different ideology might have led (in an imaginary counterfactual world) to a different course of scientific development.

Keller's next three chapters employ the branch of psychoanalytic theory known as "object relations theory", as reworked by Nancy Chodorow and other feminist theorists, to show how the methodology of science, which stresses detachment and objectivity, allegedly privileges "masculine" over "feminine" values. As feminist and epistemologist (but *not* feminist epistemologist!) Susan Haack comments:

> My perhaps uncharitable response would be, first, that it seems more than a little naive to take the truth ('truth'?) of this vague and speculative bit of psychoanalytic theory uncritically for granted; second, that if it is any sense true that women tend to be less detached and objective than men, it is in a sense of 'detached' and 'objective' in which it is false that science requires detachment and objectivity; third, that if it *were* true that girls are brought up in such a way that women are deficient in objectivity in the sense in which objectivity is required by science, the proper moral would be, not that science should be changed, but that girls should be brought up differently; for, fourth, the goal of science is to discover truths about the world, and the normative conception of scientific method as requiring sensitivity to the evidence, as repudiating intellectual laziness and wishful thinking (objectivity in the sense explained [earlier in Haack's essay]) is justified by its aptness to that goal.[42]

After all this speculation, one might want to see some concrete examples of gender metaphors biasing science (in areas outside the obvious ones of psychology, human biology, and so forth). Keller's last three chapters give us the meat, but it is exceedingly meager.

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[41] Keller (1985, p. 65), italics in the original.

[42] Haack (1992, p. 17), italics in the original. See also Soble (2003a) for a sensitive and detailed critique of Keller's line of argument.

For example, one chapter addresses the conceptual foundations of quantum mechanics. Here is a fundamental pillar of modern physics, now 80 years old and abundantly confirmed by experiment; and yet, any physicist who claims to really *understand* quantum mechanics is, I think, either a fool or a liar. Keller is neither, and she rightly criticizes the evasion of key interpretive questions by all but "a small group of philosophically inclined physicists".[43] Unfortunately, her survey of the various proposed interpretations of quantum mechanics is brief and superficial. Some of her comments are (in my opinion) well-taken, some are (in my opinion) mistaken; but none are crazy, none are new, and none are particularly insightful. Keller concludes with some psychoanalytic speculations about the "emotional functions" served by the "continuing adherence to the belief in the objectifiability [and knowability] of nature"; she argues for a "more realistic, more mature, and more humble relation to the world in which the boundaries between subject and object are acknowledged to be never quite rigid and in which knowledge of any sort is never quite total. In such a frame," she suggests, "the antinomies of quantum mechanics would no longer be so problematic."[44] Alas, what we have here is not a theory, not even the vaguest sketch of a theory, but merely a promissory note (unbacked by any assets). If feminist (or psychoanalytic) thought has anything to contribute to the interpretation of quantum mechanics — or for that matter to *any* branch of the philosophy of physics — we're still waiting.

I apologize for this swift and selective refutation, in the space of a few pages, of several entire books. (For example, Haraway could justifiably reply: "But not *all* of my work is as meaningless as the paragraph you quoted!") I therefore urge the reader to consult the original works and judge for herself their philosophical value. But don't expect too much.[45]

"Feminist science studies" in its epistemologically radical form[46] could perhaps be chalked up as a quaint but ultimately innocuous academic fad,

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[43] Keller (1985, p. 140).

[44] Keller (1985, pp. 148–149).

[45] Let me stress that the work of Merchant and Keller may well have value — possibly even great value — as a contribution to the history of science and, more generally, to the history of ideas (I do not feel competent to venture an opinion on this question). But their discussion of the *philosophical* implications of these historical analyses is, in my opinion, sloppy and superficial. See also Soble (2003a, pp. 81–88) for a critique of Keller's "vulgar antirealism".

[46] Let me emphasize once again that I am *not* discussing here the more traditional feminist critiques of psychology, biology, medicine, etc., which accept standard scientific epistemology and attempt to show how sexist presuppositions (often unconscious ones) have led researchers to violate the ordinary canons of good science. Each such critique must of course be judged on its own merits, but the general idea is both intellectually and politically sound.

were it not for the fact that this work has political consequences — and these are harmful to the cause of women. In my *Social Text* article, I quoted — as a joke — a passage from Luce Irigaray: "The mathematical sciences, in the theory of wholes, concern themselves with closed and open spaces ... They concern themselves very little with the question of the partially open, with wholes that are not clearly delineated, with any analysis of the problem of borders".[47] So, imagine my surprise when I saw this same passage quoted — approvingly! — by a prominent American feminist pedagogue of mathematics who goes on to say: "In the context provided by Irigaray we can see an opposition between the linear time of mathematics problems of related rates, distance formulas, and linear acceleration versus the dominant experiential cyclical time of the menstrual body. Is it obvious to the female mind-body that intervals have endpoints, that parabolas neatly divide the plane, and, indeed, that the linear mathematics of schooling describes the world of experience in intuitively obvious ways?"[48]

This theory is startling, to say the least: Does the author really believe that menstruation makes it more difficult for young women to understand elementary notions of geometry? Evidently we are not far from the Victorian gentlemen who held that women, with their delicate reproductive organs, are unsuited to rational thought and to science. With friends like this, the feminist cause has no need of enemies.

Nor is this an isolated case. Hayles concludes her article on fluid mechanics by saying that "the experiences articulated in this essay are shaped by the struggle to remain within the bounds of rational discourse while still questioning some of its major premises. Whereas the flow of the argument has been female and feminist, the channel into which it has been directed is male and masculinist."[49] Hayles thus accepts, without the slightest hint of self-consciousness, the identification of "rational discourse" with

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[47] Irigaray (1987, pp. 76–77).

[48] Damarin (1995, p. 252). Let me note in passing that of the three uses of "linear" in this pair of sentences, two of them ("linear acceleration" and "linear mathematics") are meaningless. For postmodern literary critics this is perhaps par for the course: the pejorative emotional connotations of "linearity" suffice, and any precise meaning (or the lack thereof) is irrelevant. However, for the author of a high-school-level algebra textbook (Damarin and Leitzel 1984), this mathematical ignorance is a bit shocking. See annotation #54 in Chapter 1 above.

[49] Hayles (1992, p. 40).

"male and masculinist". Simone de Beauvoir must be turning over in her grave.

Gross and Levitt were the first to draw attention, in a systematic way, to the excesses of social-constructivist and feminist[50] science-criticism, and my analysis has drawn heavily on their research. But I differ with them on several points.

First of all, it seems to me that Gross and Levitt's picture of the "academic left" is overdrawn. Some of the trendy theoretical gadgets of the (post)modern academic humanities do in fact derive from leftist or feminist politics, but many others evolved as weapons for use in old-fashioned academic turf battles. Much of present-day scholarship marks, in my estimation, not the triumph of politics over intellectual inquiry but rather a retreat from real politics into careerism disguised as progressive politics.[51] Indeed, many of those criticized by Gross and Levitt are only marginally "leftist" in the usual political sense, even if by "politics" we mean simply political rhetoric. What Gross and Levitt represent as a *political* conflict may be more adequately conceptualized as a new phase in the *disciplinary* conflict

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[50] Or rather, for the reasons I have just explained, "feminist".

[51] This observation is by no means new: it has been made by Harold Fromm (1991), Russell Jacoby (1994), Todd Gitlin (1995) and Barbara Epstein (2001), among numerous others — not to mention by David Lodge in his inimitable satires of academic life (1975, 1984, 1988). In a memorable phrase, Gitlin laments the academic left's "marching on the English Department while the Right took the White House" (the title of his chapter 5). Jacoby, after quoting several nauseating examples of postmodernist academics' boosterism and self-promotion, comments that

> The lingo of theoretical breakthroughs and explosions partakes of the language of the market because it is a market. Talk of new paradigms slips into the idiom of new items and new marketing strategies. Advanced theory sounds very much like advanced capitalism. (p. 181)

Epstein concurs, and points out the embarrassing congruence between the "star system" in the academic humanities and the market forces leading to increasing inequality in all areas of the economy, not excluding the universities:

> In an increasingly competitive academic environment in which pressures to succeed have been vastly amplified, political postures have become utterly intertwined with the strategies of individuals and groups to rise within the hierarchy. (p. 192)

Fromm is perhaps the most trenchant of all:

> In what is now a rapid turnover of marketable ideas in the academy, a turnover similar to the one in technology ("You're still using that ancient 4.77 mhz computer?"),

(and economic competition) between the "two cultures" of humanists and scientists.[52,53]

Furthermore, the "postmodern" revolt against science and rationalism is not confined to the political left. Gross and Levitt themselves cite attacks on scientific rationality by right-wing thinkers such as Brian Appleyard and John Lukacs, who accuse science of strangling the human soul, and they note that " 'traditionalist' views like this flourish in the same soil as postmodern or cultural constructivist arguments".[54] The former Czech president Václav Havel has given the same theme a new twist:

> The fall of Communism can be regarded as a sign that modern thought — based on the premise that the world is objectively knowable, and that the knowledge so obtained can be absolutely generalized — has come to a final crisis.[55]

(One wonders why a renowned intellectual such as Havel is incapable of making the elementary distinction between science — especially *natural* science — and the Communist regimes' unjustified *claim* to possess a "scientific" theory of human history.) One can also find conservatives who invoke "chaos theory" as an excuse to avoid confronting serious environmental

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> astonishing one's colleagues has less to do with "truth" than with conspicuous production and consumption, a need to banish last year's models from the showroom floor. (p. 220)

Observing that "the marketplace of ideas, once only a metaphor, has literally become just that, a system of commodities" (p. 251), Fromm comments scathingly that

> The radical academic exhibits the verbal trappings and forms of Marxist renunciation while acting as paradigmatic acquisitive capitalist ... In acting out with such precision the roles assigned to him by capitalist ideology while attacking the false consciousness of everyone else, he is pretty much in the same class as the television evangelist who pretends to be amassing millions for Jesus, even as he lives a life of luxurious debauchery. (p. 252)

This last parallel is certainly an exaggeration, but the point is well taken.

[52] Sandra Harding (1991, p. 5) recognizes this: "The attractions of the postmodernist critique are many, but among them are surely its perceived usefulness as a means to restore status to the humanities, status that has stolen away to science and technology without public discussion of the benefits and losses of such a move."

[53] These points are already made *to some extent* by Gross and Levitt themselves (1994a, pp. 12, 32–41, 74–76, 82–86 and *passim*). Still, it seems to me that they exaggerate the uniformity of their targets' "leftism", even when this term is understood at the purely rhetorical level.

[54] Gross and Levitt (1994a, pp. 259–261), Appleyard (1993), Lukacs (1993).

[55] Havel (1992). For an excellent critique of Havel's confusions, see Kleppner (1993).

issues or as alleged proof that governmental regulation of the economy is always harmful.[56]

Gross and Levitt's extensive research is marred by a few inaccuracies. They mistakenly accuse Jacques Derrida of making "portentous references to mathematical terms such as 'differential topology,' used without definition and without any contextual justification" (p. 79). Unfortunately, the alleged reference turns out to be an artifact of translation: the French original reads "topique différantielle" [*sic*], a Derridean neologism that may or may not have any precise meaning but in any case has nothing to do with mathematical topology.[57]

On the other hand, Gross and Levitt erroneously conclude that psychoanalyst Jacques Lacan and his literary-critic acolytes "ha[ve] been getting literary *topoi* mixed up with the subject matter of mathematical topology" (p. 266). The truth is much worse: Lacan, especially in the last two decades of his life, was indeed obsessed with mathematical topology and saw in it a key to understanding the human psyche. Here, for instance, is an excerpt from Lacan's 1966 lecture, "Of Structure as an Inmixing of an Otherness Prerequisite to any Subject Whatever" (!):

> This diagram [the Möbius strip] can be considered the basis of a sort of essential inscription at the origin, in the knot which constitutes the subject. This goes much further than you may think at first, because you can search for the sort of surface able to receive such inscriptions. You can perhaps see that the sphere, that old symbol for totality, is unsuitable. A torus, a Klein bottle, a cross-cut surface, are able to receive such a cut. And this diversity is very important as it explains many things about the structure of mental disease. If one can symbolize the subject by this fundamental cut, in the same way one can show that a cut on a torus corresponds to the neurotic subject, and on a cross-cut surface to another sort of mental disease.[58]

Mathematicians and physicists are used to receiving this sort of stuff in typewritten envelopes from unknown correspondents. Lacan's grammar and spelling are better than in most of these treatises, but his logic isn't. To put it

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[56] Farney (1994), Lavoie (1989). For a lucid critique of Lavoie's misuses of chaos theory, see Kellert (1995, pp. 42–44).

[57] Derrida (1992, p. 208). The French mathematical term is "topologie différentielle". Gross and Levitt's error was independently noted by Hart (1996, pp. 277–278).

[58] Lacan (1970, pp. 192–193).

bluntly, Lacan is a crank — an unusually erudite one, to be sure, but a crank nonetheless.[59]

Gross and Levitt's assessments are sometimes unfairly harsh. For example, N. Katherine Hayles' philosophico-literary reflections on physics and mathematics are basically silly, but they are not quite as silly as Gross and Levitt make them out to be. To make matters worse, Gross and Levitt conscript literary theorist Alexander Argyros as a critic of Hayles, when in the cited passage Argyros is actually *endorsing* Hayles' warnings *against* pushing too far the analogy between deconstructive literary theory and the mathematical theory of chaos.[60] Furthermore, it is very unwise to drag in Argyros as an ally here, since his own knowledge of mathematics and physics is exceedingly hazy, probably hazier than Hayles'.[61]

Sometimes Gross and Levitt's choice of texts to criticize is bizarre and unfair. They ridicule Donna Haraway on the basis of an interview in *Socialist Review* (in which her epistemological position is incoherent) and overlook her published works (in which her epistemological position is equally incoherent).

Since some of the radical social constructivists' most egregious *non sequiturs* are, at bottom, philosophical in nature, any serious critique of

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[59] For further evidence of Lacan's gross misuses of mathematical concepts, see Sokal and Bricmont (1998, chapter 2).

[60] Gross and Levitt (1994a, pp. 99 and 270n52), Argyros (1991, pp. 238–239). In this passage, Argyros is endorsing Hayles' warnings *and* gently chiding her for sometimes failing to heed her own warnings.

[61] Argyros (1991, p. 234) conflates "linear function" with "continuously differentiable function" — a howler that would merit an F in freshman calculus (mentioned also by Gross and Levitt in an endnote, p. 267n15). After correctly defining "linear system", Argyros goes on to say (p. 237):

> Linearity tends to be deterministic in a Laplacian way. Even if a linear system evolves, its evolution is discrete and sequential. Therefore, the time of linear systems is eotemporal, succession without a preferred direction.

Every one of these statements is wrong. The dichotomies linear/nonlinear, deterministic/stochastic, discrete-time/continuous-time and time-reversal-invariant/time-reversal-noninvariant are *completely unrelated*; all 16 possible combinations are possible.

In view of these egregious errors — and many others that would be tedious to cite here — it is hard to see how Gross and Levitt could have concluded (p. 270n52) that "his [Argyros'] mathematical exposition is ... far more systematic and coherent" than Hayles'. They do concede that Argyros' mathematics is "far from flawless" (p. 270n52) and that he is "slightly guilty of bluffing his way through mathematical points" (p. 266n15), but these are massive understatements. Were Gross and Levitt perhaps influenced — even unconsciously — by sympathy with Argyros' anti-postmodernism? Kellert (1996) has a sober and enlightening discussion of these issues, though I disagree with some of his more general conclusions about the cultural meanings of science.

constructivist theorizing must engage — at least to the limited extent needed to unravel these errors — with questions in the philosophy of science.[62] Unfortunately, Gross and Levitt's treatment of these matters is rather too cavalier. Indeed, they disclaim any need to analyze such issues at all with the breezy observation that "serious philosophers of science have been at it for decades" (p. 48).[63] They rightly decry a sloppy piece of philosophizing from Andrew Ross, but their own critique of Ross' errors is hardly more substantial (pp. 89–90). Gross and Levitt state — correctly in my view — that

> When it comes to the core of scientific substance ... and the deep methodological and epistemological questions — above all, the incredibly difficult *ontological* questions — that arise in scientific contexts, perspectivism can make at best a trivial contribution. The attempts to read scientific knowledge as the mere transcription of Western male capitalist social perspectives, or as the deformed handicraft of the prisonhouse of language, are hopelessly naive and reductionistic. (p. 40)

The trouble, however, is that they provide little or no *argument* in support of this assertion.[64]

Gross and Levitt's zeal for flaunting their political incorrectness sometimes leads them to undermine their own credibility. In discussing discrimination against women scientists, they say that "sexist discrimination, while certainly not vanished into history, is largely vestigial in the universities; the only widespread, *obvious* discrimination today is against white males"

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[62] I stress that it is *not* necessary to put forth a fully worked-out philosophy of science in order to refute the postmodernists and radical social constructivists; in particular, it is not necessary to resolve the debate between moderate forms of realism and instrumentalism (see Chapter 7 below for an opinionated introduction to this debate). As Brown (2001, p. 101) observes:

> A successful defense of realism would, of course, be a successful attack on social constructivism. Yet ... there are several forms of anti-realism that are equally opposed to constructivism. Realism isn't the proper notion to defend here. Instead it is *objectivity*.

See also the beginning of Chapter 7 below for further discussion of this point.

[63] In a footnote attached to the following page, Gross and Levitt cite *one* such work: Alan Chalmers' *Science and Its Fabrication* (1990), which they describe (accurately in my view) as "an extensive rejoinder to the constructivist viewpoint, temperate in tone and sympathetic to the political motives of constructivist theorists but adamant in insisting on the shallow and unconvincing nature of cultural constructivism in general and in its most vaunted examples" (p. 261n5).

[64] Zammito (2004, pp. 255–256) makes the same criticism. Arguments of the required type can be found in Chalmers (1990) and Brown (2001), as well as in Chapters 6 and 7 below.

(p. 110). The first half of this assertion may well be true (though they provide no evidence for it); the second half is simply silly. But more importantly, this issue is completely irrelevant to Gross and Levitt's main concern, which is the fate of ideas, not of individuals. There is no inconsistency in holding that science produces reliable and objective knowledge about nature *and* in admitting that the scientific community (like many other communities in our society) has been guilty of grievous discrimination against women and racial minorities.

Gross and Levitt's diatribe against animal-rights activists is similarly problematic, as it involves issues of ethics as well as epistemology. No one has a right to misrepresent the scientific facts in order to advance his or her position on animal research (or stem-cell research, etc.); but reasonable people, even when they agree on the scientific facts, may well come to different moral judgments. This section distracts attention from Gross and Levitt's main argument, and should simply have been omitted.

Gross and Levitt's reasoning is sometimes infected by an unjustified condescension towards humanists and social scientists. For example, they rightly point out that

> A serious investigation of the interplay of cultural and social factors with the workings of scientific research ... requires an intimate appreciation of the science in question, of its inner logic and of the store of data on which it relies, of its intellectual and experimental tools.... [A] scholar devoted to a project of this kind must be, *inter alia*, a scientist of professional competence, or nearly so. (p. 235)

But they underestimate the need for equal rigor in the handling of historical evidence. Amateur history of science, as produced by scientists, has too often tended toward Whiggish history. Such accounts have perhaps some pedagogical value as "rational reconstructions" of the inner logic of the final scientific product; but as history they are false and misleading. A scholar devoted to producing serious history of science must *also* be a historian of professional competence, or nearly so.[65]

Throughout the book, Gross and Levitt resort heavily to sarcasm and ridicule; but, with few exceptions, they do so not as a substitute for rational argument but rather as a (usually justifiable) complement to it.[66] Indeed, some of the writings they examine are so silly that they almost demand

[65] Indeed, historian John Zammito (2004, pp. 170–171, 256) criticizes, with some justice, Gross and Levitt's own cursory approach to historical evidence in their discussion of the Hobbes–Boyle dispute (pp. 63–69).

[66] One egregious exception is their assertion that Katherine Hayles "is one of those who are eager to tell you, earnestly and at length, precisely why a raven *is* like a writing

ridicule along with refutation. Here, for example, is Jean Baudrillard holding forth on topology:

> There is no topology more beautiful than Moebius' to designate the contiguity of the close and the distant, of interior and exterior, of object and subject in the same spiral where the screen of our computers and the mental screen of our own brain become intertwined with each other as well.[67]

As Gross and Levitt correctly observe, "this is as pompous as it is meaningless" (p. 80).

Finally, many readers will be irritated by the *tone* of Gross and Levitt's book, which is frequently self-satisfied and arrogant. (This is a common occupational disease among scientists: we possess an incredibly powerful method for obtaining reliable knowledge about the universe, and we know it.) The book could benefit, as one wag put it, from "a bit less grossness and a bit more levity". But this is a stylistic criticism, not a substantive one. If Gross and Levitt's contentions are wrong, then let it be said that the authors are mistaken and, to boot, unsufferably arrogant. But if, on the other hand, their contentions are right, then discussion of their personal qualities is merely a distraction from the serious intellectual matters at hand.[68]

Some commentators on Gross and Levitt's work seem, indeed, to have been so offended by the tone of the book that they have been unable to read its actual words (or else have for polemical reasons willfully distorted them).

The late Dorothy Nelkin, a distinguished sociologist of science *not* aligned with the social constructivists, describes Gross and Levitt's attitude as follows:

> Concerned about declining public support for science, some scientists are alarmed by efforts to demythologize their work. They have attacked science studies scholars as science bashers, alarmists, ideologues, or at

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desk — especially if a publication can be got out of it" (p. 99). This claim may possibly be true, but they give no evidence to back it up.

[67] Baudrillard (1990, pp. 62–63).

[68] Among the negative commentary on Gross and Levitt's book, the most intellectually serious is Hart (1996), who subjects a selection of Gross and Levitt's claims to close scrutiny and uncovers several examples of sloppy scholarship. My own view is that in many cases Gross and Levitt's *conclusions* are correct but that their *arguments* for those conclusions are insufficient.

> best foolish, faddish, muddled or left wing. The only reason to study science, they believe, is to explain or promote it to a wary public.[69]

Here is what Gross and Levitt actually say:

> Natural scientists ... do not feel that their particular expertise in some area of science automatically endows them with insight into the human phenomenology of scientific practice, or that familiarity with the recent results and the liveliest questions of their specialty qualifies them to pronounce on its evolution as that relates to the course of human development. Apart from the most arrogant, they concede that the psychological quirks and modes of personal interaction characteristic of working scientists are not entitled to special immunity from the scrutiny of social science. If bricklayers or insurance salesmen are to be the objects of vocational studies by academics, there is no reason why mathematicians or molecular biologists shouldn't sit still for the same treatment. (p. 42)

In a lecture at the University of London, Andrew Ross criticized Gross and Levitt as follows:

> let me draw attention briefly to one of the weapons deployed in the Science Wars, which is the charge of technical ignorance ... In other words, if you have not solved a first order linear differential equation, then you have no business recording your opinion on any of the pressing business that science does in society.[70]

Here is what Gross and Levitt actually say:

> Thus we encounter books that pontificate about the intellectual crisis of contemporary physics, whose authors have never troubled themselves with a simple problem in statics; essays that make knowing reference to chaos theory, from writers who could not recognize, much less solve, a first-order linear differential equation ...[71] (p. 6)

Ross is thus attacking a straw man; no one, to my knowledge, has ever claimed that the study of differential equations is a prerequisite for informed

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[69] Nelkin (1996, p. 31). Nelkin's footnote 2, attached to this passage, explicitly cites Gross and Levitt.

[70] Ross (1995a).

[71] For nonscientists (including Andrew Ross) a clarification is perhaps in order: A first-order linear differential equation is the *very simplest* type of differential equation; it is typically studied in the second semester of an introductory calculus course.

discussion of the impact of science on society. Rather, Gross and Levitt are making a much narrower point: that authors who purport to analyze the philosophical implications of recent developments in mathematics or physics ought to have at least an elementary understanding of the mathematics or physics in question (and *not* merely at the level of journalistic paraphrases).[72] In particular, chaos theory deals with the "sensitive dependence on initial conditions" that is observed in some nonlinear differential equations; it would thus behoove commentators on chaos theory to know at least a little bit about differential equations.

One reviewer refers to "their [Gross and Levitt's] proposal that all hiring in the humanities be left to scientists".[73] Another reviewer, a prominent sociologist of science, is more modest: he claims only that Gross and Levitt "propose to grant to natural scientists veto power over the hiring, teaching and research of any colleagues in the humanities and social sciences who dare say anything about the inner workings or deeper motives of science".[74] Here, in fact, is what Gross and Levitt say on the matter:

> If an aspiring scholar is to be judged on work affecting to make deep pronouncements on questions of science, scientific methodology, history of science, or the very legitimacy of science, it strikes us that scientists should have some say in evaluating it. This holds even if the candidate resides academically in the English department or the art department or the sociology department. It will be objected that scientists, as a hermetic, self-protective guild, ought not to sit in judgment of those who are studying *them*. But academic leftists, postmodernists, deconstructionists, and the like have their *own* self-protective guilds, and experience shows they are not at all reluctant to rally round their own. Elementary fairness requires that a broader spectrum of opinion should be brought into the process. If an assistant professor of English is to stake his bid for tenure on work that, for example, purports to analyze quantum mechanics as an ideological construct, then he has no right to complain

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[72] In truth, this requirement is much too modest. Even professional mathematicians and physicists can easily make fools of themselves when they attempt to address the philosophical implications of subfields of mathematics or physics in which they are not specialists.

[73] Ruse (1994, p. 44). Even when a letter-writer corrected this gross distortion, Ruse refused to back down, saying that "I am not impressed whether Gross and Levitt want one, many, or all hiring committees to have scientists" (Ruse 1995, p. 9).

[74] Winner (1995).

> if a professor of physics is brought into the evaluation to say whether he evidences any real understanding of quantum mechanics. . . .
>
> It will be argued immediately that this is an asymmetric, and therefore inequitable, proposition. If physicists are to judge scholars of English, why shouldn't English professors judge physicists? The fallacy here is that the asymmetry originates from the pretensions, legitimate or otherwise, of members of the English (or sociology or cultural studies or women's studies or African-American studies) department to qualification on scientific questions. If, say, a member of the mathematics department were to engage in the (most unlikely) scholarly project of analyzing the rhetorical and stylistic elements of certain mathematics papers, it would be entirely legitimate for literary scholars to pronounce judgment on the work, and for the promotion process to take that judgment fully into account. (pp. 255–256)

Now, one may well disagree with even this modest proposal — I, for one, am worried that weakening departmental autonomy might open the doors to abusive manipulation by unscrupulous or politically-motivated administrators — but it is undignified and unethical to misrepresent its contents.

> What a man [*sic*] had rather were true he more readily believes. Therefore he rejects difficult things from impatience of research.
>
> — *Francis Bacon, Novum Organum (Book I, aphorism 49)*

It is unfair to inquire into an adversary's motives before addressing the content of his or her argument. But *after* analyzing an argument and finding it grossly wanting, it is legitimate to ask how an intelligent person could have advanced such an argument in the first place. Moreover, what is mere curiosity as regards an individual becomes intellectual history and sociology when it concerns a school of thought: one wants to understand why certain manifestly inadequate ideas could nevertheless have enjoyed wide popularity (at least in certain restricted circles).

I would argue that perspectivism and radical social constructivism are an exceedingly natural philosophy for people who are politically committed but intellectually lazy.[75] Let's take an example: Suppose someone argues that sex differences in mathematical ability "have been definitely verified by the Benbow–Stanley study at Johns Hopkins of tens of thousands of mathematically precocious junior-high-school-age boys and girls. Girls in the

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[75] The cultural anthropologist Robin Fox (1992, pp. 51 ff.) has made a similar observation.

very top of their age group in mathematical ability, as determined by age-appropriate tests, are vastly outperformed by precocious boys of the same age on tests of mathematical ability meant for high school seniors."[76] How should a feminist react to this?

One possible (though uncommon) attitude is to accept this assertion with equanimity. "All I want is for individual girls and women to be treated fairly, based on their talents and not on the statistics for their sex. If, in a fair world, only 40% of mathematicians turn out to be women, so what?" (Or it could be 30% of topologists and 60% of algebraists: different mathematical subfields require different talents.)[77]

Another sensible approach, pursued by many feminists, is to find the flaws in the study and to design better studies. By junior-high-school age, boys and girls have had vastly different upbringings; so let's retry the study with much younger children, let's make cross-cultural comparisons, and so forth. Is the result an artifact of the test instrument used? — let's vary the test instrument and see. Were the data analyzed correctly?[78]

But this kind of critique is hard work: one has to acquire a rather deep knowledge of statistics and experimental design, something that American nonscientists of either sex are unfortunately ill-prepared for. How much easier it is to dismiss the results as biased by the researchers' prejudices. (Which might well be true; but in that case the critics should be able to *identify* the flaw in the study through which those prejudices corrupted the result.) How much easier to dismiss statistics as merely "the master's tools", with which one can never dismantle the master's house (in Audre Lorde's famous phrase[79]). How much easier, in fact, to dismiss the value of mathematics altogether.

The great advantage of radical-social-constructivist philosophizing is that it is an all-purpose tool with which to discredit any empirical study whose conclusions one dislikes, *without* the need to enter into (or even to understand) the grubby details of the data and their interpretation. But radical

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[76] Levin (1988, p. 101).

[77] Furthermore, genetic differences, when they exist, can often be mitigated by compensatory strategies. For instance, there are clearly genetic differences in eyesight (my own is particularly poor), but their practical effects can be reduced drastically (even if not totally eliminated) by eyeglasses. I thank Helena Cronin for discussions on this point.

[78] For superb examples of this type of critique, see Ruskai (1991) and Spelke (2005).

[79] Lorde (1983).

constructivism is, if valid, a universal acid[80], which attacks also the claims of those who wield it.[81]

When all is said and done, Gross and Levitt — despite the flaws in their book — have done an immense public service by shining the harsh light of criticism on the social-constructivist and feminist analysts of science, and most importantly by bringing this debate to the attention of outsiders (including scientists themselves). But where does this leave us? Shall we simply dismiss these nosy sociologists and rabble-rousing feminists, and go back to our labs?

That would, in my estimation, be a mistake, for the social constructivists are raising important questions, despite the inadequacies of their own answers. Susan Haack's measured verdict on "feminist science studies" can serve, I think, as a report on Science Studies quite generally:

> Some, no doubt, would regard the whole project of looking at science 'from a feminist perspective' as absurd. I think they would be wrong; for looking at science from this perspective one encounters, from a promisingly unfamiliar angle, a whole host of good, hard questions: about the internal organization of science, about the role of science in society, about the character and status of scientific method, about scientific language, about metaphor, about men's and women's cognitive abilities, about family structures, about the labour market, and so on.

But, Haack continues,

> it would be equally wrong to imagine that a feminist approach is bound to give simple, easy answers to these good, hard questions. They *are* hard, and they will not be answered without hard, self-critical work. In the books I have been discussing, regrettably, the soggy and self-indulgent predominates over the detailed and discriminating, leaving one with the feeling that most of this work remains to be done.[82]

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[80] My apologies to Daniel Dennett for using his term in a different context. See Dennett (1995).

[81] Thus, Evelyn Fox Keller (1992, p. 86) asserts that "Historians of science have *demonstrated* that the very ideal of pure science is itself a historical construction" (emphasis mine), apparently oblivious to the self-undermining nature of her own assertion. For a more detailed discussion of this issue, see Soble (2003a, pp. 81–88; 2003b, pp. 239–248).

[82] Haack (1992, p. 18), italics in the original.

I am grateful to Evelyn Fox Keller and Norman Levitt for critical comments on an earlier draft of this essay. It goes without saying that both of these people disagree with significant (but different!) parts of what I have written. I also wish to thank Carolyn Merchant for drawing my attention to her 2006 article; Bruce Venarde for consultations on Bacon's Latin (footnote 37); Beth Ruskai for information concerning gender and mathematics; Diana Judd for helpful comments; and Sergio Caracciolo for supplying me with a copy of Bacon (1954).

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5

What the *Social Text* affair does and does not prove*

> I did not write this work merely with the aim of setting the exegetical record straight. My larger target is those contemporaries who — in repeated acts of wish-fulfillment — have appropriated conclusions from the philosophy of science and put them to work in aid of a variety of social cum political causes for which those conclusions are ill adapted. Feminists, religious apologists (including "creation scientists"), counterculturalists, neoconservatives, and a host of other curious fellow-travelers have claimed to find crucial grist for their mills in, for instance, the avowed incommensurability and underdetermination of scientific theories. The displacement of the idea that facts and evidence matter by the idea that everything boils down to subjective interests and perspectives is — second only to American political campaigns — the most prominent and pernicious manifestation of anti-intellectualism in our time.
>
> — *Larry Laudan, Science and Relativism (1990, p. x)*

I confess to some embarrassment at being asked to contribute an introductory essay to this collection of critical studies in the history, sociology and philosophy of science. After all, I'm neither a historian nor a sociologist nor a philosopher; I'm merely a theoretical physicist with an amateur interest in the philosophy of science and perhaps some modest skill at thinking clearly. *Social Text* co-founder Stanley Aronowitz was, alas, absolutely right when he called me "ill-read and half-educated".[1]

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* Slightly condensed version of an essay published in *A House Built on Sand: Exposing Postmodernist Myths about Science*, edited by Noretta Koertge (Oxford University Press, New York–Oxford, 1998), pp. 9–22.

[1] Quoted in Scott (1996). But Franco Moretti's retort is delicious: "How does it feel being duped by the half-educated?" (Robbins, Ross *et al.* 1996, p. 60)

My own contribution to this field began, as the reader undoubtedly knows, with an unorthodox (and admittedly uncontrolled) experiment. I wrote a parody of postmodern science criticism, entitled "Transgressing the Boundaries: Towards a Transformative Hermeneutics of Quantum Gravity", and submitted it to the cultural-studies journal *Social Text* (of course without telling the editors that it was a parody). They published it as a serious scholarly article in their Spring 1996 special issue devoted to what they call the "Science Wars".[2] Three weeks later I revealed the hoax in an article in *Lingua Franca*[3], and all hell broke loose.[4]

In this essay I'd like to discuss briefly what I think the "*Social Text* affair" does and does not prove. But first, to fend off the accusation that I'm an arrogant physicist who rejects all sociological intrusion on our "turf", I'd like to lay out some positive things that I think social studies of science can accomplish. The following propositions are, I hope, noncontroversial:

1) Science is a human endeavor, and like any other human endeavor it merits being subjected to rigorous social analysis. Which research problems count as important; how research funds are distributed; who gets prestige and power; what role scientific expertise plays in public-policy debates; in what form scientific knowledge becomes embodied in technology, and for whose benefit — all these issues are strongly affected by political, economic and to some extent ideological considerations, as well as by the internal logic of scientific inquiry. They are thus fruitful subjects for empirical study by historians, sociologists, political scientists and economists.

2) At a more subtle level, even the content of scientific debate — what types of theories can be conceived and entertained, what criteria are to be used for deciding between competing theories — is constrained in part by the prevailing attitudes of mind, which in turn arise in part from deep-seated historical factors. It is the task of historians and sociologists of science to sort out, in each specific instance, the roles played by "external" and "internal" factors in determining the course of scientific development. Not surprisingly, scientists tend to stress the "internal" factors while sociologists tend to stress the "external", if only because each group tends to have a poor grasp

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[2] Sokal (1996a), reproduced here with annotations as Chapter 1.

[3] Sokal (1996b).

[4] The "official" reply from the editors of *Social Text* appears in Robbins, Ross *et al.* (1996) along with a brief rejoinder from myself and letters from readers. For a more detailed explanation of my motivations in undertaking the parody, see Sokal (1996c, 1997), reprinted here as Chapters 2 and 3, respectively. For further commentary, see e.g. Frank (1996), Pollitt (1996), Weinberg (1996) and Boghossian (1996).

on the other group's concepts. But these problems are perfectly amenable to rational debate.

3) There is nothing wrong with research informed by a political commitment, as long as that commitment does not blind the researcher to inconvenient facts. Thus, there is a long and honorable tradition of socio-political critique of science[5], including antiracist critiques of anthropological pseudoscience and eugenics[6] and feminist critiques of psychology and parts of medicine and biology.[7] These critiques typically follow a standard pattern: First one shows, using conventional scientific arguments, why the research in question is flawed *according to the ordinary canons of good science*; then, *and only then*, one attempts to explain how the researchers' social prejudices (which may well have been unconscious) led them to violate these canons. Of course, each such critique has to stand or fall on its own merits; having good political intentions doesn't guarantee that one's analysis will constitute good science, good sociology or good history. But this general two-step approach is, I think, sound; and empirical studies of this kind, if conducted with due intellectual rigor, could shed useful light on the social conditions under which good science (defined normatively as the search for truths or at least approximate truths about the world) is fostered or hindered.[8]

Now, I don't want to claim that these three points *exhaust* the field of fruitful inquiry for historians and sociologists of science, but they certainly do lay out a big and important area. And yet, some sociologists and literary intellectuals over the past three decades have gotten greedier: roughly speaking, they want to attack the normative conception of scientific inquiry as a search for truths or approximate truths about the world; they want to see science as just another social practice, which produces "narrations" and "myths" that are no more valid than those produced by other social practices; and some of them want to argue further that these social practices encode a bourgeois and/or Eurocentric and/or masculinist worldview. Of course, like

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[5] I limit myself here to critiques challenging the substantive content of scientific theories or methodology. Other important types of critiques challenge the uses to which scientific knowledge is put (e.g. in technology) or the social structure of the scientific community.

[6] See, for example, Gould (1996).

[7] See, for example, Fausto-Sterling (1992) and Tavris (1992).

[8] Of course, I don't mean to imply that the *only* (or even the principal) purpose of the history of science is to help working scientists. History of science obviously has intrinsic value as a contribution to the history of human society and human thought. But it seems to me that history of science, when done well, can *also* help working scientists and scientific policymakers.

all brief summaries this one is an oversimplification; and in any case there is no canonical doctrine in the "new" sociology of science, just a bewildering variety of individuals and schools. More importantly, the task of summarization is here made more difficult by the fact that this literature is often *ambiguous* in crucial ways about its most fundamental claims (as I'll illustrate later using the cases of Latour and Barnes–Bloor). Still, I think most scientists and philosophers of science would be astonished to learn that "the natural world has a small or non-existent role in the construction of scientific knowledge", as prominent sociologist of science Harry Collins claims[9]; or that "reality is the consequence rather than the cause" of the so-called "social construction of facts", as Bruno Latour and Steve Woolgar assert.[10]

With this preamble out of the way, I'd now like to consider what (if anything) the "*Social Text* affair" proves — and also what it does *not* prove, because some of my over-enthusiastic supporters have claimed too much. In this analysis, it's crucial to distinguish between what can be deduced from the *fact of publication* and what can be deduced from the *content of the article.*

From the mere fact of publication of my parody I think that not much can be deduced. It doesn't prove that the whole field of cultural studies, or cultural studies of science — much less sociology of science — is nonsense. Nor does it prove that the intellectual standards in these fields are generally lax. (This might be the case, but it would have to be established on other grounds.) It proves only that the editors of *one* rather marginal journal were derelict in their intellectual duty, by publishing an article on quantum physics that they admit they could not understand, without bothering to get an opinion from anyone knowledgeable in quantum physics, solely because it came from a "conveniently credentialed ally" (as *Social Text* co-editor

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[9] Collins (1981, p. 3). Two qualifications need to be made: First, this statement is offered as part of Collins' introduction to a set of studies (edited by him) employing the relativist approach, and constitutes his summary of that approach; he does not *explicitly* endorse this view, though an endorsement seems implied by the context. Second, while Collins appears to intend this assertion as an empirical claim about the history of science, it is *possible* that he intends it neither as an empirical claim nor as a normative principle of epistemology, but rather as a *methodological* injunction to sociologists of science: namely, to act *as if* "the natural world ha[d] a small or non-existent role in the construction of scientific knowledge", or in other words to *ignore* ("bracket") whatever role the natural world may in fact play in the construction of scientific knowledge. I shall argue below, in discussing Barnes–Bloor, that this approach is seriously deficient *as methodology* for sociologists of science.

[10] Latour and Woolgar (1979, p. 237).

Bruce Robbins later candidly admitted[11]), flattered the editors' ideological preconceptions, and attacked their "enemies".[12]

To which, one might justifiably respond: So what?[13]

The answer comes from examining the *content* of the parody. In this regard, one important point has gotten lost in much of the discussion of my article: Yes, the article is screamingly funny — I'm not modest, I'm proud of my work — but the most hilarious parts of my article were not written by me. Rather, they are direct quotes from the postmodern Masters, upon whom I lavish feigned adoration. In fact, the article is structured around the silliest quotations I could find about mathematics and physics (and the philosophy of mathematics and physics) from some of the most prominent French and American intellectuals; my only contribution was to invent a nonsensical argument linking these quotations together and praising them. This involved, of course, advocating an incoherent mishmash of trendy ideas — deconstructive literary theory, New Age ecology, so-called "feminist epistemology"[14], extreme social-constructivist philosophy of science, even Lacanian psychoanalysis — but that just made the parody all the more fun. Indeed, in some cases I took the liberty of parodying extreme or ambiguously stated versions of views that I myself hold in a more moderate and precisely stated form.

Now, what precisely do I mean by "silliness"? Here's a very rough categorization: First of all, one has *meaningless or absurd statements*, *name-dropping*, and the display of *false erudition*. Secondly, one has *sloppy thinking* and *poor philosophy*, which come together notably (though not always) in the form of *glib relativism*.

The first of these categories wouldn't be so important, perhaps, if we were dealing with a few assistant professors of literature making fools of themselves while holding forth on quantum mechanics or Gödel's theorem. It becomes more relevant because we're dealing with important intellectuals,

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[11] Robbins (1996, p. 28).

[12] The "Science Wars" special issue of *Social Text* was conceived primarily to attack Paul Gross and Norman Levitt's *Higher Superstition: The Academic Left and its Quarrels with Science* (1994). See Ross (1996); and see also Andrew Ross and Stanley Aronowitz, unpublished letter to the author (and to other contributors to the "Science Wars" issue), March 8, 1995.

[13] Indeed, a mainstream journal in the sociology of science would almost certainly *not* have fallen for my parody. (On the other hand, *Social Studies of Science* published a long article on the theory of relativity which, if it wasn't in fact a parody, might as well have been: see below.) I chose *Social Text* because my primary motivation was *political*: see Chapters 2 and 3 above.

[14] I emphasize that this term is a misnomer, as these ideas are hotly debated among feminists, among whom I include myself. For incisive feminist critiques of "feminist epistemology", see Haack (1992, 1993) and Richards (1996).

at least as measured by shelf space in the cultural-studies section of university bookstores. Here, for instance, are Gilles Deleuze and Félix Guattari pontificating on chaos theory:

> To slow down is to set a limit in chaos to which all speeds are subject, so that they form a variable determined as abscissa, at the same time as the limit forms a universal constant that cannot be gone beyond (for example, a maximum degree of contraction). The first functives are therefore the limit and the variable, and reference is a relationship between values of the variable or, more profoundly, the relationship of the variable, as abscissa of speeds, with the limit.[15]

And there's much more — Jacques Lacan and Luce Irigaray on differential topology, Jean-François Lyotard on cosmology, Michel Serres on nonlinear time — but let me not spoil the fun.[16] (By the way, if you worry that I'm quoting out of context, just follow my footnotes, look up the originals, and decide for yourself. You'll find that these passages are even worse in context than out of context.)

Nor is all the nonsense of French origin. Connoisseurs of fashionable American work in the Cultural Studies of Science will, I think, find ample food for thought.

Fine, the Science Studies contingent might now object: maybe some of our friends in the English Department take Lacan or Deleuze seriously, but no one in *our* community does. True enough; but then take a look at Bruno Latour's semiotic analysis of the theory of relativity, published in *Social Studies of Science*, in which "Einstein's text is read as a contribution to the sociology of delegation".[17] How so? Well, Latour observes that Einstein's popular book on relativity is full of situations in which the author delegates one observer to stand on the platform and make certain measurements, and another observer to stand on the train and make certain measurements; and of course the results won't obey the Lorentz transformations unless the two observers do what they're told! You think I exaggerate? Latour emphasizes Einstein's

> obsession with transporting *in*formation through *trans*formations without *de*formation; his passion for the precise superimposition of readings; his panic at the idea that observers sent away might betray, might retain

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[15] Deleuze and Guattari (1994, p. 119).

[16] For an extensive compilation of postmodern French philosophers' abuses of mathematics and physics, along with commentary for non-experts, see Sokal and Bricmont (1998).

[17] Latour (1988, p. 3).

> privileges, and send reports that could not be used to expand our knowledge; his desire to discipline the delegated observers and to turn them into dependent pieces of apparatus that do nothing but watch the coincidence of hands and notches ...[18]

Furthermore, because Latour doesn't understand what the term "frame of reference" means in physics — he confuses it with "actor" in semiotics — he claims that relativity cannot deal with the transformation laws between two frames of reference, but needs at least *three*:

> If there are only one, or even *two*, frames of reference, no solution can be found ... Einstein's solution is to consider *three* actors: one in the train, one on the embankment and a third one, the author [enunciator] or one of its representants, who tries to superimpose the coded observations sent back by the two others.[19]

Finally, Latour somehow got the idea that relativity concerns the problems raised by the relative *location* (rather than the relative *motion*) of different observers. (Of course, even the word "observer" here is potentially misleading; it belongs to the pedagogy of relativity, not to the theory itself.) Here is Latour's summary of the meaning of relativity:

> provided the two relativities [special and general] are accepted, more frames of reference with less privilege can be accessed, reduced, accumulated and combined, observers can be delegated to a few more places in the infinitely large (the cosmos) and the infinitely small (electrons), and the readings they send will be understandable. His [Einstein's] book could well be titled: "New Instructions for Bringing Back Long-Distance Scientific Travellers".[20]

I needn't pursue the point: physicist John Huth has provided a sober and detailed exegesis of Latour's confusions about relativity.[21] The upshot is that Latour has produced 40 pages of comical misunderstandings of a theory that is nowadays routinely taught to intelligent college freshmen, and *Social Studies of Science* found it a worthy scholarly contribution.

OK, enough for examples of nonsense (although a lot more are available). More interesting intellectually, I think, are the sloppy thinking and glib relativism that have become prevalent in many parts of Science Studies

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[18] Latour (1988, p. 22), emphasis in the original.

[19] Latour (1988, pp. 10–11), emphasis in the original.

[20] Latour (1988, pp. 22–23).

[21] Huth (1998). See also Sokal and Bricmont (1998, chapter 6).

(albeit *not*, by and large, among serious philosophers of science). When one analyzes these writings, one often finds radical-sounding assertions whose meaning is ambiguous, and which can be given two alternate readings: one as interesting, radical, and grossly false; the other as boring and trivially true.

Let me start again with Latour, this time taken from his book *Science in Action*, in which he develops seven Rules of Method for the sociologist of science. Here is his Third Rule of Method:

> Since the settlement of a controversy is the *cause* of Nature's representation, not the consequence, we can never use the outcome — Nature — to explain how and why a controversy has been settled.[22]

Note how Latour slips, without comment or argument, from "Nature's representation" in the first half of this sentence to "Nature" *tout court* in the second half. If we were to read "Nature's representation" in *both* halves, then we'd have the truism that scientists' *representations* of Nature (that is, their theories) are arrived at by a social process, and that the course and outcome of that social process can't be explained simply by its outcome. If, on the other hand, we take seriously "Nature" in the second half, linked as it is to the word "outcome", then we would have the claim that the external world is *created* by scientists' negotiations: a claim that is bizarre to say the least, given that the external world has been around for about 10 billion years longer than the human race.[23] Finally, if we take seriously "Nature" in the second half but expunge the word "outcome" preceding it, then we would have either (a) the weak (and trivially true) claim that the course and outcome of a scientific controversy cannot be explained *solely* by the nature of the external world (obviously *some* social factors play a role, if only in

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[22] Latour (1987, pp. 99 and 258). This "rule" is the culmination of an argument (pp. 96–99) in which ontology, epistemology and the sociology of knowledge are gradually conflated.

[23] You might worry that here my argument is circular, in that it takes for granted the truth of the current scientific consensus in cosmology and paleontology. But this is not the case. First of all, my phrase "given that ... " is a rhetorical flourish that plays no essential role in the argument; the idea that the external world is created by scientists' negotiations is bizarre irrespective of the details of cosmology and paleontology. Secondly, my phrase "the external world has been around ... " should, if one wants to be super-precise, be amended to read: "there is a vast body of extremely convincing (and diverse) evidence in support of the belief that the external world has been around ... ; and *if* this belief is correct, *then* the claim that the external world is created by scientists' negotiations is bizarre to say the least." Indeed, *all* of my assertions of fact — including "today in New York it's raining" — should be glossed in this way. Since I shall claim below that much contemporary work in Science Studies elides the distinction between ontology and epistemology, I don't want to leave myself open to the same accusation.

determining which experiments are technologically feasible at a given time, not to mention other, more subtle social influences); or (b) the strong (and manifestly false) claim that the nature of the external world plays *no* role in constraining the course and outcome of a scientific controversy.[24]

On the other hand, if we apply the First Rule of Interpretation of Postmodern Academic Writing — "no sentence means what it says" — we can perhaps make sense of Latour's dictum. Let's read it not as a philosophical principle, but rather as a methodological principle for a sociologist of science — more precisely, for a sociologist of science who does not have the scientific competence to make an independent assessment of whether the experimental/observational data do in fact warrant the conclusions the scientific community has drawn from them. (The principle applies with particular force when such a sociologist is studying contemporary science, because in this case there is no other scientific community besides the one under study who could provide such an independent assessment. By contrast, for studies of the distant past, one can always look at what subsequent scientists learned, including the results from experiments going beyond those originally performed.) In such a situation, the sociologist will be understandably reluctant to say that "the scientific community under study came to conclusion X because X is the way the world really is" — *even if it is in fact the case* that X is the way the world is and that is the reason the scientists came to believe it — because the sociologist has no independent *grounds to believe* that X is the way the world really is other than the fact that the scientific community under study came to believe it.

Of course, the sensible conclusion to draw from this *cul de sac* is that sociologists of science ought not to study scientific controversies on which they lack the competence to make an independent assessment of the facts, if there is no other (for example, historically later) scientific community on which they could justifiably rely for such an independent assessment. But it goes without saying that Latour and his colleagues would not enjoy this conclusion, because their goal, as Steve Fuller put it, is to "employ methods that enable them to fathom both the 'inner workings' and the 'outer character' of science without having to be expert in the fields they study".[25]

It seems to me that much sloppy thinking in Science Studies, like that in Latour's Third Rule of Method, involves conflating concepts that need to be distinguished. Most frequently this conflation is accomplished by terminological fiat: the author intentionally uses an old word or phrase in a radically

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[24] Re (b), the "homely example" in Gross and Levitt (1994, pp. 57–58) makes the point clearly.

[25] Fuller (1993, p. xii). For further analysis of *Science in Action*, see Amsterdamska (1990).

new sense, thereby undermining any attempt to distinguish between the two meanings. The clear goal here is to achieve by definition what one could not achieve by logic. For example, one often finds phrases like "the social construction of facts"[26] that intentionally elide the distinction between facts and our knowledge of them. Or to take another example, philosophers usually understand the word "knowledge" to mean "justified true belief" or some similar concept; but Barry Barnes and David Bloor redefine "knowledge" to mean "any collectively accepted system of belief".[27] Now, perhaps Barnes and Bloor are *uninterested* in inquiring whether a given belief is true or rationally justified; but if they think these properties of beliefs are *irrelevant* for their purposes, then they should say so and explain why, without confusing the issue by redefining words.

More generally, it seems to me that much sloppy thinking in Science Studies involves conflating two or more of the following levels of analysis:

1) *Ontology.* What objects *exist* in the world? What statements about these objects are *true*?
2) *Epistemology.* How can human beings obtain *knowledge* of truths about the world? How can they assess the *reliability* of that knowledge?
3) *Sociology of knowledge.* To what extent are the truths *known* (or *knowable*) by humans in any given society influenced (or determined) by social, economic, political, cultural and ideological factors? Same question for the false statements erroneously believed to be true.
4) *Individual ethics.* What types of research *ought* a scientist (or technologist) to undertake (or refuse to undertake)?
5) *Social ethics.* What types of research *ought* society to encourage, subsidize or publicly fund (or alternatively to discourage, tax or forbid)?

These questions are obviously related — for example, if there are no objective truths about the world, then there isn't much point in asking how one can know those (nonexistent) truths — but they are conceptually distinct.

The extreme versions of social constructivism and relativism — such as the Edinburgh "strong programme" — are, I think, largely based on this failure to distinguish clearly between ontology, epistemology, and the sociology of knowledge.[28] Here is how Barnes and Bloor describe the form of relativism that they defend:

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[26] Latour and Woolgar (1979).

[27] Barnes and Bloor (1981, p. 22n5).

[28] See also Chapter 2 above for a brief analysis of similar elisions in the work of feminist philosopher of science Sandra Harding.

> Our equivalence postulate is that all beliefs are on a par with one another with respect to the causes of their credibility. It is not that all beliefs are equally true or equally false, but that regardless of truth and falsity the fact of their credibility is to be seen as equally problematic. The position we shall defend is that the incidence of all beliefs without exception calls for empirical investigation and must be accounted for by finding the specific, local causes of this credibility. This means that regardless of whether the sociologist evaluates a belief as true or rational, or as false and irrational, he must search for the causes of its credibility.... All these questions can, and should, be answered without regard to the status of the belief as it is judged and evaluated by the sociologist's own standards.[29]

It seems clear from this passage, as well as from the paragraph that precedes it, that Barnes and Bloor are *not* advocating an ontological relativism: they recognize that "to say that all beliefs are equally true encounters the problem of how to handle beliefs which contradict one another", and that "to say that all beliefs are equally false poses the problem of the status of the relativist's own claims."[30] They *might* be advocating an epistemological relativism — that all beliefs are equally credible, or equally rational — and indeed, their attack on the universal validity of even the simplest rules of deductive inference (such as *modus ponens*) lends some support to this interpretation.[31] But more likely what they are advocating is some form of *methodological* relativism for sociologists of knowledge. The problem is, what form?

If the claim were merely that we should use the same principles of sociology and psychology to explain the causation of all beliefs irrespective of whether we evaluate them as true or false, rational or irrational, then I would have no particular objection (though one might have qualms about the hyperscientistic attitude that human beliefs are always to be explained causally through social science). But if the claim is that only *social* causes can enter into such an explanation — that the way the world *is* cannot enter — then I cannot disagree more strenuously.

Let's take a concrete example: Why did the European scientific community become persuaded of the truth of Newtonian mechanics somewhere between 1700 and 1750? Undoubtedly a variety of historical, sociological, ideological and political factors must play a role in this explanation — one must explain, for example, why Newtonian mechanics was accepted quickly

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[29] Barnes and Bloor (1981, p. 23).

[30] Barnes and Bloor (1981, p. 22).

[31] Barnes and Bloor (1981, pp. 35–47).

in England but more slowly in France[32] — but certainly *some* part of the explanation must be that the planets and comets really do move (to a very high degree of approximation, though not exactly) as predicted by Newtonian mechanics.[33] Or to take another example: Why did the majority view in the European and North American scientific communities shift from creationism to Darwinism over the course of the nineteenth century? Again, numerous historical, sociological, ideological and political factors will play a role in this explanation; but can one plausibly explain this shift without *any* reference to the fossil record or to the Galápagos fauna?

In the unlikely event that the argument isn't already clear, here's a more homely example: Suppose we encounter a man running out of a lecture hall screaming at the top of his lungs that there's a stampeding herd of elephants in there. What we are to make of this assertion, and in particular how we are to evaluate its "causes", should, I think, depend heavily on whether or not there *is* in fact a stampeding herd of elephants in there — or, more precisely, since I admit that we have no direct, unmediated access to external reality — whether when I and other people peek (cautiously!) into the room *we* see or hear a stampeding herd of elephants (or the destruction that such a herd might recently have caused before themselves exiting the room). If we do see such evidence of elephants, then the most plausible explanation of this set of observations is that there *is* (or was) in fact a stampeding herd of elephants in the lecture hall, that the man saw and/or heard it, and that his subsequent fright (which we might well share under the circumstances) led him to exit the room in a hurry and to scream the assertion that we overheard. And our reaction would be to call the police and the zookeepers. If, on the other hand, our own observations reveal no evidence of elephants in the lecture hall, then the most plausible explanation is that there was *not* in fact a stampeding herd of elephants in the room, that the man *imagined* the elephants as a result of some psychosis (whether internally or chemically induced), and that *this* led him to exit the room in a hurry and to scream the assertion

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[32] The consensus of historians appears to be that the slow acceptance of Newtonian mechanics in France arose from scholastic attachment to Cartesian theories as well as from certain theological considerations: see, for example, Brunet (1931) and Dobbs and Jacob (1995).

[33] Or more precisely: There is a vast body of extremely convincing astronomical evidence in support of the belief that the planets and comets do move (to a very high degree of approximation, though not exactly) as predicted by Newtonian mechanics; and *if* this belief is correct, then it is the fact of this motion (and not merely our belief in it) that forms part of the explanation of why the eighteenth-century European scientific community came to believe in the truth of Newtonian mechanics.

that we overheard. And we'd call the police and the psychiatrists.[34] And I daresay that Barnes and Bloor, whatever they might write in journal articles for sociologists and philosophers, would do the same in real life.

The bottom line, it seems to me, is that there is no fundamental "metaphysical" difference between the epistemology of science and the epistemology of everyday life. Historians, detectives and plumbers — indeed, all human beings — use the same basic methods of induction, deduction, and assessment of evidence as do physicists or biochemists. Modern science tries to carry out these operations in a more careful and systematic way — using controls and statistical tests, insisting on replication, and so forth — but nothing more.[35] Any philosophy of science — or methodology for sociologists — that is so blatantly wrong when applied to the epistemology of everyday life must be severely flawed at its core.

In summary, it seems to me that the "strong programme", like Latour's Third Rule of Method, is ambiguous in its intent; and, depending on how one resolves the ambiguity, it becomes either a valid and mildly interesting corrective to the most naive psychological and sociological notions — reminding us that "true beliefs have causes too" — or else a gross and blatant error.

Philosopher Philip Kitcher concludes a recent critical analysis of Science Studies by saying, "I doubt that this essay will please anyone, for it attempts to occupy middle ground."[36] In this he's certainly too pessimistic, for there's at least one counterexample: his essay pleases *me*. Indeed, I agree with nearly everything in it.

Now, perhaps this means only that I too — arrogant scientist though I may be — am one of those select few occupying the "middle ground". But I

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[34] For what it's worth, these decisions can presumably be justified on Bayesian grounds, using our prior experience of the probability of finding elephants in lecture halls, of the incidence of psychosis, of the reliability of our own visual and auditory perceptions, and so forth.

[35] Please note: I am *not* claiming that inference from scientific observations to scientific theories is as simple or unproblematic as inference from seeing elephants in front of me to the conclusion that elephants are in front of me. (In truth, even this latter inference is not so simple or unproblematic: to fully ground it requires some knowledge about optics and about the mechanisms of human vision.) As all practicing scientists and historians of science well know, the reasoning from scientific observations to scientific theories is far more indirect, and typically involves a vast web of empirical evidence rather than a single observation. My point is simply that in *all* of these cases — Newtonian mechanics, Darwinian evolution, or elephants — it is absurd to try to explain the "causes" of people's beliefs without including the natural (non-social) world as one of those causes.

[36] Kitcher (1998, p. 49).

suspect that in fact more of us occupy the "middle ground" in this debate than might at first appear. The point, of course, isn't to embrace "middle ground" (whatever that may be) abstractly and for its own sake, without regard to its content: that would be a grave dereliction of intellectual duty.[37] But here the middle ground as set forth in Kitcher's essay — based on a respect for both the "realist-rationalist cluster" and the "socio-historical cluster", even as we may debate their relative importance in specific cases — is so eminently sensible that nearly all scientists[38] and philosophers of science would give their assent, as would most (though apparently not all) sociologists of science. And this fact might give us some cause for reflection about the so-called — and I think grossly misnamed — "Science Wars".

The term was apparently first coined by *Social Text* co-editor Andrew Ross, who explained that "the Science Wars [are] a second front opened up by conservatives cheered by the successes of their legions in the holy Culture Wars. Seeking explanations for their loss of standing in the public eye and the decline in funding from the public purse, conservatives in science have joined the backlash against the (new) usual suspects — pinkos, feminists, and multiculturalists".[39] This theme was further elaborated in the now-famous special issue of *Social Text*.[40] But, just as in the dreary "culture wars", the truth is rather more complicated than this Manichean portrayal would allow. The alleged one-to-one correspondence between epistemological and political views is a gross misrepresentation.[41] So, too, is the idea that in this debate there are only two positions.

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[37] In American politics, the pernicious consequences of such a search for "middle ground" between two morally and intellectually bankrupt (and indeed barely distinguishable) positions hardly need further comment. "Middle ground" is, of course, meaningless until one specifies *between what*; and the corporate media's tacit definition of the outer limits of respectable opinion is, of course, a large part of the problem. On what grounds, for instance, is single-payer health insurance — long in use in most industrialized countries — defined as "extreme" and "unrealistic" in the United States?

[38] Including Gross and Levitt, as they make amply clear in their book (1994).

[39] Ross (1995, p. 346). See also Ross (1996, p. 6).

[40] Five of the essay titles (Martin, Nelkin, Franklin, Kovel, Aronowitz) include the term "Science Wars", and three more titles (Rose, Winner, Levidow) contain assorted martial metaphors.

[41] My own leftist political views are a matter of record, as are those of many of my supporters (e.g. Michael Albert, Barbara Epstein, Barbara Ehrenreich, Meera Nanda, Ruth Rosen and James Weinstein, among many others). Even Gross and Levitt, the original targets of Ross' wrath, make clear that their political views are basically left-liberal; they note that one of them (Levitt as it turns out) is a member of Democratic Socialists of America: see Gross and Levitt (1994, p. 261, note 7).

This conception of debate as combat is, in fact, probably the main reason why the *Social Text* editors fell for my parody. Acting not as intellectuals seeking the truth, but as self-appointed generals in the "Science Wars", they apparently leapt at the chance to get a "real" scientist on their "side". Now, ruing their blunder, they must surely feel a kinship with the Trojans.

But the military metaphor is a mistake; the *Social Text* editors are not my enemies. Ross has legitimate concerns about new technologies and about the increasingly unequal distribution of scientific expertise. Aronowitz raises important questions about technological unemployment and the possibility of a "jobless future".[42] But, *pace* Ross, nothing is gained by denying the existence of objective scientific knowledge; it does exist, whether we like it or not. Political progressives should seek to have that knowledge distributed more democratically and to have it employed for socially useful ends. Indeed, the radical epistemological critique fatally *undermines* the needed political critique, by removing its factual basis. After all, the only reason why nuclear weapons are a danger to anyone is that the theories of nuclear physics on which their design is based are, at least to a very high degree of approximation, objectively *true*.[43]

Science Studies' epistemological conceits are a diversion from the important matters that motivated Science Studies in the first place: namely, the social, economic and political roles of science and technology. To be sure, those conceits are not an accident; they have a history, which can be subjected to sociological study.[44] But Science Studies practitioners are not obliged to persist in a misguided epistemology; they can give it up, and go on to the serious task of studying science. Perhaps, from the perspective of a few years from now, today's so-called "Science Wars" will turn out to have marked such a turning point.[45]

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[42] Aronowitz and DiFazio (1994).

[43] This point was made, long before me, by Levin (1988, p. 104).

[44] For four interesting conjectures — different but not incompatible — concerning the social origin of Science Studies' penchant for glib relativism, see Fox (1992), Gross and Levitt (1994, pp. 74, 82–88, 217–233), Nanda (1997, pp. 79–80) and Kitcher (1998, pp. 55–56, note 46). These conjectures merit careful empirical investigation by intellectual and social historians.

[45] **Note added for this edition:** In a very recent article, prominent sociologist of science Harry Collins, who was formerly identified with the relativist school of SSK (see note 9 above), seems to take a similar view. He now advocates "replacing implicit and generalized criticism of science as a whole with explicit attacks on specific episodes of science. Thus refreshed there would be large areas of STS [Science and Technology Studies] that would look much like the movements for social responsibility in science popular in the 1950s and 1960s. In these areas the questions originally posed by philosophy of science that SSK sought to answer in a new, yet positive, way would be displaced." (Collins *et al.* 2006, p. 658)

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PART II

Science and Philosophy

You do not know anything until you know why you know it.

— *Clovis Andersen, The Principles of Private Detection**

* As cited in Alexander McCall Smith, *The Good Husband of Zebra Drive* (Polygon, Edinburgh, 2007), p. 118.

6

Cognitive relativism in the philosophy of science*

> The road to relativism is paved with the best of intentions and the worst of arguments.
>
> — *Philip Kitcher (1998, p. 44)*

One curious feature of contemporary intellectual life — especially in the academic humanities and social sciences, but also in the wider culture — is the widespread currency of one form or another of cognitive relativism (a term that will be defined more precisely in a moment). Surprisingly many people, especially those of a liberal or radical political orientation, tend to feel uncomfortable with assertions concerning the objective truth or falsity of purportedly factual statements about the world. The Big Bang theory of cosmology may be true "for us" or "in our culture", these people maintain, but the Zunis' creation story is "equally valid" *for them*.[1]

It seems to us that this relativist attitude is pernicious both intellectually and politically, and that the arguments commonly invoked in support of cognitive relativism are based on a series of conceptual confusions. But that is only an assertion, not yet an argument! Clearly, an intellectually adequate

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[1] See pp. 108–110 above for a brief discussion of this example, focussing on elucidating the different possible meanings of "equally valid". Some relativists (the consistent ones) extend this "epistemic charity" (Nanda 2003) also to the creation story of fundamentalist Christians; others shrink in embarrassment from taking their doctrine so far.

response to contemporary relativism requires a deeper analysis of the concepts of truth, objectivity and evidence that were raised in Part I of this book. That is the purpose of this chapter and the next: our principal aim is to clarify the issues under debate, identifying the kernels of truth in the relativist argumentation and separating them from the misguided (as we see it) conclusions. Along the way, we aim to provide a concise introduction (albeit an opinionated one) to contemporary debates in the philosophy of science, aimed at the general educated reader with no special background in either philosophy or science.[2]

It goes without saying that we will be dealing with difficult problems concerning the nature of knowledge and objectivity, which have worried philosophers for centuries. We certainly do not claim to have the last word on these matters, nor do we have the space here to analyze these issues in as much depth as professional philosophers would like. In this chapter we shall criticize ideas that are in our view erroneous, but which are sometimes (not always) so for subtle reasons. Our philosophical argumentation will, in any case, be rather minimalist; we shall not enter here into the more delicate philosophical debates between, for instance, moderate forms of realism and instrumentalism.[3]

In brief, we shall be concerned here with a potpourri of ideas, often imprecisely formulated, that can be generically classified as "relativist" and which are nowadays influential in some fashionable sectors of the academic humanities and social sciences as well as in parts of the general population. The sources of this relativist zeitgeist are myriad — ranging from Romanticism to Heidegger and from decolonization to gay pride — but it is not our intention here (or even within our competence) to address this question of intellectual history in any detail.[4] Rather, we shall concentrate on the relativist ideas themselves and on the arguments most commonly offered in their support. Among these, a prominent role is played by readings (or perhaps misreadings) of twentieth-century works in the philosophy of science, notably Thomas Kuhn's *The Structure of Scientific Revolutions*

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[2] See also Brown (2001) and Godfrey-Smith (2003) for excellent introductions to the philosophy of science from points of view slightly different from ours.

[3] But see Chapter 7 for a discussion of these issues.

[4] See, however, Sokal and Bricmont (1998, Epilogue) and Nanda (2003, chapter 5) for brief discussions of some of the intellectual and political sources of contemporary relativism. We think that this is an important issue that merits a more detailed and rigorous investigation by intellectual and social historians.

and Paul Feyerabend's *Against Method*, along with extrapolations of these philosophers' ideas by their successors. Of course, we do not purport to examine the entire oeuvre of these authors; that would be an unmanageable task. Rather, we shall limit ourselves to an analysis of selected texts that illustrate rather widespread ideas. We intend to show that these texts are often ambiguous and can be read in at least two distinct ways: a "moderate" reading, which leads to claims that are either worth discussing or else true but trivial; and a "radical" reading, which leads to claims that are surprising but false. Unfortunately, the radical interpretation is often taken not only as the "correct" interpretation of the original text but also as a well-established fact ("X has shown that . . . ") — a conclusion that we shall sharply criticize. It might, of course, be argued that no one really holds this radical interpretation anyway; and all the better if that is true. But the numerous discussions we have had during which the theory-ladenness of observation, the underdetermination of theory by evidence or the alleged incommensurability of paradigms have been put forward in order to support relativist positions leave us rather skeptical. And to show that we are not criticizing a mere figment of our imagination, we shall give, at the end of this chapter, a few practical examples of the relativism that is widespread in the United States, in Europe and in parts of the Third World.

We are well aware that we will be criticized for our lack of formal philosophical training. In the Preface we explained why we find this sort of objection unpersuasive, but it seems particularly off the mark here. After all, there is no doubt that the relativist attitude is at odds with scientists' idea of their own practice. While scientists try, as best they can, to obtain an objective view of (certain aspects of) the world[5], relativist thinkers tell them that they are wasting their time and that such an enterprise is, in principle, an illusion. We are thus dealing with a fundamental conflict. And as physicists who have long pondered the foundations of our discipline and of scientific knowledge in general, we think it important to try to give a reasoned answer to the relativist objections, even though we do not hold any diploma in philosophy.

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[5] With, of course, many nuances about the meaning of the word "objective", which are reflected, for instance, in the opposition between such doctrines as realism, conventionalism and positivism (see Chapter 7 for further discussion). Nevertheless, few scientists would be ready to accept that the whole of scientific discourse is a mere social construction. As one of us wrote, we have no desire to be the Emily Post of quantum field theory (Sokal 1996, p. 94, reproduced here in Chapter 2).

The plan of this chapter is as follows: After giving a more precise definition of what we mean by "relativism", we shall begin by sketching our attitude toward knowledge in general and scientific knowledge in particular.[6] Next we shall review some aspects of twentieth-century epistemology (Popper, Quine, Kuhn, Feyerabend); our aim will mostly be to disentangle some of the confusions concerning notions such as "underdetermination" and "incommensurability". Finally, we shall examine critically some recent tendencies in the sociology of science (Barnes, Bloor, Latour) and shall give some practical examples of the effects of contemporary relativism.

Relativism defined

Roughly speaking, we shall use the term "relativism" to designate any philosophy that claims that the truth or falsity of a statement is relative to an individual or to a social group. One may distinguish different forms of relativism according to the nature of the statement in question: *cognitive* relativism when one is dealing with an assertion of purported fact (that is, about what exists or is claimed to exist); *moral* or *ethical* relativism when one is dealing with a value judgment (about what is good or bad, desirable or pernicious); and *aesthetic* relativism when one is dealing with an artistic judgment (about what is beautiful or ugly, pleasant or unpleasant). Here we shall be concerned only with *cognitive* relativism and not with moral or aesthetic relativism, which raise very different issues.

To be more precise, each of the three types of relativism — cognitive, moral and aesthetic — comes in three variants, which are important to distinguish. The one we have just discussed — relativism about the truth and falsity of statements — can be termed *ontological relativism*, or more simply *relativism about truth*. A second (and very important) variant of relativist theorizing focusses not on the truth or falsity of statements but on their *degree of (rational) justification* in the light of some specified body of evidence. Relativists of this persuasion may concede that the truth or falsity

[6] Limiting ourselves to the natural sciences and taking most of the examples from our own field, physics. We shall not deal with the delicate question of the scientificity of the various social sciences.

of statements is objective (albeit unknown to us), but they claim that the standards for making epistemic judgments — that is, judgments concerning the degree to which evidence E provides rational warrant for proposition P — are not objective but are, once again, relative to an individual or to a social group. We shall call this view *epistemological relativism* or *relativism about justification* or *relativism about epistemic standards*.[7,8] Finally, we shall consider, towards the end of this chapter, a *methodological relativism* for sociologists of knowledge, which concedes that statements can be objectively true or false and objectively justified or unjustified relative to some specified body of evidence, but insists that sociologists should ignore (or "bracket") these properties when they attempt to explain why certain individuals or social groups hold certain beliefs.

In the remainder of this chapter we shall criticize all three types of cognitive relativism — ontological, epistemological and methodological — but the arguments will be quite different in each case; that is why we have taken such pains to stress (perhaps a bit too pedantically) these crucial distinctions. Alas, one feature of much relativist writing is (as we shall see) that it freely mixes the three levels of analysis, usually without any awareness that it is doing so.[9] Indeed, we would go farther and argue that a large part of the superficial attractiveness of relativist ideas arises precisely from this type of conceptual confusion.

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[7] Let us stress the importance of specifying the evidence E. Everyone (relativist or not) realizes that the degree of rational justification of any proposition is relative to the evidence at one's disposal: for instance, for a person who has never travelled more than 10 miles from his home village and has had no contact with outsiders, it is perfectly rational to believe that the Earth is (approximately) flat. By "epistemological relativism" we do not mean this trivial observation, which no one disputes, but rather the non-trivial claim that *even with the same set of evidence at everyone's disposal*, the degree of rational justification is relative to an individual or to a social group.

[8] Boghossian (2006) has carefully underlined the importance of the distinction between relativism about truth and relativism about justification. To put it bluntly, cognitive relativism about truth is barely even a coherent doctrine, much less a plausible one (see Chapter 7 for further discussion), while cognitive relativism about justification is a serious view that merits careful analysis, even if we believe that it is ultimately misguided.

[9] Even worse, many of these writings fail to distinguish adequately between *cognitive* questions and *ethical* questions; for instance, they confuse the *validity* of a scientific theory with its *value* for humanity (whether as pure knowledge or via its technological applications).

Solipsism and radical skepticism

> When my brain excites in my soul the sensation of a tree, or of a house, I pronounce, without hesitation, that a tree, or a house, really exists out of me, of which I know the place, the size, and other properties. Accordingly, we find neither man nor beast who calls this truth in question. If a peasant should take it into his head to conceive such a doubt, and should say, for example, he does not believe that his bailiff exists, though he stands in his presence, he would be taken for a madman, and with good reason; but when a philosopher advances such sentiments, he expects we should admire his knowledge and sagacity, which infinitely surpass the apprehensions of the vulgar.
>
> — *Leonhard Euler (1997 [1761], pp. 428–429)*

Let us start at the beginning. How can one possibly hope to attain an objective (albeit approximate and incomplete) knowledge of the world? We never have direct access to the world; we have direct access only to our sensations. How do we know that there even *exists* anything outside of those sensations?

The answer, of course, is that we have no *proof*; it is simply a perfectly reasonable hypothesis. The most natural way to explain the persistence of our sensations (in particular, the unpleasant ones) is to suppose that they are caused by agents outside our consciousness. We can almost always change at will the sensations that are pure products of our imagination, but we cannot stop a war, stave off a lion or start a broken-down car by pure thought alone. Nevertheless — and it is important to emphasize this — this argument *does not refute* solipsism. If anyone insists that he is a "harpsichord playing solo" (Diderot), there is no way to convince him of his error. However, we have never met a sincere solipsist and we doubt that any exist.[10] This illustrates an important principle that we shall use several times in this chapter: *the mere fact that an idea is irrefutable does not imply that there is any reason to believe it is true.*

Another position that one sometimes encounters, in place of solipsism, is radical skepticism: "Of course there exists an external world, but it is impossible for me to obtain any reliable knowledge of that world." In essence the argument is the same as that of the solipsist: I have immediate access only to my sensations; how can I know whether they *accurately reflect* reality? To

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[10] Bertrand Russell (1948, p. 196) tells the following amusing story: "I once received a letter from an eminent logician, Mrs Christine Ladd Franklin, saying that she was a solipsist, and was surprised that there were no others." We learned this reference from Devitt (1997, p. 64).

be certain that they do, I would need to invoke an *a priori* argument, such as the proof of the existence of a benevolent deity in Descartes' philosophy; and such arguments have fallen into disfavor in modern philosophy, for all sorts of good reasons that we need not rehearse here.

This problem, like many others, was very well formulated by Hume:

> It is a question of fact, whether the perceptions of the senses be produced by external objects, resembling them: How shall this question be determined? By experience surely; as all other questions of a like nature. But here experience is, and must be entirely silent. The mind has never any thing present to it but the perceptions, and cannot possibly reach any experience of their connexion with objects. The supposition of such a connexion is, therefore, without any foundation in reasoning.[11]

What attitude should one adopt toward radical skepticism? The key observation is that such skepticism applies to *all* our knowledge: not only to the existence of atoms, electrons or genes, but also to fact that blood circulates in our veins, that the Earth is (approximately) round, and that at birth we emerged from our mother's womb. Indeed, even the most commonplace knowledge in our everyday lives — there is a glass of water in front of me on the table — depends entirely on the supposition that our perceptions do not *systematically* mislead us and that they are indeed produced by external objects that, in some way, resemble those perceptions.[12]

The universality of Humean skepticism is also its weakness. Of course, it is irrefutable. But since no one is systematically skeptical (when he or she is sincere) with respect to ordinary knowledge, one ought to ask *why* skepticism is rejected in that domain and *why* it would nevertheless be valid when applied elsewhere, for instance, to scientific knowledge. Now, the reason why we reject systematic skepticism in everyday life is more or less obvious and is similar to the reason we reject solipsism. The best way to account for the coherence of our experience is to suppose that the outside world corresponds, at least approximately, to the image of it provided by our senses.[13]

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[11] Hume (2000 [1748], pp. 114–115). This passage is from *An Enquiry Concerning Human Understanding*, section 12, part I.

[12] To claim this does not mean that we claim to have an entirely satisfactory answer to the question of *how* such a correspondence between objects and perceptions is established.

[13] This hypothesis receives a deeper explanation with the subsequent development of science, in particular of the biological theory of evolution. Clearly, the possession of sensory organs that reflect more or less *faithfully* the outside world (or, at least, some important

Science as practice

> For my part, I have no doubt that, although progressive changes are to be expected in physics, the present doctrines are likely to be nearer to the truth than any rival doctrines now before the world. Science is at no moment quite right, but it is seldom quite wrong, and has, as a rule, a better chance of being right than the theories of the unscientific. It is, therefore, rational to accept it hypothetically.
>
> — *Bertrand Russell (1995 [1959]), p. 13*

Once the general problems of solipsism and radical skepticism have been set aside, we can get down to work. Let us suppose that we are able to obtain some more-or-less reliable knowledge of the world, at least in everyday life. We can then ask: *To what extent* are our senses reliable or not? To answer this question, we can compare sense impressions among themselves and vary certain parameters of our everyday experience. We can map out in this way, step by step, a practical rationality. When this is done systematically and with sufficient precision, science can begin.

For us, the scientific method is not radically different from the rational attitude in everyday life or in other domains of human knowledge. Historians, detectives and plumbers — indeed, all human beings — use the same basic methods of induction, deduction and assessment of evidence as do physicists or biochemists.[14] Modern science tries to carry out these operations in a more careful and systematic way, by using controls and statistical tests, insisting on replication, and so forth. Moreover, scientific measurements are often much more precise than everyday observations; they allow us to discover hitherto unknown phenomena; and they often conflict with "common sense". But the conflict is at the level of conclusions, not the basic approach.[15,16]

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aspects of it) confers an evolutionary advantage. Let us stress that this argument does not refute radical skepticism, but it does increase the coherence of the anti-skeptical worldview.

[14] The allusion to historians and detectives was employed independently (and prior to us) by Haack (1993, p. 137): "there is no reason to think that [science] is in possession of a special method of inquiry unavailable to historians, detectives, and the rest of us". See also Haack (1998, pp. 96–97).

[15] For example: Water appears to us as a continuous fluid, but chemical and physical experiments teach us that it is made of atoms.

[16] Throughout this chapter, we stress the methodological continuity between scientific knowledge and everyday knowledge. This is, in our view, the proper way to respond to various skeptical challenges and to dispel the confusions generated by radical interpretations of correct philosophical ideas such as the underdetermination of theories by data. But it would

The main reason for believing scientific theories (at least the best-verified ones) is that they explain the coherence of our experience. Let us be precise: here "experience" refers to *all* our observations, including the results of laboratory experiments whose goal is to test quantitatively (sometimes to incredible precision) the predictions of scientific theories. To cite just one example, quantum electrodynamics predicts that the magnetic moment of the electron has the value[17]

$$1.001\,159\,652\,201 \pm 0.000\,000\,000\,030,$$

where the "±" denotes the uncertainties in the theoretical computation (which involves several approximations). A recent experiment gives the result

$$1.001\,159\,652\,188 \pm 0.000\,000\,000\,004,$$

where the "±" denotes the experimental uncertainties.[18] This agreement between theory and experiment[19], when combined with thousands of other similar though less spectacular ones, would be a miracle if science said nothing true — or at least *approximately* true — about the world. The experimental confirmations of the best-established scientific theories, taken together,

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be naive to push this connection too far. Science — particularly fundamental physics — introduces concepts that are hard to grasp intuitively or to connect directly to common-sense notions. (For example: forces acting instantaneously throughout the universe in Newtonian mechanics, electromagnetic fields "vibrating" in vacuum in Maxwell's theory, curved spacetime in Einstein's general relativity.) And it is in discussions about the meaning of these theoretical concepts that various brands of realists and anti-realists (e.g. instrumentalists, pragmatists) tend to part company. Relativists sometimes tend to fall back on instrumentalist positions when challenged, but there is a profound difference between the two attitudes. Instrumentalists may want to claim either that we have no way of knowing whether "unobservable" theoretical entities really exist, or that their meaning is defined solely through measurable quantities; but this does not imply that they regard such entities as "subjective" in the sense that their meaning would be significantly influenced by extra-scientific factors (such as the personality of the individual scientist or the social characteristics of the group to which she belongs). Indeed, instrumentalists may regard our scientific theories as, quite simply, the most satisfactory way that the human mind, with its inherent biological limitations, is capable of understanding the world. For a critical discussion of instrumentalism, see Chapter 7 below.

[17] Expressed in a well-defined unit which is unimportant for the present discussion.

[18] See Kinoshita (1995) for the theory, and Van Dyck *et al.* (1987) for the experiment. Crane (1968) provides a non-technical introduction to this problem.

[19] As Feynman (1985, p. 7) memorably describes this extraordinarily precise agreement: "If you were to measure the distance from Los Angeles to New York to this accuracy, it would be exact to the thickness of a human hair."

are evidence that we really have acquired an objective (albeit approximate and incomplete) knowledge of the natural world.[20]

Having reached this point in the discussion, the radical skeptic or relativist will ask what distinguishes science from other types of discourse about reality — religions or myths, for example, or pseudosciences such as astrology — and, above all, what *criteria* are used to make such a distinction. Our answer is nuanced. First of all, there are some general (but basically negative) epistemological principles, which go back at least to the seventeenth century: to be skeptical of *a priori* arguments, revelation, sacred texts and arguments from authority. Moreover, the experience accumulated during three centuries of scientific practice has given us a series of more-or-less general methodological principles — for example, to replicate experiments, to use controls, to test medicines in double-blind protocols — that can be justified by rational arguments. However, we do not claim that these principles can be codified in a definitive way, nor that the list is exhaustive. In other words, there does not exist (at least at present) a complete codification of scientific rationality, and we seriously doubt that one could ever exist. After all, the future is inherently unpredictable; rationality is always an adaptation to a new situation. Nevertheless — and this is the main difference between us and the radical skeptics — we think that well-developed scientific theories are in general supported by good arguments, but the rationality of those arguments must be analyzed case-by-case.[21]

To illustrate this, let us consider an example that is in a certain sense intermediate between scientific and ordinary knowledge, namely criminal investigations.[22] There are some cases in which even the hardiest skeptic will find it difficult to doubt, in practice, that the culprit has really been found: one may, after all, possess the weapon, fingerprints, DNA evidence, documents,

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[20] Subject, of course, to many nuances on the precise meaning of the phrases "approximately true" and "objective knowledge of the natural world", which are reflected in the diverse versions of realism and anti-realism (see note 16 above and Chapter 7 below). For these debates, see for example Leplin (1984).

[21] It is also by proceeding on a case-by-case basis that one can appreciate the immensity of the gulf separating the sciences from the pseudosciences.

[22] We hasten to add — as if this should even be necessary — that we harbor no illusions about the behavior of real-life police forces, which are by no means always and exclusively dedicated to finding the truth. We employ this example solely to illustrate the abstract epistemological question in a simple concrete context, namely: Suppose that one *does* wish to find the truth about a practical matter (such as who committed a murder); how would one go about it? For an extreme example of this misreading — in which we are compared to former Los Angeles Detective Mark Fuhrman (of O.J. Simpson fame) and his infamous Brooklyn counterparts — see Robbins (1998).

a motive, and so forth. Nevertheless, the path leading to those discoveries can be very complicated: the investigator has to make decisions (on the leads to follow, on the evidence to seek) and draw provisional inferences, in situations of incomplete information. Nearly every investigation involves inferring the unobserved (who committed the crime) from the observed. And here, as in science, some inferences are more rational than others. The investigation could have been botched, or the "evidence" might simply have been fabricated by the police. But there is no way to decide *a priori*, independently of the circumstances, what distinguishes a good investigation from a bad one. Nor can anyone give an absolute guarantee that a particular investigation has yielded the correct result. Moreover, no one can write a definitive treatise on *The Logic of Criminal Investigation*. Nevertheless — and this is the main point — no one doubts that, for some investigations at least (the best ones), the result does indeed correspond to reality. Furthermore, history has permitted us to develop certain rules for conducting an investigation: no one believes anymore in trial by fire, and we doubt the reliability of confessions obtained under torture. It is crucial to compare testimonies, to cross-examine witnesses, to search for physical evidence, etc. Even though there does not exist a methodology based on unquestionable *a priori* reasoning, these rules (and many others) are not arbitrary. They are rational and are based on a detailed analysis of prior experience. In our view, the "scientific method" is not radically different from this kind of approach.

The absence of any "absolutist" criteria of rationality, independent of all circumstances, implies also there is no *general* justification of the principle of induction (another problem going back to Hume). Quite simply, some inductions are justified and others are not; or, to be more precise, some inductions are more reasonable and others are less so. Everything depends on the case at hand: to take a classic philosophical example, the fact that we have seen the Sun rise every day, together with all our astronomical knowledge, gives us good reasons to believe that it will rise tomorrow. But this does not imply that it will rise ten billion years from now (indeed, current astrophysical theories predict that it will exhaust its fuel before then).

In a sense, we always return to Hume's problem: No statement about the real world can ever literally be *proven*; but to use the eminently appropriate expression from Anglo-American law, it can sometimes be proven beyond any *reasonable* doubt. The unreasonable doubt subsists.

If we have spent so much time on these rather elementary remarks, it is because much of the relativist drift that we shall criticize has a double origin:

- Part of twentieth-century epistemology (the Vienna Circle, Popper and others) has attempted to formalize the scientific method.
- The partial failure of this attempt has led, in some circles, to an attitude of unreasonable skepticism.

In the rest of this chapter, we intend to show that a series of relativist arguments concerning scientific knowledge are either (a) valid critiques of some attempts to formalize the scientific method, which do not, however, in any way undermine the rationality of the scientific enterprise; or (b) mere reformulations, in one guise or another, of Humean radical skepticism, most often applied in unjustifiably selective ways.

Epistemology in crisis

> Science without epistemology is — insofar as it is thinkable at all — primitive and muddled. However, no sooner has the epistemologist, who is seeking a clear system, fought his way through such a system, than he is inclined to interpret the thought-content of science in the sense of his system and to reject whatever does not fit into his system. The scientist, however, cannot afford to carry his striving for epistemological systematic that far.... He therefore must appear to the systematic epistemologist as an unscrupulous opportunist.
>
> — *Albert Einstein (1949, p. 684)*

Much contemporary skepticism claims to find support in the writings of philosophers such as Quine, Kuhn or Feyerabend who have called into question the epistemology of the first half of the twentieth century. This epistemology is indeed in crisis. In order to understand the nature and the origin of the crisis and the impact that it may have on the philosophy of science, let us go back to Popper.[23] Of course, Popper is not a relativist, quite the contrary. He is nevertheless a good starting point, first of all because many of the modern developments in epistemology (Kuhn, Feyerabend) arose in reaction to him, and secondly because, while we disagree strongly with some of the conclusions reached by Popper's critics such as Feyerabend, it is nevertheless true that a significant part of our problems can be traced to ambiguities or

[23] We could go back to the Vienna Circle, but that would take us too far afield. Our analysis in this section is inspired in part by Putnam (1974), Stove (1982) and Laudan (1990b). Tim Budden has drawn our attention to Newton-Smith (1981), where a similar critique of Popper's epistemology can be found.

inadequacies in Popper's *The Logic of Scientific Discovery*.[24] It is important to understand the limitations of this work in order to face more effectively the irrationalist drift created by the critiques it provoked.

Popper's basic ideas are well known. He wants, first of all, to give a criterion for demarcating between scientific and non-scientific theories, and he thinks he has found it in the notion of *falsifiability*: in order to be scientific, a theory must make predictions that can, in principle, be false in the real world. For Popper, theories such as astrology or psychoanalysis avoid subjecting themselves to such a test, either by not making precise predictions or by tinkering with their statements in an *ad hoc* fashion in order to accommodate empirical results whenever they contradict the theory.[25]

If a theory is falsifiable, hence scientific, it may be subjected to attempts at *falsification*. That is, one may compare the theory's empirical predictions with observations or experiments; and if the latter contradict the predictions, it follows that the theory is false and must be rejected. This emphasis on falsification (as opposed to verification) underlines, according to Popper, a crucial asymmetry: one can never prove that a theory is *true*, because it makes, in general, an infinite number of empirical predictions, of which only a finite subset can ever be tested; but one can nevertheless prove that a theory is *false*, because, to do that, a single (reliable) observation contradicting the theory suffices.[26]

The Popperian scheme — falsifiability and falsification — is not a bad one, if it is taken with a grain of salt. But numerous difficulties spring up as soon as one tries to take falsificationist doctrine literally. It may appear attractive to abandon the uncertainty of verification in favor of the certainty of falsification. But this approach runs into two problems: by abandoning verification, one pays too high a price; and one fails to obtain what is promised, because falsification is much less certain than it seems.

The first difficulty concerns the status of scientific induction. When a theory successfully withstands an attempt at falsification, a scientist will, quite naturally, consider the theory to be partially confirmed and will accord it a greater likelihood or a higher subjective probability. The degree of likelihood

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[24] Popper (1959).

[25] As we shall see below, whether an explanation is *ad hoc* or not depends strongly upon the context.

[26] In this brief summary we have, of course, grossly oversimplified Popper's epistemology: we have glossed over the distinction between observations, the Vienna-Circle notion of observation statements (which Popper criticizes), and Popper's notion of basic statements; we have omitted Popper's qualification that only *reproducible* effects can lead to falsification; and so forth. However, nothing in the subsequent discussion will be affected by these simplifications.

depends, of course, upon the circumstances: the quality of the experiment, the unexpectedness of the result, etc. But Popper will have none of this: throughout his life, he was a stubborn opponent of any idea of "confirmation" of a theory, or even of its "probability". He wrote:

> *Are we rationally justified in reasoning from repeated instances of which we have experience to instances we have had no experience?* Hume's unrelenting answer is: No, we are not justified ... My own view is that Hume's answer to this problem is right.[27]

Obviously, every induction is an inference from the observed to the unobserved, and no such inference can be justified using solely *deductive* logic. But, as we have seen, if this argument were to be taken seriously — if rationality were to consist only of deductive logic — it would imply also that there is no good reason to believe that the Sun will rise tomorrow, and yet no one *really* expects the Sun not to rise.

With his method of falsification, Popper thinks that he has solved Hume's problem[28], but his solution, taken literally, is a purely negative one: we can be certain that some theories are false, but never that a theory is true or even probable. Clearly, this "solution" is unsatisfactory from a scientific point of view. In particular, at least one of the roles of science is to make predictions on which other people (engineers, doctors, ...) can reliably base their activities, and all such predictions rely on some form of induction.

Besides, the history of science teaches us that scientific theories come to be accepted above all because of their successes. For example, on the basis of Newtonian mechanics, physicists have been able to deduce a great number of both astronomical and terrestrial motions, in excellent agreement with observations. Moreover, the credibility of Newtonian mechanics was reinforced by correct predictions such as the return of Halley's comet in 1759[29]

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[27] Popper (1974, pp. 1018–1019), italics in the original. See also Stove (1982, p. 48) for further similar quotes from Popper. Note that Popper calls a theory "corroborated" whenever it successfully passes falsification tests. But the meaning of this word is unclear; it cannot just be a synonym of "confirmed", for otherwise the entire Popperian critique of induction would be empty. See Putnam (1974) for a more detailed discussion.

[28] For example, he writes: "The proposed criterion of demarcation also leads us to a solution of Hume's problem of induction — of the problem of the validity of natural laws.... [T]he method of falsification presupposes no inductive inference, but only the tautological transformations of deductive logic whose validity is not in dispute." (Popper 1959, p. 42)

[29] As Laplace wrote: "The learned world awaited with impatience this return which was to confirm one of the greatest discoveries that have been made in the sciences ..." (Laplace 1902 [1825], p. 5).

and by spectacular discoveries such as finding Neptune in 1846 where Le Verrier and Adams predicted it should be.[30] It is hard to believe that such a simple theory could predict so precisely *entirely new* phenomena if it were not at least approximately true.

The second difficulty with Popper's epistemology is that falsification is much more complicated than it seems.[31] To see this, let us take once again the example of Newtonian mechanics[32], understood as the combination of two laws: the law of motion, according to which force is equal to mass times acceleration; and the law of universal gravitation, according to which the force of attraction between two bodies is proportional to the product of their masses and inversely proportional to the square of the distance separating them. In what sense is this theory falsifiable? By itself, it doesn't predict much; indeed, a great variety of motions are *compatible* with the laws of Newtonian mechanics and even *deducible* from them, if one makes appropriate assumptions about the masses of the various celestial bodies. For example, Newton's famous deduction of Kepler's laws of planetary motion requires certain *additional assumptions*, which are logically independent of the laws of Newtonian mechanics, principally that the masses of the planets are small relative to the mass of the Sun: this implies that the mutual interactions between the planets can be neglected, in a first approximation. But this hypothesis, while reasonable, is by no means self-evident: the planets could be made of a very dense material, in which case the additional hypothesis would fail. Or there could exist a large amount of invisible matter affecting the motion of the planets.[33] Moreover, the interpretation of any astronomical observation depends on certain theoretical propositions, in particular on optical hypotheses concerning the functioning of telescopes and the propagation of light through space. The same is true, in fact, for any observation: for example, when one "measures" an electrical current, what one really sees is the position of a needle on a screen (or numbers on a digital readout),

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[30] For a detailed history, see, for example, Grosser (1962) or Moore (1996, chapters 2 and 3).

[31] Let us emphasize that Popper himself is perfectly aware of the ambiguities associated with falsification. What he does not do, in our opinion, is to provide a satisfactory alternative to "naive falsificationism" — that is, one which would correct its defects while retaining at least some of its virtues.

[32] See, for example, Putnam (1974). See also the reply of Popper (1974, pp. 993–999) and the response of Putnam (1978).

[33] Note that the existence of such "dark" matter — invisible, though not necessarily undetectable by other means — is postulated in some contemporary cosmological theories, and these theories are not declared unscientific *ipso facto*.

which is interpreted, in accordance with our theories, as indicating the presence and the magnitude of a current.[34]

It follows that scientific propositions cannot be falsified one by one, because to deduce from them any empirical proposition whatsoever, it is necessary to make numerous additional assumptions, if only on the way measuring devices work; moreover, these hypotheses are often implicit. The American philosopher Quine has expressed this idea in a rather radical fashion:

> [O]ur statements about the external world face the tribunal of sense experience not individually but only as a corporate body.... Taken collectively, science has its double dependence upon language and experience; but this duality is not significantly traceable into the statements of science taken one by one....
>
> The idea of defining a symbol in use was ... an advance over the impossible term-by-term empiricism of Locke and Hume. The statement, rather than the term, came with Bentham to be recognized as the unit accountable to an empiricist critique. But what I am now urging is that even in taking the statement as unit we have drawn our grid too finely. The unit of empirical significance is the whole of science.[35]

What can one reply to such objections? First of all, it must be emphasized that scientists, in their practice, are perfectly aware of the problem. Each time an experiment contradicts a theory, scientists ask themselves a host of questions: Is the error due to the way the experiment was performed or analyzed? Is it due to the theory itself, or to some additional assumption? The experiment itself never dictates what must be done. The notion (what Quine calls the "empiricist dogma") that scientific propositions can be tested one by one belongs to a fairy tale about science.

But Quine's assertions demand serious qualifications.[36] In practice, experience is not given; we do not simply contemplate the world and then

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[34] The importance of theories in the interpretation of experiments has been emphasized by Duhem (1954 [1914], second part, chapter VI).

[35] Quine (1980 [1953], pp. 41–42). Let us emphasize that, in the foreword to the 1980 edition, Quine disavows the most radical reading of this passage, saying (correctly in our view) that "empirical content is shared by the statements of science in clusters and cannot for the most part be sorted out among them. Practically the relevant cluster is indeed never the whole of science" (p. viii).

[36] As do some of Quine's related assertions, such as: "Any statement can be held true come what may, if we make drastic enough adjustments elsewhere in the system. Even a statement very close to the periphery [i.e. close to direct experience] can be held true in the face of

interpret it. We perform specific experiments, motivated by our theories, precisely in order to test the different parts of those theories, if possible independently of one another or, at least, in different combinations. We use a *set* of tests, some of which serve only to check that the measuring devices indeed work as expected (by applying them to well-known situations). And, just as it is the totality of the relevant theoretical propositions that is subjected to a falsification test, so it is the totality of our empirical observations that constrains our theoretical interpretations. For example, while it is true that our astronomical knowledge depends upon hypotheses about optics, these hypotheses cannot be modified in an arbitrary way, because they can be tested, at least in part, by numerous *independent* experiments.

We have not, however, reached the end of our troubles. If one takes the falsificationist doctrine literally, one should declare that Newtonian mechanics was falsified already in the mid-nineteenth century by the anomalous behavior of Mercury's orbit.[37] For a strict Popperian, the idea of putting aside certain difficulties (such as the orbit of Mercury) in the hope that they will be temporary amounts to an illegitimate strategy aimed at evading falsification. However, if one takes into account the context, one may very well maintain that it is *rational* to proceed in this way, at least for a certain period of time — otherwise science would be impossible. There are always experiments or observations that cannot be fully explained, or that even seem to contradict the theory, which are put aside awaiting better days.[38] Given the immense successes of Newtonian mechanics, it would have been unreasonable to

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recalcitrant experience by pleading hallucination or by amending certain statements of the kind called logical laws." (p. 43) Though this passage, taken out of context, might be read as an apologia for radical relativism, Quine's discussion (pp. 43–44) suggests that this is *not* his intention, and that he thinks (again correctly in our view) that certain modifications of our belief systems in the face of "recalcitrant experiences" are much more reasonable than others.

[37] Astronomers, beginning with Le Verrier in 1859, noticed that the observed orbit of the planet Mercury differs slightly from the orbit predicted by Newtonian mechanics: the discrepancy corresponds to a precession of the perihelion (point of closest approach to the Sun) of Mercury by approximately 43 seconds of arc per century. (This is an incredibly small angle: recall that one second of arc is 1/3600 of a degree, and one degree is 1/360 of the entire circle.) Various attempts were made to explain this anomalous behavior within the context of Newtonian mechanics: for example, by conjecturing the existence of a new intra-Mercurial planet (a natural idea, given the success of this approach with regard to Neptune). However, all attempts to detect this planet failed. The anomaly was finally explained in 1915 as a consequence of Einstein's general theory of relativity. For a detailed history, see Roseveare (1982).

[38] Kuhn (1970, pp. 79–82 and 146–147) makes this same point.

reject it because of a single prediction (apparently) refuted by observations, since this disagreement could have all sorts of other explanations.[39] Science is a rational enterprise, but difficult to codify.

Without a doubt, Popper's epistemology contains some valid insights: the emphasis on falsifiability and falsification is salutary, provided it is not taken to extremes (e.g. the blanket rejection of induction). In particular, when comparing radically different endeavors such as astronomy and astrology, it is useful, to some extent, to employ Popperian criteria. But there is no point in demanding that the pseudosciences follow strict rules that the scientists themselves do not follow literally (otherwise one exposes oneself to Feyerabend's critiques, which we shall discuss later).

It is obvious that, in order to be scientific, a theory must be tested empirically in one way or another — and the more stringent the tests, the better. It is also true that predictions of unexpected phenomena often constitute the most spectacular tests. Finally, it is easier to show that a precise quantitative claim is false than to show that it is true. And it is probably a combination of these three ideas that explains, in part, Popper's popularity among many scientists. But these ideas are not due to Popper, nor do they constitute what is original in his work. The necessity of empirical tests goes back at least to the seventeenth century, and is simply the lesson of empiricism: the rejection of *a priori* or revealed truths. Besides, predictions are not always the most powerful tests[40]; and those tests may take relatively complex forms,

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[39] Indeed, the error could have been in one of the additional hypotheses and not in Newton's theory itself. For example, the anomalous behavior of Mercury's orbit could have been caused by an unknown planet, by a ring of asteroids, or by a small asphericity of the Sun. Of course, these hypotheses can and should be subjected to tests independent of Mercury's orbit; but these tests depend in turn on additional hypotheses (concerning, for example, the difficulty of seeing a planet close to the Sun) that are not easy to evaluate. We are by no means suggesting that one can continue in this way *ad infinitum* — after a while, the *ad hoc* explanations become too bizarre to be acceptable — but this process may easily take half a century, as it did with Mercury's orbit (see Roseveare 1982).

Besides, Weinberg (1992, pp. 93–94) notes that at the beginning of the twentieth century there were *several* anomalies in the mechanics of the solar system: not only in Mercury's orbit, but also in the orbits of the Moon and of Halley's and Encke's comets. We know now that the latter anomalies were due to errors in the additional hypotheses — the evaporation of gases from comets and the tidal forces acting on the Moon were imperfectly understood — and that only Mercury's orbit constituted a true falsification of Newtonian mechanics. But this was not at all evident at the time.

[40] For example, Weinberg (1992, pp. 90–107) explains why the *retro*diction of the orbit of Mercury was a much more convincing test of general relativity than the *pre*diction of the deflection of starlight by the Sun. See also Brush (1989).

which cannot be reduced to the simple falsification of hypotheses taken one by one.

All these problems would not be so serious had they not given rise to a strongly irrationalist reaction: some thinkers, notably Feyerabend, reject Popper's epistemology for many of the reasons just discussed, and then fall into an extreme anti-scientific attitude (see below). But the rational arguments in favor of the theory of relativity or the theory of evolution are to be found in the works of Einstein, Darwin and their successors, not Popper. Thus, even if Popper's epistemology were entirely false (which is certainly not the case), that would imply nothing concerning the validity of scientific theories.[41]

The Duhem–Quine thesis: Underdetermination

Another idea, often called the "Duhem–Quine thesis", is that theories are underdetermined by evidence.[42] The set of all our experimental data is finite; but our theories contain, at least potentially, an infinite number of empirical predictions. For example, Newtonian mechanics describes not only how the planets move, but also how a yet-to-be-launched satellite will move. How can one pass from a finite set of data to a potentially infinite set of assertions? Or, to be more precise, is there a unique way of doing this? This is rather like asking whether, given a finite set of points, there is a unique curve that passes through these points. Clearly the answer is no: there are infinitely many curves passing through any given finite set of points. Similarly, there is always a large (even infinite) number of theories compatible with the data — and this, whatever the data and whatever their number.

There are two ways to react to such a general thesis. The first approach is to apply it systematically to *all* our beliefs (as one is logically entitled to do). So we would conclude, for example, that, whatever the facts, there will always be just as many suspects at the end of any criminal investigation as

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[41] By way of analogy, consider Zeno's paradox: it does not show that Achilles will not, in actual fact, catch the tortoise; it shows only that the concepts of motion and limit were not well understood in Zeno's time. Likewise, we may very well practice science without necessarily understanding how we do it.

[42] Let us emphasize that Duhem's version of this thesis is much less radical than that of Quine. Note also that the term "Duhem–Quine thesis" is sometimes used to designate the idea (analyzed in the previous section) that observations are theory-laden. See Laudan (1990b) for a more detailed discussion of the ideas in this section.

there were at the beginning. Clearly, this looks absurd. But it is indeed what can be "shown" using the underdetermination thesis: one can always invent a story (possibly a very bizarre one) in which X is guilty and Y is innocent and in which "the data are accounted for" in an *ad hoc* fashion. We are simply back to Humean radical skepticism. The weakness of this thesis is again its generality.

Another way to deal with this problem is to consider the various concrete situations that can occur when one confronts theory with evidence:

1) One may possess evidence in favor of a given theory that is so strong that to doubt the theory would be almost as unreasonable as to believe in solipsism. For example, we have good reasons to believe that blood circulates, that biological species have evolved, that matter is composed of atoms, and a host of other things. The analogous situation, in a criminal investigation, is that in which one is sure, or almost sure, of having found the culprit.
2) One may have a number of competing theories, none of which seems totally convincing. For example, the problem of the origin of life provides (at least at present) a good example of such a situation. The analogy in criminal investigations is obviously the case in which there are several plausible suspects but it is unclear which one is really guilty. The situation may also arise in which one has just one theory, which, however, is not very convincing due to the lack of sufficiently powerful tests. In such a case, scientists implicitly apply the underdetermination thesis: since another theory, not yet conceived, might well be the right one, one confers on the sole existing theory a rather low subjective probability.
3) Finally, one may lack even a single plausible theory that accounts for all the existing data. This is probably the case today for the unification of general relativity with elementary-particle physics, as well as for many other difficult scientific problems.

Let us come back for a moment to the problem of the curve drawn through a finite number of points. What convinces us most strongly that we found the right curve is, of course, that when we perform additional experiments, the *new* data fit the *old* curve. One has to assume implicitly that there is not a cosmic conspiracy in which the real curve is very different from the curve we have drawn, but in which all our data (old and new) happen to fall on the intersection of the two. To take a phrase from Einstein, one must imagine that the Lord is subtle, but not malicious.

Kuhn and the incommensurability of paradigms

> Much more is known now than was known fifty years ago, and much more was known then than in 1580. So there has been a great accumulation or growth of knowledge in the last four hundred years. This is an extremely well-known fact ... So a writer whose position inclined him to deny [it], or even made him at all reluctant to admit it, would inevitably seem, to the philosophers who read him, to be maintaining something extremely implausible.
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> — *David Stove, Popper and After (1982, p. 3)*

Let us now turn our attention towards some historical analyses that have apparently provided grist for the mill of contemporary relativism. The most famous of these is undoubtedly Thomas Kuhn's *The Structure of Scientific Revolutions*.[43] We shall deal here exclusively with the epistemological aspect of Kuhn's work, putting aside the details of his historical analyses.[44] There is no doubt that Kuhn envisions his work as a historian as having an impact on our conception of scientific activity and thus, at least indirectly, on epistemology.[45]

Kuhn's scheme is well known: The bulk of scientific activity — what Kuhn calls "normal science" — takes place within "paradigms", which define what kinds of problems are studied, what criteria are used to evaluate a solution, and what experimental procedures are deemed acceptable. From time to time, normal science enters into crisis — a "revolutionary" period — and the paradigm changes. For instance, the birth of modern physics with Galileo and Newton constituted a rupture with Aristotle; similarly, in the twentieth century, relativity theory and quantum mechanics have overturned the Newtonian paradigm. Comparable revolutions took place in biology, during the

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[43] Kuhn (1962, 2nd ed. 1970). For this section, see Shimony (1976), Siegel (1987) and especially Maudlin (1996) for more detailed critiques.

[44] We shall also limit ourselves to *The Structure of Scientific Revolutions*. For two quite different analyses of Kuhn's later ideas, see Maudlin (1996) and Weinberg (1996b, p. 56). See also Godfrey-Smith (2003, chapters 5 and 6) for a balanced assessment of Kuhn's ideas from the *Structure* and afterwards.

[45] Speaking of "the image of science by which we are now possessed" and which is propagated, among others, by scientists themselves, he writes: "This essay attempts to show that we have been misled ... in fundamental ways. Its aim is a sketch of the quite different concept of science that can emerge from the historical record of the research activity itself." (Kuhn 1970, p. 1)

development from a static view of species to the theory of evolution, or from Lamarck to modern genetics.

This vision of things fits so well with scientists' perception of their own work that it is difficult to see, at first glance, what is revolutionary in this approach, much less how it could be used for anti-scientific purposes. The problem arises only when one faces the notion of the *incommensurability* of paradigms. On the one hand, scientists think, in general, that it is possible to decide rationally between competing theories (Newton and Einstein, for example) on the basis of observations and experiments, even if those theories are accorded the status of "paradigms". By contrast, though one can give several meanings to the word "incommensurable" and a good deal of the debate about Kuhn's work has centered on this question, there is at least one version of the incommensurability thesis that casts doubt on the possibility of rational comparison between competing theories, namely the idea that our experience of the world is radically conditioned by our theories, which in turn depend upon the paradigm.[46] For example, Kuhn observes that chemists after Dalton reported chemical compositions as ratios of integers rather than as percentages.[47] And while the atomic theory accounted for much of the data available at that time, some experiments gave conflicting results. The conclusion drawn by Kuhn is rather radical:

> Chemists could not, therefore, simply accept Dalton's theory on the evidence, for much of that was still negative. Instead, even after accepting the theory, they had still to beat nature into line, a process which, in the event, took almost another generation. When it was done, even the percentage

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[46] Note that this assertion is much more radical than Duhem's idea that observation depends *in part* on additional theoretical hypotheses. In one extreme passage, Kuhn even draws an explicit epistemological parallel between scientific revolutions and political revolutions:

> Because they differ about the institutional matrix within which political change is to be achieved and evaluated, because they acknowledge no supra-institutional framework for the adjudication of revolutionary difference, the parties to a revolutionary conflict must finally resort to the techniques of mass persuasion, often including force.... [T]he historical study of paradigm change reveals very similar characteristics in the evolution of the sciences. Like the choice between competing political institutions, that between competing paradigms proves to be a choice between incompatible modes of community life.... As in political revolutions, so in paradigm choice — there is no standard higher than the assent of the relevant community. (Kuhn 1970, chapter IX, pp. 93–94)

[47] Kuhn (1970, pp. 130–135). Integer ratios are what one would expect on the basis of Dalton's atomic theory, according to which chemical compounds are formed out of chemical elements in fixed small-integer proportions, e.g. H_2O (water) or $CaCO_3$ (calcium carbonate).

> composition of well-known compounds was different. The data themselves had changed. That is the last of the senses in which we may want to say that after a revolution scientists work in a different world.[48]

But what exactly does Kuhn mean by, "they had still to beat nature into line"? Is he suggesting that chemists after Dalton manipulated their data in order to make them agree with the atomic hypothesis, and that their successors keep on doing so today? And that the atomic hypothesis is false? Obviously, this is not what Kuhn thinks, but at the very least it is fair to say that he has expressed himself in an ambiguous way.[49] It is likely that the measurements of chemical compositions available in the nineteenth century were rather imprecise, and it is possible that the experimenters were so strongly influenced by the atomic theory that they considered it better confirmed than it actually was. Nevertheless, we have *today* so much evidence in favor of atomism (much of which is independent of chemistry) that it has become irrational to doubt it.

Of course, historians have the perfect right to say that this is not what interests them: their aim is to understand what happened when the change of paradigm occurred.[50] And it is interesting to see to what extent that change

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[48] Kuhn (1970, p. 135).

[49] Note also that Kuhn's phrasing — "the percentage composition was different" — confuses *facts* with our *knowledge* of them. What changed, of course, is the chemists' knowledge of (or beliefs about) the percentages, not the percentages themselves.

Radical-sounding statements of this kind recur frequently throughout what Godfrey-Smith (2003, p. 96) calls "the X-rated Chapter X ... the worst material in Kuhn's great book". For instance:

> At the very least, as a result of discovering oxygen, Lavoisier saw nature differently. And in the absence of some recourse to that hypothetical fixed nature that he "saw differently," the principle of economy will urge us to say that after discovering oxygen Lavoisier worked in a different world. (Kuhn 1970, p. 118)

As Godfrey-Smith comments incredulously:

> The passage is very strange. "Principle of economy"? Would it be *economical* for us to give up the idea that Lavoisier was living in the same world as the rest of us and acquiring new ideas about it? It is supposed to be *economical* to think that with every conceptual change of this kind, the scientist comes to live in a new, different world? Appeals to "economy" are often suspicious in the philosophy of science. They are usually weak arguments. This one also seems to have the accounting wrong. (p. 97, italics in the original)

[50] The historian thus rightly rejects "Whig history": the history of the past rewritten as a forward march toward the present. However, this quite reasonable attitude ought not be confused with another, and rather dubious, methodological proscription, namely the refusal to use all the information available today (including scientific evidence) in order to draw the best possible inferences concerning history, on the pretext that this information was unavailable in the

was based on solid empirical arguments or on extra-scientific beliefs such as sun worship.[51] In an extreme case, a correct change of paradigm may even have occurred, by fortunate accident, for completely irrational reasons. This would in no way alter the fact that the theory originally adopted for faulty reasons is *today* empirically established beyond any reasonable doubt. Furthermore, changes of paradigm, at least in most cases since the birth of modern science, have not occurred for *completely* irrational reasons. The writings of Galileo or Harvey, for instance, contain many empirical arguments and they are by no means all wrong. There is always, to be sure, a complex mixture of good and bad reasons that lead to the emergence of a new theory, and scientists' adherence to the new paradigm may very well have taken place before the empirical evidence became totally convincing. This is not at all surprising: scientists must try to guess, as best they can, which paths to follow — life is, after all, short — and provisional decisions must often be taken in the absence of sufficient empirical evidence. This does not undermine the long-term rationality of the scientific enterprise, but it does contribute to making the history of science so fascinating.

The basic problem is that there are, as the philosopher of science Tim Maudlin has eloquently pointed out, *two* Kuhns — a moderate Kuhn and his immoderate brother — jostling elbows throughout the pages of *The Structure of Scientific Revolutions*. The moderate Kuhn admits that the scientific debates of the past were settled correctly, but emphasizes that the evidence available at the time was weaker than is generally thought and that non-scientific considerations played a role. We have no objection of principle to the moderate Kuhn, and we leave to historians the task of investigating the extent to which these ideas are correct in concrete situations.[52] By contrast, the immoderate Kuhn — who became, perhaps involuntarily, one of the founding fathers of contemporary relativism — thinks that changes of paradigm are due principally to non-empirical factors and that, once accepted, they condition our perception of the world to such an extent that they can *only* be confirmed by our subsequent experiences. Maudlin eloquently refutes this idea:

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past. After all, art historians utilize contemporary physics and chemistry in order to determine provenance and authenticity; and these techniques are useful for art history even if they were unavailable in the era under study. For interesting examples of similar reasoning in the history of science, see Weinberg (1996a, p. 15) and Kitcher (1998, pp. 43–44).

[51] "[S]un worship ... helped make Kepler a Copernician" (Kuhn 1970, p. 152).

[52] See, for example, the studies in Donovan *et al.* (1988).

> If presented with a moon rock, Aristotle would experience it as a rock, and as an object with a tendency to fall. He could not fail to conclude that the material of which the moon is made is not fundamentally different from terrestrial material with respect to its natural motion.[53] Similarly, ever better telescopes revealed more clearly the phases of Venus, irrespective of one's preferred cosmology[54], and even Ptolemy would have remarked the apparent rotation of a Foucault pendulum.[55] The sense in which one's paradigm may influence one's experience of the world cannot be so strong as to guarantee that one's experience will always accord with one's theories, else the need to revise theories would never arise.[56]

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[53] [This note and the two following are added by us.] According to Aristotle, terrestrial matter is made of four elements — fire, air, water and earth — whose natural tendency is to rise (fire, air) or to fall (water, earth) according to their composition; while the Moon and other celestial bodies are made of a special element, "aether", whose natural tendency is to follow a perpetual circular motion.

[54] Ever since antiquity, it was observed that Venus is never very far from the Sun in the sky. In Ptolemy's geocentric cosmology, this was explained by supposing *ad hoc* that Venus and the Sun revolve more or less synchronously around the Earth (Venus being closer). It follows that Venus should be seen always as a thin crescent, like the "new moon". On the other hand, the heliocentric theory accounts naturally for the observations by supposing that Venus orbits the Sun at a smaller radius than the Earth. It follows that Venus should, like the Moon, exhibit phases ranging from "new" (when Venus is on the same side of the Sun as the Earth) to almost "full" (when Venus is on the far side of the Sun). Since Venus appears to the naked eye as a point, it was not possible to distinguish empirically between these two predictions until telescopic observations by Galileo and his successors clearly established the existence of the phases of Venus. While this did not *prove* the heliocentric model (other theories were also able to explain the phases), it did give significant evidence in its favor, as well as strong evidence against the Ptolemaic model.

[55] According to Newtonian mechanics, a swinging pendulum remains always in a single plane; this prediction holds, however, only with respect to a so-called "inertial frame of reference", such as one fixed with respect to the distant stars. A frame of reference attached to the Earth is *not* precisely inertial, due to the Earth's daily rotation around its axis. The French physicist Jean Bernard Léon Foucault (1819–1868) realized that the direction of swinging of a pendulum, seen relative to the Earth, would gradually precess, and that this can be understood as evidence for the Earth's rotation. To see this, consider, for example, a pendulum located at the north pole. Its direction of swing will remain fixed relative to the distant stars, while the Earth rotates underneath it; therefore, *relative to an observer on the Earth*, its direction of swing will make one full rotation every 24 hours. At all other latitudes (except the equator), a similar effect holds but the precession is slower: for example, at the latitude of Paris (49° N), the precession is once every 32 hours. In 1851 Foucault demonstrated this effect, using a pendulum 67 meters long hung from the dome of the Panthéon. Shortly thereafter, the Foucault pendulum became a standard demonstration in science museums around the world.

[56] Maudlin (1996, p. 442). This essay has thus far been published only in French translation. We thank Professor Maudlin for supplying us with the original English text.

Thus, while it is true that scientific experiments do not provide their own interpretation, it is also true that the theory does not determine the perception of the results.

The second objection against the radical version of Kuhn's history of science — an objection we shall also use later against the "strong programme" in the sociology of science — is that of self-refutation. Research in history, and in particular in the history of science, employs methods that are not radically different from those used in the natural sciences: studying documents, drawing the most rational inferences, making inductions based on the available data, and so forth. If arguments of this type in physics or biology did not allow us to arrive at reasonably reliable conclusions, what reason would there be to trust them in history? Why speak in a realist mode about historical categories, such as Kuhnian paradigms, if it is an illusion to speak in a realist mode about scientific concepts (which are in fact much more precisely defined) such as electrons or DNA?[57]

But one may go further. It is natural to introduce a hierarchy in the degree of credence accorded to different theories, depending on the quantity and quality of the evidence supporting them.[58] Every scientist — indeed, every human being — proceeds in this way and grants a higher subjective probability to the best-established theories (for instance, the evolution of species or the existence of atoms) and a lower subjective probability to more speculative theories (such as detailed theories of quantum gravity). The same reasoning applies when comparing theories in natural science with those in history or sociology. For example, the evidence of the Earth's rotation is vastly stronger than anything Kuhn could put forward in support of his historical theories. This does not mean, of course, that physicists are cleverer than historians or that they use better methods, but simply that they deal with less complex problems, involving a smaller number of variables which, moreover, are easier to measure and to control. It is impossible to avoid introducing such a hierarchy in our beliefs, and this hierarchy implies that there is no conceivable argument based on the Kuhnian view of history

[57] It is worth noting that a similar argument was put forward by Feyerabend in the last edition of *Against Method*: "It is not enough to undermine the authority of the sciences by historical arguments: why should the authority of history be greater than that of, say, physics?" (Feyerabend 1993, p. 271) See also Ghins (1992, p. 255) for a similar argument.

[58] This type of reasoning goes back at least to Hume's argument against miracles: see Hume (2000 [1748], section 10).

that could give succor to those sociologists or philosophers who wish to challenge, in a blanket way, the reliability of scientific results.[59]

Feyerabend: "Anything goes"

Another famous philosopher who is often quoted in discussions about relativism is Paul Feyerabend. Let us begin by acknowledging that Feyerabend is a complicated character. His personal and political attitudes have earned him a fair amount of sympathy, and his criticisms of attempts at codifying scientific practice are often justified. Moreover, despite the title of one of his books, *Farewell to Reason*, he never became entirely and openly irrationalist; towards the end of his life he started to distance himself (or so it seems) from the relativist and anti-scientific attitudes of some of his followers.[60] Nevertheless, Feyerabend's writings contain numerous ambiguous or confused statements, which sometimes end in violent attacks against modern science: attacks which are simultaneously philosophical, historical

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[59] A similar point is made entertainingly by philosopher Alan Soble (2003). After showing how social-constructivist historian Thomas Laqueur unwittingly undermines his own interesting historical work by trotting out the Duhem–Quine thesis, Soble observes that

> "Laqueur's Disease," as I call it, is infectious, especially, it seems, among historians. The major symptoms of Laqueur's Disease are a hurried eagerness to criticize the bona fides of science, the espousal of fantastic and seductive reasons for doing so, and the failure (through self-deception? false consciousness? bad faith? indigestion?) to recognize that this critique of science applies as well to the historical studies carried out by the afflicted person. Its causes are peer pressure from admired and similarly afflicted colleagues, a delusionary sense that something important socially and politically is "at stake" in the doing of the philosophy of science, and a bit of softness in the cerebral cortex. The disease has no rational cure, although a boot to the butt may be tried, and the patient (like the rest of us) eventually dies. (p. 245)

Soble goes on (pp. 245–248) to diagnose this same disease in the work of feminist historian/philosopher of science Evelyn Fox Keller. See also Laudan (1990a, pp. 157–159) for a similar observation.

[60] For example, in 1992 he wrote:

> How can an enterprise [science] depend on culture in so many ways, and yet produce such solid results? ... Most answers to this question are either incomplete or incoherent. Physicists take the fact for granted. Movements that view quantum mechanics as a turning-point in thought — and that include fly-by-night mystics, prophets of a New Age, and relativists of all sorts — get aroused by the cultural component and forget predictions and technology. (Feyerabend 1992, p. 29)

See also Feyerabend (1993, p. 13n12).

and political, and in which judgments of fact are mixed with judgments of value.[61]

The main problem in reading Feyerabend is to know when to take him seriously. On the one hand, he is often considered as a sort of court jester in the philosophy of science, and he seems to have taken some pleasure in playing this role.[62] At times he himself emphasized that his words ought not be taken literally.[63] On the other hand, his writings are full of references to specialized works in the history and philosophy of science, as well as in physics; and this aspect of his work has greatly contributed to his reputation as a major philosopher of science. Bearing all this in mind, we shall discuss what seem to us to be his fundamental errors, and illustrate the excesses to which they can lead.

We fundamentally agree with what Feyerabend says about the scientific method, considered in the abstract:

> The idea that science can, and should, be run according to fixed and universal rules, is both unrealistic and pernicious.[64]

He criticizes at length the "fixed and universal rules" through which earlier philosophers thought that they could express the essence of the scientific method. As we have said, it is extremely difficult, if not impossible, to codify the scientific method, though this does not prevent the development of certain rules, with a more-or-less general degree of validity, on the basis of previous experience. If Feyerabend had limited himself to showing, through historical examples, the limitations of any general and universal codification

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[61] See, for example, chapter 18 of *Against Method* (Feyerabend 1975). This chapter is not, however, included in the later editions of the book in English (Feyerabend 1988, 1993). See also chapter 9 of *Farewell to Reason* (Feyerabend 1987).

[62] For example, he writes: "Imre Lakatos, somewhat jokingly, called me an anarchist and I had no objection to putting on the anarchist's mask." (Feyerabend 1993, p. vii)

[63] For example: "the main ideas of [this] essay ... are rather trivial and appear trivial when expressed in suitable terms. I prefer more paradoxical formulations, however, for nothing dulls the mind as thoroughly as hearing familiar words and slogans." (Feyerabend 1993, p. xiv) And also: "Always remember that the demonstrations and the rhetorics used do not express any 'deep convictions' of mine. They merely show how easy it is to lead people by the nose in a rational way. An anarchist is like an undercover agent who plays the game of Reason in order to undercut the authority of Reason (Truth, Honesty, Justice, and so on)." (Feyerabend 1993, p. 23) This passage is followed by a footnote referring to the Dadaist movement.

[64] Feyerabend (1975, p. 295).

of the scientific method, we could only agree with him.[65] Unfortunately, he goes much farther:

> All methodologies have their limitations and the only 'rule' that survives is 'anything goes'.[66]

This is an erroneous inference that is typical of relativist reasoning. Starting from a correct observation — "all methodologies have their limitations" — Feyerabend jumps to a totally false conclusion: "anything goes". There are several ways to swim, and all of them have their limitations, but it is not true that all bodily movements are equally good (if one prefers not to sink). There is no unique method of criminal investigation, but this does not mean that all methods are equally reliable (think about trial by fire). The same is true of scientific methods.

In the second edition of his book, Feyerabend tries to defend himself against a literal reading of "anything goes". He writes:

> A naive anarchist says (a) that both absolute rules and context-dependent rules have their limits and infers (b) that all rules and standards are worthless and should be given up. Most reviewers regard me as a naive anarchist in this sense ... [But] while I agree with (a) I do not agree with (b). I argue that all rules have their limits and that there is no comprehensive 'rationality', I do not argue that we should proceed without rules and standards.[67]

The problem is that Feyerabend gives little indication of the *content* of these "rules and standards"; and unless they are constrained by some notion of rationality, one arrives easily at the most extreme form of relativism.

When Feyerabend addresses concrete issues, he frequently mixes reasonable observations with rather bizarre suggestions:

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[65] However, we take no position on the validity of the details of Feyerabend's historical analyses. See, for example, Clavelin (1994) for a critique of Feyerabend's theses concerning Galileo.

Let us note also that several of his discussions of problems in modern physics are erroneous or grossly exaggerated: see, for example his claims concerning Brownian motion (Feyerabend 1993, pp. 27–29), renormalization (p. 46), the orbit of Mercury (pp. 47–49), and scattering in quantum mechanics (pp. 49–50n). To disentangle all these confusions would take too much space; but see Bricmont (1995, p. 184) for a brief analysis of Feyerabend's claims concerning Brownian motion and the second law of thermodynamics.

[66] Feyerabend (1975, p. 296).

[67] Feyerabend (1993, p. 231).

> [T]he first step in our criticism of customary concepts and customary reactions is to step outside the circle and either to invent a new conceptual system, for example a new theory, that clashes with the most carefully established observational results and confounds the most plausible theoretical principles, or to import such a system from outside science, from religion, from mythology, from the ideas of incompetents, or the ramblings of madmen.[68]

One could defend these assertions by invoking the classical distinction between the context of *discovery* and the context of *justification*. Indeed, in the idiosyncratic process of inventing scientific theories, all methods are in principle admissible — deduction, induction, analogy, intuition and even hallucination[69] — and the only real criterion is pragmatic. On the other hand, the justification of theories must be rational, even if this rationality cannot be definitively codified. One might be tempted to think that Feyerabend's admittedly extreme examples concern solely the context of discovery, and that there is thus no real contradiction between his viewpoint and ours.

But the problem is that Feyerabend explicitly *denies* the validity of the distinction between discovery and justification.[70] Of course, the sharpness of this distinction was greatly exaggerated in traditional epistemology. We always come back to the same problem: it is naive to believe that there exist general, context-independent rules that allow us to verify or falsify a theory; otherwise put, the context of justification and the context of discovery evolve historically in parallel.[71] Nevertheless, at each moment of history, such a distinction exists. If it didn't, the justification of theories would be unconstrained by any considerations of rationality. Let us think again about criminal investigations: the culprit can be discovered thanks to all sorts of fortuitous events, but the evidence put forward to prove his guilt does not enjoy such a freedom (even if the standards of evidence also evolve historically).[72]

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[68] Feyerabend (1993, pp. 52–53). For a similar statement, see Feyerabend (1993, p. 33).

[69] For example, it is said that the chemist Friedrich August Kekule (1829–1896) was led to conjecture (correctly) the structure of benzene as the result of a dream.

[70] Feyerabend (1993, pp. 147–149).

[71] For example, the anomalous behavior of Mercury's orbit acquired a different epistemological status with the advent of general relativity (see notes 37–40 above).

[72] A similar remark can be made about the classical distinction, also criticized by Feyerabend, between observational and theoretical statements. One should not be naive when saying that one "measures" something; nevertheless, there do exist "facts" — for example, the position of a needle on a screen or the characters on a computer printout — and these facts do not always coincide with our desires.

Once Feyerabend has made the leap to "anything goes", it is not surprising that he constantly compares science with mythology or religion, as, for example, in the following passage:

> Newton reigned for more than 150 years, Einstein briefly introduced a more liberal point of view only to be succeeded by the Copenhagen Interpretation. The similarities between science and myth are indeed astonishing.[73]

Here Feyerabend is suggesting that the so-called Copenhagen interpretation of quantum mechanics, due principally to Niels Bohr and Werner Heisenberg, was accepted by physicists in a rather dogmatic way, which is not entirely false. (It is less clear which point of view of Einstein he is alluding to.) But what Feyerabend does not give are examples of myths that change because experiments contradict them, or that suggest experiments aimed at discriminating between earlier and later versions of the myth. It is only for this reason — which is crucial — that the "similarities between science and myth" are superficial.

This analogy occurs again when Feyerabend suggests separating Science and the State:

> While the parents of a six-year-old child can decide to have him instructed in the rudiments of Protestantism, or in the rudiments of the Jewish faith, or to omit religious instruction altogether, they do not have a similar freedom in the case of the sciences. Physics, astronomy, history *must* be learned. They cannot be replaced by magic, astrology, or by a study of legends.
>
> Nor is one content with a merely *historical* presentation of physical (astronomical, historical, etc.) facts and principles. One does not say: *some people believe* that the earth moves round the sun while others regard the earth as a hollow sphere that contains the sun, the planets, the fixed stars. One says: the earth *moves* round the sun — everything else is sheer idiocy.[74]

In this passage Feyerabend reintroduces, in a particularly brutal form, the classical distinction between "facts" and "theories" — a basic tenet of the Vienna Circle epistemology that he rejects. At the same time he appears to use implicitly in the social sciences a naively realist epistemology that he rejects for the natural sciences. How, after all, does one find out exactly

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[73] Feyerabend (1975, p. 298).

[74] Feyerabend (1975, p. 301), italics in the original.

what "some people believe", if not by using methods analogous to those of the sciences (observations, polls, etc.)? If, in a survey of Americans' astronomical beliefs, the sample were limited to physics professors, there would probably be no one who "regards the earth as a hollow sphere"; but Feyerabend could respond, quite rightly, that the poll was poorly designed and the sampling biased (would he dare say that it is unscientific?). The same goes for an anthropologist who stays in New York and invents in his office the myths of other peoples. But which criteria acceptable to Feyerabend would be violated? Doesn't anything go? Feyerabend's methodological anarchism, if taken literally, is so radical that it becomes self-refuting. Without a minimum of (rational) method, even a "merely historical presentation of facts" becomes impossible.

What is striking in Feyerabend's writings is, paradoxically, their abstractness and generality. His arguments show, at best, that science does not progress by following a well-defined method, and with that we basically agree. But Feyerabend never explains in what sense atomic theory or evolution theory might be *false*, despite all that we know today. And if he does not say that, it is probably because he does not believe it, and shares (at least in part) with most of his colleagues the scientific view of the world, namely that species evolved, that matter is made of atoms, etc. And if he shares those ideas, it is probably because he has good reasons to do so. Why not think about those reasons and try to make them explicit, rather than just repeating over and over again that they are not justifiable by some universal rules of method? Working case by case, he could show that there are indeed solid empirical arguments supporting those theories.

Of course, this may or may not be the kind of question that interests Feyerabend. He often gives the impression that his opposition to science is not of a cognitive nature but follows rather from a choice of lifestyle, as when he says: "love becomes impossible for people who insist on 'objectivity', i.e. who live entirely in accordance with the spirit of science."[75] The trouble is that he fails to make a clear distinction between factual judgments and value judgments. He could, for example, maintain that evolution theory is infinitely more plausible than any creationist myth, but that parents nevertheless have a right to demand that schools teach false theories to their children. We would disagree, but the debate would no longer be purely on the cognitive level, and would involve political and ethical considerations.

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[75] Feyerabend (1987, p. 263).

In the same vein, Feyerabend writes in the introduction to the Chinese edition of *Against Method*[76]:

> *First-world science is one science among many* ... My main motive in writing the book was humanitarian, not intellectual. I wanted to support people, not to 'advance knowledge'.[77]

The problem is that the first thesis is of a purely cognitive nature (at least if he is speaking of science and not of technology), while the second is linked to practical goals. But if, in reality, there are no "other sciences" really distinct from those of the "first world" that are nevertheless equally powerful at the cognitive level, in what way would asserting the first thesis (which would be false) allow him to "support people"? The problems of truth and objectivity cannot be evaded so easily.

The "strong programme" in the sociology of science

During the 1970s, a new school in the sociology of science arose. While previous sociologists of science were, in general, content to analyze the social context in which scientific activity takes place, the researchers gathered under the banner of the "strong programme" were, as the name indicates, considerably more ambitious. Their aim was to explain in sociological terms the *content* of scientific theories.

Of course, most scientists, when they hear about these ideas, protest and point out the substantial missing piece in this kind of explanation: Nature itself.[78] In this section we shall explain the fundamental conceptual problems faced by the strong programme. While some of its supporters have recently made corrections to their initial claims, they do not seem to realize the extent to which their starting point was misguided.[79]

Let us start by quoting the principles set forth for the sociology of knowledge by one of the founders of the strong programme, David Bloor:

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[76] Reproduced in the second and third English editions.

[77] Feyerabend (1988, p. 3 and 1993, p. 3), italics in the original.

[78] For case studies in which scientists and historians of science explain the concrete mistakes contained in analyses by supporters of the strong programme, see, for example, Gingras and Schweber (1986), Franklin (1990, 1994), Mermin (1996a, 1996b, 1996c, 1997), Gottfried and Wilson (1997), and Koertge (1998). See also Collins (1994) for an unconvincing (in our opinion) response to Franklin (1994).

[79] See also Laudan (1981, 1990a), Slezak (1994a, 1994b), Murphy (1994) and Kitcher (1998) for related criticisms of the strong programme. Note particularly Kitcher's criticism of the "Four Dogmas of Science Studies" (1998, pp. 38–45), which is quite similar to our own critique.

> 1. It would be causal, that is, concerned with the conditions which bring about belief or states of knowledge. Naturally there will be other types of causes apart from social ones which will cooperate in bringing about belief.
>
> 2. It would be impartial with respect to truth and falsity, rationality or irrationality, success or failure. Both sides of these dichotomies will require explanation.
>
> 3. It would be symmetrical in its style of explanation. The same types of cause would explain, say, true and false beliefs.
>
> 4. It would be reflexive. In principle its patterns of explanation would have to be applicable to sociology itself.[80]

To grasp what is meant by "causal", "impartial" and "symmetrical", we shall analyze an article of Bloor and his colleague Barry Barnes in which they explain and defend their programme.[81] The article begins with an apparent statement of good will:

> Far from being a threat to the scientific understanding of forms of knowledge, relativism is required by it.... It is those who oppose relativism, and who grant certain forms of knowledge a privileged status, who pose the real threat to a scientific understanding of knowledge and cognition.[82]

However, this already raises the issue of self-refutation: Doesn't the discourse of the sociologist who wants to provide "a scientific understanding of knowledge and cognition" claim "a privileged status" with respect to other discourses, for example those of the "rationalists" that Barnes and Bloor criticize in the rest of their article? It seems to us that, if one seeks to have a "scientific" understanding of anything, one is forced to make a distinction between a good and a bad understanding. Barnes and Bloor seem to be aware of this, since they write:

> The relativist, like everyone else, is under the necessity to sort out beliefs, accepting some and rejecting others. He will naturally have preferences and these will typically coincide with those of others in his locality. The words 'true' and 'false' provide the idiom in which those evaluations are expressed, and the words 'rational' and 'irrational' will have a similar function.[83]

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[80] Bloor (1991, p. 7).

[81] Barnes and Bloor (1981).

[82] Barnes and Bloor (1981, pp. 21–22).

[83] Barnes and Bloor (1981, p. 27).

But this is a strange notion of "truth", which manifestly contradicts the notion used in everyday life.[84] If I regard the statement "I drank coffee this morning" as true, I do not mean simply that I *prefer* to believe that I drank coffee this morning, much less that "others in my locality" think that I drank coffee this morning![85] What we have here is a radical redefinition of the concept of truth, which nobody (starting with Barnes and Bloor themselves) would accept in practice for ordinary knowledge. Why, then, should it be accepted for scientific knowledge? Note also that, even in the latter context, this definition doesn't hold water: Galileo, Darwin and Einstein did not sort out their beliefs by following those of others in their locality.

Moreover, Barnes and Bloor fail to use systematically their new notion of "truth"; from time to time they fall back, without comment, on the traditional sense of the word. For example, at the beginning of their article, they admit that "to say that all beliefs are equally true encounters the problem of how to handle beliefs which contradict one another", and that "to say that all beliefs are equally false poses the problem of the status of the relativist's own claims".[86] But if "a true belief" meant only "a belief that one shares with other people in one's locality", the problem of the contradiction between beliefs held in different places would no longer pose any problem.[87]

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[84] One could of course interpret these words as a mere *description*: people tend to call "true" what they believe. But, with that interpretation, the statement would be banal.

[85] This example is adapted from Bertrand Russell's critique of the pragmatism of William James and John Dewey: see chapters 24 and 25 of Russell (1961), in particular p. 779.

[86] Barnes and Bloor (1981, p. 22).

[87] A similar slippage arises in their use of the word "knowledge". Philosophers usually understand "knowledge" to mean "justified true belief" or some similar concept, but Bloor begins by offering a radical redefinition of the term:

> Instead of defining it as true belief — or perhaps, justified true belief — knowledge for the sociologist is whatever people take to be knowledge. It consists of those beliefs which people confidently hold to and live by.... Of course knowledge must be distinguished from mere belief. This can be done by reserving the word 'knowledge' for what is collectively endorsed, leaving the individual and idiosyncratic to count as mere belief. (Bloor 1991, p. 5; see also Barnes and Bloor 1981, p. 22n)

However, only nine pages after enunciating this non-standard definition of "knowledge", Bloor reverts without comment to the standard definition of "knowledge", which he contrasts with "error": "[I]t would be wrong to assume that the natural working of our animal resources always produces knowledge. They produce a mixture of knowledge and error with equal naturalness ... " (Bloor 1991, p. 14).

A similar ambiguity plagues their discussion of rationality:

> For the relativist there is no sense attached to the idea that some standards or beliefs are really rational as distinct from merely locally accepted as such.[88]

Again, what exactly does this mean? Isn't it "really rational" to believe that the Earth is (approximately) round, at least for those of us who have access to airplanes and satellite photos? Is this merely a "locally accepted" belief?

Barnes and Bloor seem here to be playing on two levels: a general skepticism, which of course cannot be refuted; and a concrete program aiming at a "scientific" sociology of knowledge. But the latter presupposes that one has given up radical skepticism and that one is trying, as best one can, to understand some part of reality.

Let us therefore temporarily put aside the arguments in favor of radical skepticism, and ask whether the "strong programme", considered as a scientific project, is plausible. Here is how Barnes and Bloor explain the symmetry principle on which the strong programme is based:

> Our equivalence postulate is that all beliefs are on a par with one another with respect to the causes of their credibility. It is not that all beliefs are equally true or equally false, but that regardless of truth and falsity the fact of their credibility is to be seen as equally problematic. The position we shall defend is that the incidence of all beliefs without exception calls for empirical investigation and must be accounted for by finding the specific, local causes of this credibility. This means that regardless of whether the sociologist evaluates a belief as true or rational, or as false and irrational, he must search for the causes of its credibility. . . . All these questions can, and should, be answered without regard to the status of the belief as it is judged and evaluated by the sociologist's own standards.[89]

Here, instead of a *general* skepticism or philosophical relativism, Barnes and Bloor are clearly proposing a *methodological* relativism for sociologists of knowledge. But the ambiguity remains: What exactly do they mean by "without regard to the status of the belief as it is judged and evaluated by the sociologist's own standards"?

In order to see the difficulty, let us first consider perception in everyday life (we shall turn to scientific theories in a moment). Suppose that several

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[88] Barnes and Bloor (1981, p. 27).

[89] Barnes and Bloor (1981, p. 23).

of us are standing outdoors in the rain, and someone says: "It is raining today." That statement expresses a belief; how are we to explain this belief "causally"? Well, no one today knows the complete details of the causal mechanisms, but it seems obvious that part of the explanation involves the fact that it really is raining today. If someone said that it is raining when it is not, one might think that he is joking or that he is mentally disturbed; but the explanations would be very asymmetrical, depending on whether it is raining or not.[90]

Faced with this problem, supporters of the strong programme could admit what we say for ordinary knowledge but maintain that it does not apply to scientific knowledge: in the latter, reality would play little or no role in constraining our beliefs.[91] However, this claim looks particularly implausible, since scientific activity — far more so than everyday life — is set up (through experiments, etc.) precisely so as to make Nature itself constrain our beliefs about it as strongly as possible.[92]

It is instructive to consider, once again, a concrete example: Why did the European scientific community become convinced of the truth of Newtonian mechanics sometime between 1700 and 1750? Undoubtedly a variety of historical, sociological, ideological and political factors must play a part in this explanation — one must explain, for example, why Newtonian mechanics was accepted quickly in England but more slowly in France[93] — but

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[90] See Gross and Levitt (1994, pp. 57–58) for a similar discussion; and see Chapter 5 above (pp. 160–161) for another example.

Of course, even ordinary perception is "social" in some sense. For example, in order to see clearly, some people need eyeglasses that are socially produced. More fundamentally, the meaning of the words through which one expresses one's perceptions is to some extent influenced by the environment in which they are used. Sometimes relativists insist that all they claim is that science is "social" in some equally weak sense; but that seems to us like a considerable watering-down of the "symmetry" thesis. Indeed, when one studies perception scientifically, there is no "symmetry", in any meaningful sense, between hallucination and correct perception. And the difference between the two is related to how the world really is, so that the latter is partly causally responsible for correct perceptions.

[91] See footnote 9 in Chapter 5 above for an explicit assertion of this thesis by sociologist of science Harry Collins.

[92] Elsewhere, Bloor does state explicitly that "Naturally there will be other types of causes apart from social ones which will cooperate in bringing about belief" (Bloor 1991, p. 7). The trouble is that he fails to make explicit *in what way* natural causes will be allowed to enter into the explanation of belief, or what precisely will be left of the symmetry principle if natural causes are taken seriously. For a more detailed critique of Bloor's ambiguities (from a philosophical point of view slightly different from ours), see Laudan (1981); see also Slezak (1994b).

[93] See, for example, Brunet (1931) and Dobbs and Jacob (1995).

certainly *some* part of the explanation (and a rather important part at that) must be that the planets and comets really do move (to a very high degree of approximation, though not exactly) as predicted by Newtonian mechanics.[94]

At the risk of beating a dead horse, let us rephrase our critique of the strong programme's sociological reductionism as a *reductio ad absurdum*. Consider the following thought-experiment: Suppose that a Laplacian demon were to give us all conceivable information about seventeenth-century England that could in any way be called sociological or psychological: all the conflicts between members of the Royal Society, all the data about economic production and class relations, etc. Let's even include documents that have been destroyed and private conversations that were never recorded. Add to this a gigantic super-fast computer that can process all this information as much as desired. But do not include any astronomical data (such as Brahe's and Kepler's observations). Now, try to "predict" from those data that scientists will accept a theory in which the gravitational force decays with the inverse square of the distance, rather than the inverse cube. How could one do it? What kind of reasoning could one use? It seems obvious to us that this result simply cannot be "extracted" from the given data.[95]

Now suppose, by contrast, that one wants to give a causal account of belief in astrology. In this case it is at least conceivable that one could obtain a purely sociological or psychological account of the incidence of such beliefs, without ever invoking the good evidence supporting those beliefs — simply because there is no such evidence.[96] This comparison

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[94] Or more precisely: There is a vast body of extremely convincing astronomical evidence in support of the belief that the planets and comets do move (to a very high degree of approximation, though not exactly) as predicted by Newtonian mechanics; and *if* this belief is correct, then it is the fact of this motion (and not merely our belief in it) that forms part of the explanation of why the eighteenth-century European scientific community came to believe in the truth of Newtonian mechanics. Please note that *all* our assertions of fact — including "today in New York it's raining" — should be glossed in this way.

[95] Of course, one can argue that the rise of science is linked to the rise of the bourgeoisie (although the causal link between the two, if any, is unclear); one might even argue that a "mechanical worldview" is associated with the bourgeois ethos. But that kind of argument will not extend to detailed empirical statements like the inverse-square law.

See Collins (2001, pp. 187–189) for a criticism of this argument, and Bricmont and Sokal (2001, pp. 245–248) for our reply.

[96] Of course, one may have a separate worry: Does anyone at present have a well-tested sociological or psychological theory that yields a causal and explanatory account of *any* system of beliefs, even superstitious ones?

between Newtonian mechanics and astrology shows clearly a necessary and crucial asymmetry in the explanatory scheme: in the one case, evidence must enter into any satisfactory explanation, in the other case not. Note, of course, that if you happen to believe (wrongly) that astrology *is* well supported by evidence, then this factor *should* presumably enter into what you regard as a satisfactory causal account of belief in astrology.[97]

In summary, it seems clear that an adequate causal explanation of how scientific theories come to be accepted would have to combine "natural" and "social" factors, just as for ordinary perception. Of course, explaning scientific knowledge is much more complicated than explaining perception, which is complicated enough.

Earlier in this chapter, we drew an analogy between scientific investigations and police enquiries. Continuing this analogy, one could say that ontological relativism amounts to saying that there is no objective fact of the matter about whether a particular suspect is innocent or guilty, while epistemological relativism is the assertion that no method of enquiry can be said to be objectively better than another (e.g., carefully analyzing fingerprints versus planting evidence). Methodological relativism, on the other hand, amounts to trying to understand how the police, judge and jury become convinced of X's guilt without ever taking into account the fact that, in some cases at least, there might be good evidence for X's guilt.

Let us consider in this light an assertion of sociologists of science Harry Collins and Trevor Pinch about Einstein's theory of relativity:

> Relativity ... is a truth which came into being as a result of decisions about how we should live our scientific lives, and how we should licence our scientific observations; it was a truth brought about by agreement to agree about new things. It was not a truth forced on us by the inexorable logic of a set of crucial experiments.[98]

Wouldn't it sound odd to say that "it is true that X is guilty" but that this truth "came into being as a result of decisions about how we should licence our police investigations; it was a truth brought about by agreement to agree about new things"? The whole thing is plagued with ambiguities: Does one mean to say that X is guilty or not? Is this merely a confusing way of

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[97] See also Bricmont and Sokal (2001, pp. 180–181) for a similar example concerning belief in transubstantiation.

[98] Collins and Pinch (1993, p. 54).

stating the banal observation that our *belief* in X's guilt arose from a social process?[99]

When all is said and done, methodological relativism makes no sense unless one adheres to the idea that the natural sciences form some kind of ideology or religion, while our knowledge of the social world is truly scientific and explains (or will someday explain) why natural scientists believe what they do. But then, we have a direct competition: Which theories are more scientific, i.e. are better supported by evidence, make more accurate predictions, etc.? Those of physics and chemistry and biology, or those of sociology (including the sociology of religion and of fashion)? The answer seems clear enough.[100,101] This unpleasant situation (for sociologists of science) sometimes leads them to employ arguments supporting an ontological or epistemological relativism, which have the "merit" (from their point of view) of stopping the "direct competition": if no theory is objectively better than another, then physics is not more scientific than sociology. But cognitive relativism of an ontological or epistemological sort is not a view that any scientist — natural or social — should want to hold.[102]

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[99] Let us note in passing that the last sentence of the quote is correct: the notion of "crucial experiment", which is used by some philosophers of science, grossly oversimplifies the complex web of interlocking evidence that gives support to well-confirmed scientific theories. The physicist David Mermin, in his excellent critique of the account of relativity given by Collins and Pinch, correctly concedes that scientists' oversimplified histories, as presented in textbooks, sometimes do make this error (Mermin 1996a, 1996b, 1996c, 1997). On the other hand, experiments and observations, *taken collectively*, are indeed crucial since there is no other way to obtain reliable knowledge of the external world.

[100] Let us stress once again that physicists and chemists are not smarter than sociologists; rather, they study much easier problems. See also Krugman (1994, p. xi) for an amusing version of this same observation.

[101] In a similar vein, the chapter of Barnes, Bloor and Henry (1996) on "proof and self-evidence" is eerily fascinating. The authors try to refute the claim that some beliefs, like $2 + 2 = 4$ or the *modus ponens*, are so obvious that they need not be explained sociologically. But their arguments show, at most, that those beliefs are not as evident as they may seem (e.g., because the nature of arithmetic statements is open to divergent interpretations in the philosophy of mathematics, or because the *modus ponens* applies only to ideally precise propositions and not to those containing ill-defined words like "heap"). But that answer misses the obvious point that all human beings — be they physicists or sociologists or plumbers — have, in practice, no sensible alternative but to use arithmetic and logic. And to seek a sociological explanation for such basic notions surely puts the cart before the horse. Do Barnes *et al.* really think that their sociological theories are more reliable than $2 + 2 = 4$ and *modus ponens*? See Nagel (1997) for an elaboration of these arguments, and Mermin (1998) for another critique.

[102] For charity, we have here left aside Bloor's fourth principle ("reflexivity"). Indeed, it seems to us that if sociologists start trying to explain why they hold their own beliefs without taking into account the evidence that those beliefs are somehow better or more objective than those of their critics, then we simply move from error to absurdity. Note that, by contrast,

The supporters of the strong programme thus face a dilemma. They could, if they choose, adhere systematically to a philosophical skepticism or relativism; but in that case it is unclear why (or how) they would seek to build a "scientific" sociology. Alternatively, they could choose to adopt only a methodological relativism; but this position is untenable if one abandons philosophical relativism, because it ignores an essential element of the desired explanation, namely Nature itself. For this reason, the sociological approach of the strong programme and the relativistic philosophical attitude are mutually reinforcing. Therein resides the danger (and no doubt the appeal for some) of the different variants of this programme.[103]

Bruno Latour and his Rules of Method

The strong programme in the sociology of science has found an echo in France, particularly around Bruno Latour. His works contain a great number of propositions formulated so ambiguously that they can hardly be taken literally. And when one removes the ambiguity — as we shall do here in a few examples — one reaches the conclusion that the assertion is either true but banal, or else surprising but manifestly false.

In his theoretical work, *Science in Action*[104], Latour develops seven Rules of Method for the sociologist of science. Here is the Third Rule of Method:

> Since the settlement of a controversy is the *cause* of Nature's representation, not the consequence, we can never use the outcome — Nature — to explain how and why a controversy has been settled.[105]

It is telling how Latour slips here, without comment or argument, from "Nature's representation" in the first half of this sentence to "Nature" *tout court* in the second half. If we were to read "Nature's representation" in *both* halves, then we would have the truism that scientists' *representations* of Nature (that is, their theories) are arrived at by a social process, and that the

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Collins (1992, p. 188) argues that "sociologists of scientific knowledge who want to find (or help construct) new objects in the world must compartmentalise; they must not apply their methods to themselves." That move allows him to escape from self-refutation, but why should anyone accept his rule? See Friedman (1998) for a more detailed discussion.

[103] For further discussion of our objections to the strong programme's methodological relativism, see Bricmont and Sokal (2001, 2004).

[104] Latour (1987). For a more detailed analysis of *Science in Action*, see Amsterdamska (1990). For a critical analysis of the later theses of Latour's school (as well as of other trends in sociology of science), see Gingras (1995).

[105] Latour (1987, pp. 99, 258).

course and outcome of that social process cannot be explained simply by its outcome. If, on the other hand, we take "Nature" seriously in the second half, linked as it is to the word "outcome", then we would have the claim that the external world is *created* by scientists' negotiations: a claim that is, to say the least, a rather bizarre form of radical idealism. Finally, if we take "Nature" seriously in the second half but expunge the word "outcome" preceding it, then we would have either (a) the weak (and trivially true) claim that the course and outcome of a scientific controversy cannot be explained *solely* by the nature of the external world (obviously *some* social factors play a role, if only in determining which experiments are technologically feasible at a given time, not to mention other, more subtle social influences); or (b) the strong (and manifestly false) claim that the nature of the external world plays *no* role in constraining the course and outcome of a scientific controversy.[106]

We could be accused here of focusing our attention on an ambiguity of formulation and of not trying to understand what Latour really means. In order to counter this objection, let us go back to the section "Appealing (to) Nature" (pp. 94–100) where the Third Rule is introduced and developed. Latour begins by ridiculing the appeal to Nature as a way of resolving scientific controversies, such as the one concerning solar neutrinos[107]:

> A fierce controversy divides the astrophysicists who calculate the number of neutrinos coming out of the sun and Davis, the experimentalist who obtains a much smaller figure. It is easy to distinguish them and put the controversy to rest. Just let us see for ourselves in which camp the sun is really to be found. Somewhere the natural sun with its true number of neutrinos will close the mouths of dissenters and force them to accept the facts no matter how well written these papers were.[108]

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[106] Re (b), the "homely example" in Gross and Levitt (1994, pp. 57–58) makes the point clearly.

[107] The nuclear reactions that power the Sun are expected to emit copious quantities of the subatomic particle called the neutrino. By combining current theories of solar structure, nuclear physics and elementary-particle physics, it is possible to obtain quantitative predictions for the flux and energy distribution of the solar neutrinos. Since the late 1960s, experimental physicists, beginning with the pioneering work of Raymond Davis, have been attempting to detect the solar neutrinos and measure their flux. The solar neutrinos have in fact been detected; but their flux appears to be only about one-third of the theoretical prediction. At the time of Latour's writing, astrophysicists and elementary-particle physicists were actively trying to determine whether the discrepancy arises from experimental error or theoretical error, and if the latter, whether the failure is in the solar models or in the elementary-particle models. For an introductory overview, see Bahcall (1990).

[108] Latour (1987, p. 95).

Why does Latour choose to be ironic? The problem is to know how many neutrinos are emitted by the Sun, and this question is indeed difficult. We can hope that it will be resolved some day, not because "the natural sun will close the mouths of dissenters", but because sufficiently powerful empirical data will become available. Indeed, in order to fill in the gaps in the currently available data and to discriminate between the currently existing theories, several groups of physicists have recently built detectors of different types, and they are now performing the (difficult) measurements.[109] It is thus reasonable to expect that the controversy will be settled sometime in the next few years, thanks to an accumulation of evidence that, taken together, will indicate clearly the correct solution.[110] However, other scenarios are in principle possible: the controversy could die out because people stop being interested in the issue, or because the problem turns out to be too difficult to solve; and, at this level, sociological factors undoubtedly play a role (if only because of the budgetary constraints on research). Obviously, scientists think, or at least hope, that if the controversy is resolved it will be because of observations and not because of the literary qualities of the scientific papers. Otherwise, they will simply have ceased to do science.

But we, like Latour, do not work professionally on the solar-neutrino problem; we are unable to render an informed guess as to how many neutrinos the Sun emits. We could try to get a rough idea by examining the scientific literature on the subject; or failing that, we could get an even rougher idea by examining the sociological aspects of the problem, for example, the scientific respectability of the researchers involved in the controversy. And there

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[109] See, for example, Bahcall *et al.* (1996).

[110] **Note added for this edition:** The controversy has now been resolved: the culprit is *neutrino oscillation*. The key fact here is that neutrinos come in three distinct species (or "flavors"): electron-neutrinos, mu-neutrinos and tau-neutrinos. The nuclear reactions in the Sun produce only electron-neutrinos, and Davis' original experiments — which were sensitive only to electron-neutrinos — found only about one-third of the flux predicted by the solar models. But a more recent experiment at the Sudbury (Ontario) Neutrino Observatory, which was sensitive to all three species of neutrinos, found that while the electron-neutrino flux is indeed about 35% of the solar-model prediction (thereby confirming Davis' measurements), the *total* neutrino flux agrees well with the solar models! Clearly, some of the electron-neutrinos emitted by the Sun — indeed, about two-thirds of them — are metamorphosing into mu- or tau-neutrinos during their passage from the Sun to the Earth. This metamorphosis (or "neutrino oscillation") is not in fact a surprise, but is predicted by some elementary-particle models in which neutrinos have a small but nonzero mass (rather than being strictly massless as in the conventional Standard Model). So the solar-neutrino measurements have also given, for the first time, indirect but compelling evidence that neutrinos indeed have mass. For an excellent non-technical introduction to this problem and to plans for future research, see McDonald *et al.* (2003).

is no doubt that, in practice, this is what scientists themselves do when they don't work in the field, for lack of a better alternative. But the degree of certainty provided by this kind of investigation is very weak. Nevertheless, Latour seems to accord it a crucial role. He distinguishes between two "versions": according to the first, it is Nature that decides the outcome of controversies; according to the second, the power struggles between researchers play that role.

> It is crucial for us, laypeople who want to understand technoscience, to decide which version is right, because in the first version, as Nature is enough to settle all disputes, we have nothing to do since no matter how large the resources of the scientists are, they do not matter in the end – only Nature matters.... In the second version, however, we have a lot of work to do since, by analysing the allies and resources that settle a controversy we understand *everything* that there is to understand in technoscience. If the first version is correct, there is nothing for us to do apart from catching the most superficial aspects of science; if the second version is maintained, there is everything to understand except perhaps the most superfluous and flashy aspects of science. Given the stakes, the reader will realise why this problem should be tackled with caution. The whole book is in jeopardy here.[111]

Since "the whole book is in jeopardy here", let us look carefully at this passage. Latour says that if it is Nature that settles the controversies, the role of the sociologist is secondary, but if that is not the case, the sociologist can understand "*everything* that there is to understand in technoscience". How does he decide which version is the correct one? The answer appears in the subsequent text, where Latour distinguishes between the "cold parts of technoscience", for which "Nature is now taken as the cause of accurate descriptions of herself" (p. 100), and the active controversies, where Nature cannot be invoked:

> When studying controversy — as we have so far — we cannot be *less* relativist than the very scientists and engineers we accompany; they do not *use* Nature as the external referee, and we have no reason to imagine that we are more clever than they are.[112]

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[111] Latour (1987, p. 97), italics in the original.

[112] Latour (1987, p. 99), italics in the original.

In this quote and the previous one, Latour is playing constantly on the confusion between facts and our knowledge of them.[113] The correct answer to any scientific question, solved or not, depends on the state of Nature (for example, on the number of neutrinos that the Sun really emits). Now, it happens that, for the unsolved problems, nobody knows the right answer, while for the solved ones, we do know it (at least if the accepted solution is correct, which can always be challenged). But there is no reason to adopt a "relativist" attitude in one case and a "realist" one in the other. The difference between these attitudes is a philosophical matter, and is independent of whether the problem is solved or not. For the relativist, there is simply no unique correct answer, independent of all social and cultural circumstances; this holds for the closed questions as well as for the open ones. On the other hand, the scientists who seek the correct solution are not relativist, almost by definition. Of course they *do* "use Nature as the external referee": that is, they seek to know what is really happening in Nature, and they design experiments for that purpose.

Let us not, however, leave the impression that the Third Rule of Method is *only* a triviality or a gross error. We would like to give it one more interpretation (which is undoubtedly *not* Latour's own) that makes it at the same time interesting and correct. Let us read it as a methodological principle for a sociologist of science who does not himself have the scientific competence to make an independent assessment of whether the experimental/observational

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[113] An even more extreme example of this confusion appears in a recent article by Latour in *La Recherche*, a French monthly magazine devoted to the popularization of science (Latour 1998). Here Latour discusses what he interprets as the discovery in 1976, by French scientists working on the mummy of the pharaoh Ramses II, that his death (circa 1213 B.C.) was due to tuberculosis. Latour asks: "How could he pass away due to a bacillus discovered by Robert Koch in 1882?" Latour notes, correctly, that it would be an anachronism to assert that Ramses II was killed by machine-gun fire or died from the stress provoked by a stock-market crash. But then, Latour wonders, why isn't death from tuberculosis likewise an anachronism? He goes so far as to assert that "Before Koch, the bacillus has no real existence." He dismisses the common-sense notion that Koch *discovered* a pre-existing bacillus as "having only the appearance of common sense". Of course, in the rest of the article, Latour gives no argument to justify these radical claims and provides no genuine alternative to the common-sense answer. He simply stresses the obvious fact that, in order to discover the cause of Ramses' death, a sophisticated analysis in Parisian laboratories was needed. But unless Latour is putting forward the truly radical claim that *nothing* we discover *ever* existed prior to its "discovery" — in particular, that no murderer is a murderer, in the sense that he committed a crime *before* the police "discovered" him to be a murderer — he needs to explain what is special about bacilli, and this he has utterly failed to do. The result is that Latour is saying nothing clear, and the article oscillates between extreme banalities and blatant falsehoods.

data do in fact warrant the conclusions the scientific community has drawn from them.[114] In such a situation, the sociologist will be understandably reluctant to say that "the scientific community under study came to conclusion X because X is the way the world really is" — *even if it is in fact the case* that X is the way the world is and that is the reason the scientists came to believe it — because the sociologist has no independent *grounds to believe* that X is the way the world really is other than the fact that the scientific community under study came to believe it. Of course, the sensible conclusion to draw from this *cul de sac* is that sociologists of science who aim to explain the *content* of scientific theories ought not to study scientific controversies on which they lack the competence to make an independent assessment of the facts, if there is no other (for example, historically later) scientific community on which they could justifiably rely for such an independent assessment. But it goes without saying that Latour would not enjoy this conclusion.[115]

Here lies, in fact, the fundamental problem for the sociologist of "science in action". It is not enough to study the alliances or power relationships between scientists, important though they may be. What appears to a sociologist as a pure power game may in fact be motivated by perfectly rational considerations which, however, can be understood as such only through a detailed understanding of the scientific theories and experiments.

Of course, nothing prevents a sociologist from acquiring such an understanding — or from working in collaboration with scientists who already have it — but in none of his Rules of Method does Latour recommend that sociologists of science follow this route. Indeed, in the case of Einstein's relativity, we can show that Latour did not follow it himself.[116] This is understandable, because it is difficult to acquire the requisite knowledge, even for scientists working in a slightly different field. But nothing is gained by biting off more than one can chew.

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[114] The principle applies with particular force when such a sociologist is studying contemporary science, because in this case there is no other scientific community besides the one under study who could provide such an independent assessment. By contrast, for studies of the distant past, one can take advantage of what subsequent scientists learned, including the results from experiments going beyond those originally performed. See note 50 above.

[115] Nor would Steve Fuller, who asserts that "STS [Science and Technology Studies] practitioners employ methods that enable them to fathom both the 'inner workings' and the 'outer character' of science without having to be expert in the fields they study." (Fuller 1993, p. xii)

[116] See Sokal and Bricmont (1998, chapter 6).

Practical consequences

We don't want to give the impression that we are attacking only some esoteric philosophical doctrines or the methodology followed by one current in the sociology of science. In fact, our target is much wider. Relativism (as well as other postmodern ideas) has effects on the culture in general and on people's ways of thinking. Here are a few examples we have come across. We have no doubt that the reader will find many other examples in the culture sections of newspapers, in certain educational theories, or simply in day-to-day conversations.

1. Relativism and criminal investigations. We have applied various relativist arguments to criminal investigations in order to show that, since they are thoroughly unconvincing in that context, there is little reason to give them credence when applied to science. That is why the following excerpt is surprising, to say the least: taken literally, it expresses a rather strong form of relativism concerning precisely a criminal investigation. Here is the context: In 1996, Belgium was shaken by a series of kidnap-murders of children. In response to public outrage at the inept police work, a parliamentary commission was set up to examine the errors committed during the investigation. In a spectacular televised session, two witnesses — a policeman (Lesage) and a judge (Doutrèwe) — were confronted and questioned concerning the transmission of a key file. The policeman swore he had sent the file to the judge, while the judge denied having received it. The next day, an anthropologist of communication, Professor Yves Winkin of the University of Liège, was interviewed by one of the main Belgian newspapers (*Le Soir* of December 20, 1996):

> **Question:** The confrontation [between Lesage and Doutrèwe] was stimulated by an almost ultimate search for truth. Does truth exist?
>
> **Answer:** ... I think that all the work of the commission is based on a sort of presupposition that there exists, not *a* truth, but *the* truth — which, if one presses hard enough, will finally come out.
>
> However, anthropologically, there are only partial truths, shared by a larger or smaller number of people: a group, a family, a firm. There is no transcendent truth. Therefore, I don't think that judge Doutrèwe or officer Lesage are hiding anything: both are telling their truth.
>
> Truth is always linked to an organization, depending upon the elements that are perceived as important. It is not surprising that these two people,

> representing two very different professional universes, should each set forth a different truth. Having said that, I think that, in this context of public responsibility, the commission can only proceed as it does.

This answer illustrates, in a striking way, the confusions into which some sectors of the social sciences have fallen through their use of a relativist vocabulary. The dispute between the policeman and the judge concerns, after all, a material fact: the transmission of a file. (It is, of course, possible that the file was sent but got lost on the way; but this remains a well-defined factual question.) Without a doubt, the epistemological problem is complicated: how is the commission to find out what really happened? Nevertheless, there *is* a truth of the matter: either the file was sent or it wasn't. It is hard to see what is gained by redefining the word "truth" (whether or not it is "partial") to mean simply "a belief shared by a larger or smaller number of people".

In this text, one also finds the idea of "different universes". Little by little, some tendencies in the social sciences have atomized humankind into cultures and groups having their own conceptual universes — sometimes even their own "realities" — and virtually unable to communicate with one another.[117] But in this case it reaches a level bordering on the absurd: these two people speak the same language, live less than a hundred miles apart, and work in the criminal-justice system of a French-speaking Belgian community comprising barely four million people. Clearly, the problem does not arise from an inability to communicate: the policeman and the judge understand perfectly well what is being asked, and they most likely know the truth; quite simply, one of them has an interest in lying. But even if they are both telling the truth — i.e., the file was sent but got lost in transit, which is logically possible though unlikely — it makes no sense to say that "both are telling *their* truth". Fortunately, when it comes down to practical considerations, the anthropologist admits that the commission "can only proceed as it does", that is, seek *the* truth. But what incredible confusions before getting there.

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[117] The so-called Sapir–Whorf thesis in linguistics — that is, *grosso modo*, the idea that our native language radically conditions our view of the world — appears to have played an important role in this evolution. This thesis is nowadays sharply criticized by some linguists: see, for example, Pinker (1995, pp. 57–67). Note also that Feyerabend, in his autobiography (1995, pp. 151–152), disowned the radical-relativist use of the Sapir–Whorf thesis that he had made in *Against Method* (Feyerabend 1975, chapter 17).

2. Relativism and education. In a book written for high-school teachers, whose goal is to explain "some notions of epistemology"[118], one finds the following definition:

> **Fact**
>
> What one generally calls a fact is an interpretation of a situation that no one, at least for the moment, wants to call into question. It should be remembered that, as the common language says, a fact becomes established, which illustrates well that we're talking about a theoretical model that one claims is appropriate.
>
> Example: The assertions "The computer is on the desk" or "If one boils water, it evaporates" are considered to be factual propositions in the sense that no one wants to contest them at this moment in time. They are statements of theoretical interpretations that no one questions.
>
> To assert that a proposition states a fact (that is, has the status of a factual or empirical proposition) is to claim that there is hardly any controversy about this interpretation at the moment one is speaking. But a fact can be put into question.
>
> Example: For many centuries, it was considered to be a fact that the Sun revolves each day around the Earth. The appearance of another theory, such as that of the diurnal rotation of the Earth, entailed the replacement of the fact just cited by another: "The Earth rotates on its axis each day."[119]

This confuses facts with *assertions* of fact.[120] For us, as for most people, a "fact" is a situation in the external world that exists irrespective of the knowledge we have (or don't have) of it — in particular, irrespective of any consensus or interpretation. Thus, it makes sense to say there are facts of which we are ignorant (Shakespeare's exact birth date, or the number of neutrinos emitted per second by the Sun). And there is a world of difference between saying that X killed Y and saying that no one, for the moment, wants to dispute this assertion (e.g., because X is black and everyone else is racist, or because biased news media successfully make people think that X killed Y). When it comes to a concrete example, the authors backtrack:

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[118] The book's senior author is Gérard Fourez, a philosopher of science who is very influential (at least in Belgium) in pedagogical matters, and whose book *La Construction des sciences* (1992) has been translated into several languages.

[119] Fourez *et al.* (1997, pp. 76–77).

[120] Note that this appears in a text that is supposed to *enlighten* high-school teachers.

they say that the Sun's revolution around the Earth was *considered to be* a fact, which amounts to admitting the distinction we are stressing (i.e., it was not *really* a fact). But in the next sentence they fall back into confusion: one fact has been replaced by another. Taken literally, in the *usual* sense of the word "fact", this would mean that the Earth has rotated on its axis only since Copernicus. But, of course, all the authors really mean is that people's beliefs changed. Then why not say so, rather than confusing facts with (consensus) beliefs by using the same word to denote both concepts?[121]

A side benefit of the authors' non-standard notion of "fact" is that one can never be wrong (at least when asserting the same things as the people around us). A theory is never wrong in the sense that it is contradicted by the facts; rather, the facts change when the theories change.

Most importantly, it seems to us that a pedagogy based on this notion of "fact" is antithetical to encouraging a critical spirit in the student. In order to challenge prevailing assumptions — other people's as well as our own — it is essential to keep in mind that one *can* be wrong: that there exist facts independent of our claims, and that it is by comparison with these facts (to the extent we can ascertain them) that our claims have to be evaluated. When all is said and done, Fourez's redefinition of "fact" has — as Bertrand Russell noted in a similar context — all the advantages of theft over honest toil.[122]

3. Relativism in the Third World. Unfortunately, postmodern ideas are not confined to European philosophy departments or American literature

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[121] Or, worse, minimizing the importance of facts, not by giving any argument, but simply by ignoring them in favor of consensus beliefs. Indeed, the definitions in this book *systematically* conflate facts, information, objectivity and rationality with — or reduce them to — intersubjective agreement. Moreover, a similar pattern is found in Fourez's *La Construction des sciences* (1992). For example (p. 37): "To be 'objective' means to follow instituted rules.... Being 'objective' is not the opposite of being 'subjective': rather, it is to be subjective in a certain way. But it is not to be individually subjective since one will follow socially instituted rules ...". This is highly misleading: following rules does not ensure objectivity in the usual sense (people who blindly repeat religious or political slogans certainly follow "socially instituted rules", but they can hardly be called objective) and people can be objective while breaking many rules (e.g. Galileo).

[122] Note also that defining "fact" as "there is hardly any controversy ..." runs into a logical problem: Is the absence of controversy itself a fact? And if so, how to define it? By the absence of controversy about the assertion that there is no controversy? Obviously, Fourez and his colleagues are using in the social sciences a naively realist epistemology that they implicitly reject for the natural sciences. See p. 201 above for an analogous inconsistency in Feyerabend.

departments. It seems to us that they do they most harm in the Third World, where the majority of the world's population lives and where the supposedly "passé" work of the Enlightenment is far from complete.

Meera Nanda, an Indian biochemist who used to work in the "Science for the People" movements in India and who is now a philosopher-sociologist of science, tells the following story about the traditional Vedic superstitions governing the construction of sacred buildings, which aim at maximizing "positive energy". An Indian politician, who found himself in hot water, was advised that

> his troubles would vanish if he entered his office from an east-facing gate. But on the east side of his office there was a slum through which his car could not pass. [So he] ordered the slum to be demolished.[123]

Nanda observes, quite rightly, that

> If the Indian left were as active in the people's science movement as it used to be, it would have led an agitation not only against the demolition of people's homes, but also against the superstition that was used to justify it.... A left movement that was not so busy establishing "respect" for non-Western knowledge would never have allowed the power-wielders to hide behind indigenous "experts."
>
> I tried out this case on my social constructionist friends here in the United States.... [They told me] that seeing the two culturally bound descriptions of space[124] at par with each other is progressive in itself, for then *neither* can claim to know the absolute truth, and thus tradition will lose its hold on people's minds.[125]

The problem with this kind of answer is that practical choices have to be made — what type of medicine to use, or in which direction to orient buildings — and at this point theoretical nonchalance becomes untenable. As a result, intellectuals easily fall into the hypocrisy of using "Western" science when it is essential — for example, when they are *seriously* ill — while urging the common people to put their faith in superstitions.

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[123] Nanda (1997, p. 82).

[124] That is, the scientific view and the one based on traditional Vedic ideas. [Note added by us]

[125] Nanda (1997, p. 82).

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7

Defense of a modest scientific realism*

Let us begin by distinguishing *two* levels of debate about scientific knowledge: one crude, the other subtle. The crude debate pits scientific objectivists of all kinds — be they realists, pragmatists or of some other stripe — against postmodernists, relativists and radical social constructivists. The subtle debate pits scientific realists against objectivist anti-realists of various kinds (pragmatists, verificationists, instrumentalists, etc.).

This chapter is intended as a (small) contribution to both debates. We want, of course, to defend the notion of science as a cognitive endeavor seeking (and sometimes finding) objective knowledge — in some sense or other — about the external world. And we want to defend a *modest realism*: one which insists that the goal of science is to find out how things really are and which asserts we are making progress in that direction, but which recognizes that this goal will always be incompletely achieved and which is aware of the principal obstacles.[1]

The crude debate would perhaps not be worth bothering with at all, were it not for the fact that relativism and radical social constructivism have become hegemonic in vast areas of the humanities, anthropology and sociology of science (among other fields). In many intellectual circles nowadays, it is simply taken for granted that all facts are "socially constructed", scientific theories are mere "myths" or "narrations", scientific debates are resolved by "rhetoric" and "enlisting allies", and truth is a synonym for intersubjective

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[1] For related arguments, see Nagel (1997), Haack (1998), Kitcher (1998), Maxwell (1998) and Brown (2001).

agreement. If all this seems an overstatement, consider the following assertions by prominent Science Studies practitioners:

> [T]he validity of theoretical propositions in the sciences is in no way affected by factual evidence.[2]
>
> The natural world has a small or non-existent role in the construction of scientific knowledge.[3]
>
> Since the settlement of a controversy is the *cause* of Nature's representation, not the consequence, we can never use the outcome — Nature — to explain how and why a controversy has been settled.[4]
>
> For the relativist [such as ourselves] there is no sense attached to the idea that some standards or beliefs are really rational as distinct from merely locally accepted as such.[5]
>
> Science legitimates itself by linking its discoveries with power, a connection which *determines* (not merely influences) what counts as reliable knowledge ... [6]

Over the last four years, we have participated in numerous debates with sociologists, anthropologists, psychologists, psychoanalysts and philosophers. Although the reactions were extremely diverse, we have repeatedly met people who think that assertions of fact about the natural world can be true "in our culture" and yet be false in some other culture.[7] We have met people who systematically confuse facts and values, truths and beliefs, the world and our knowledge of it. Moreover, when challenged, they will consistently

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[2] Gergen (1988, p. 37).

[3] Collins (1981, p. 3). Two qualifications need to be made: First, this statement is offered as part of Collins' introduction to a set of studies (edited by him) employing the relativist approach, and constitutes his summary of that approach; he does not *explicitly* endorse this view, though an endorsement seems implied by the context. Second, while Collins appears to intend this assertion as an empirical claim about the history of science, it is possible that he intends it neither as an empirical claim nor as a normative principle of epistemology, but rather as a methodological injunction to sociologists of science: namely, to act *as if* "the natural world ha[d] a small or non-existent role in the construction of scientific knowledge", or in other words to *ignore* ("bracket") whatever role the natural world may in fact play in the construction of scientific knowledge. We have argued elsewhere (Bricmont and Sokal 2001, 2004) that this approach is seriously deficient *as methodology* for sociologists of science.

[4] Latour (1987, pp. 99, 258), emphasis in the original. See Chapter 6 above for a detailed discussion.

[5] Barnes and Bloor (1981, p. 27), clarification added by us.

[6] Aronowitz (1988, p. 204), emphasis in the original.

[7] For an example involving the origins of Native American populations, see Chapter 3 above (pp. 108–110) and Boghossian (1996).

deny that such distinctions make sense. Some will claim that witches are as real as atoms, or pretend to have no idea whether the Earth is flat, blood circulates or the Crusades really took place. Note that these people are otherwise reasonable researchers or university professors. All this indicates the existence of a radically relativist academic Zeitgeist, which is weird.[8] To be sure, these are oral statements made in seminars or private discussion, and oral statements usually tend to be more radical than written ones. But the published written assertions quoted in the preceding paragraph are already quite weird.[9]

If one inquires about the justifications for these surprising views, one is invariably led to the "usual suspects": the writings of Kuhn, Feyerabend and Rorty; the underdetermination of theories by data; the theory-ladenness of observation; some writings of (the later) Wittgenstein; the "strong programme" in the sociology of science.[10] Of course, the latter authors do not usually make the most radical claims that we have heard. Rather, what typically happens is that they make ambiguous or confused statements that are then interpreted by others in a radically relativist fashion. Therefore, one of our goals here will be to disentangle various confusions caused by fashionable ideas in the contemporary philosophy of science. Roughly speaking, we will argue that those ideas contain a kernel of truth that can be understood properly when those ideas are carefully formulated; but then they give no support to radical relativism.

A far more subtle debate in the philosophy of science concerns the relative merits of realism and instrumentalism (or pragmatism).[11] Roughly speaking, realism holds that the goal of science is to find out how the world really is, while instrumentalism holds that this goal is an illusion and that science should aim at empirical adequacy. We will address this debate in detail in a moment; for now we simply want to emphasize how it is *not* relevant for the crude debate. Relativists sometimes tend to fall back on instrumentalist positions when challenged, but in reality there is a profound difference between

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[8] We emphasize that we have no idea how widespread these extreme positions are. But their mere existence is weird enough.

[9] For extremely weird written statements, see also the discussion by Latour of the causes of the death of the pharaoh Ramses II (Latour 1998); and for a critique, see footnote 113 in Chapter 6 above.

[10] In this chapter we will be restricting our attention to epistemological questions; we will not be addressing the sociology of science, its tasks or its methodologies. See Bricmont and Sokal (2001, 2004) for a critique of the methodological relativism embodied in the strong programme.

[11] For a variety of views, see e.g. Leplin (1984).

the two attitudes.[12] Instrumentalists may want to claim either that we have no way of knowing whether "unobservable" theoretical entities really exist, or that their meaning is defined solely through measurable quantities; but this does not imply that they regard such entities as "subjective" in the sense that their meaning would be significantly influenced by extra-scientific factors (such as the personality of the individual scientist or the social characteristics of the group to which she belongs). Indeed, instrumentalists may regard our scientific theories as, quite simply, the most satisfactory way that the human mind, with its inherent biological limitations, is capable of understanding the world.

This chapter is organized as follows: We shall begin by examining some basic epistemological problems (notably the underdetermination of theory by evidence) and discuss the problems faced by both realism and instrumentalism. We shall also offer some brief comments on radical relativism and radical redefinitions of truth. Finally, we shall sketch what seems to us to be a defensible *modest realism*, and point out its relation with the picture of the world provided by the renormalization group in physics.

Some Basic Epistemological Problems

Solipsism and radical skepticism

Before discussing some serious issues in the philosophy of science, we need to clear out of the way some old red herrings. The first point that should be non-controversial is that solipsism (the idea that there is nothing in the world except my sensations) and radical skepticism (that no reliable knowledge of the world can ever be obtained) cannot be refuted. It is doubtful whether anyone really believes those doctrines — at least when crossing a city street — but their irrefutability is nevertheless an important philosophical observation. Since the arguments are standard and go back at least to Hume, we need not repeat them here.[13] Unfortunately, many of the arguments

[12] This point is also made clearly by Brown (2001, chapter 5).

[13] Of course, many philosophers both before and after Hume have attempted to refute solipsism and radical skepticism. In the (unlikely) event that some such attempt were to succeed convincingly, our arguments against relativism and in favor of scientific realism would only be strengthened. We are indebted to Mühlhölzer (2004, p. 50) for drawing this issue to our attention.

adduced in favor of relativist ideas are, in reality, banal reformulations of radical skepticism but applied in unjustifiably selective ways.[14,15]

Realism and its discontents

In the same way that nearly everyone in his or her everyday life disregards solipsism and radical skepticism and spontaneously adopts a "realist" or "objectivist" attitude toward the external world, scientists spontaneously do likewise in their professional work. Indeed, scientists rarely use the word "realist", because it is taken for granted: *of course* they want to discover (some aspects of) how the world really is! And *of course* they adhere to a "correspondence" notion of truth (again, a word that is barely used): if a biologist asserts it is true that a given disease is caused by a given virus, she means that, in actual fact, the disease is caused by the virus.[16,17] Of course, much preliminary discussion may be required, in any given case, to clarify the *meaning* of the terms used in the assertion; but once the meaning of the statement has been clarified to the point that what is being asserted is (sufficiently) unambiguous, the statement's truth value is determined solely by the extent to which the assertion does or does not correspond to reality.

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[14] As Philip Kitcher (1998, p. 40) notes,

> some practitioners [of Science Studies] effectively demand a response to the global skeptical challenge for entities they don't like (the ontologies of the sciences) and then proceed to talk quite casually and commonsensically about things they do like (people, societies, human motives).

Kitcher then rubs salt into the wound by observing astutely that "there is a name for this kind of inconsistency; it is *privileging*".

[15] Another favorite tactic employed by relativists is to conflate facts and our knowledge of them, not by giving any argument, but simply by using ambiguous terminology. See Chapter 6 above for examples in the works of Kuhn, Barnes–Bloor, Latour and Fourez.

[16] This interpretation of the word "true" is, in our view, quite simply a *precondition for the intelligibility* of people's assertions about the world.

[17] Let us stress that we are here using the term "correspondence notion of truth" in a broad sense; we do *not* intend to enter into the philosophical debate between "correspondence theories of truth" (understood in the narrow sense) and "deflationary theories of truth" (see e.g. Devitt 1997, chapter 3). Our main concerns in this chapter are ontological and epistemological, not semantic; both correspondence and deflationary theories are (insofar as we can understand them) compatible with our vision of scientific realism. Our principal aim is, rather, to distinguish the notion of truth as "correspondence with reality", broadly understood, from epistemic notions (e.g. warranted assertability, verification) and pragmatic/relativistic notions (e.g. utility, intersubjective agreement).

Please note that by adopting this notion of truth[18], we are not yet making any claim about how one *obtains evidence* concerning the truth or falsity of a given statement, or even about whether that is possible. These are separate questions: one thing is to pose a problem clearly, the other is to solve it. Consider, for example, the statement "William Shakespeare was born on April 23, 1564". No one today knows for sure whether this statement is true or false[19], and no one has yet found a method for obtaining definitive evidence one way or the other. Nevertheless, this statement *is* either true or false (once one clarifies, for example, that it is to be interpreted relative to the Julian calendar); and its truth or falsity depends only on the facts of Shakespeare's birth (and not, for example, on the beliefs or other characteristics of some individual or social group).

So, how *does* one obtain evidence concerning the truth or falsity of scientific assertions? By the same imperfect methods that we use to obtain evidence about empirical assertions generally. Modern science, in our view, is nothing more or less than the deepest (to date) refinement of the rational attitude toward investigating *any* question about the world, be it atomic spectra, the etiology of smallpox, or the London bus routes. Historians, detectives and plumbers — indeed, all human beings — use the same basic methods of induction, deduction and assessment of evidence as do physicists or biochemists.[20] Modern science tries to carry out these operations in a more careful and systematic way, by using controls and statistical tests, insisting on replication, and so forth. Moreover, scientific measurements are often much more precise than everyday observations; they allow us to discover hitherto unknown phenomena; and scientific theories often conflict with "common sense". But the conflict is at the level of conclusions, not the basic approach. As Susan Haack lucidly observes:

> Our standards of what constitutes good, honest, thorough inquiry and what constitutes good, strong, supportive evidence are not internal to science. In judging where science has succeeded and where it has failed, in what areas and at what times it has done better and in what worse, we

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[18] Or rather, simply *acknowledging* that this is how the word "true" is universally used by fluent speakers of the English language (except for a few philosophers to be discussed below).

[19] The parish register of Holy Trinity Church in Stratford-upon-Avon states that Shakespeare was baptized there on April 26, 1564. But his exact birth date is unknown.

[20] The allusion to historians and detectives was employed independently (and prior to us) by Haack (1993, p. 137): "there is no reason to think that [science] is in possession of a special method of inquiry unavailable to historians, detectives, and the rest of us". See also Haack (1998, pp. 96–97).

> are appealing to the standards by which we judge the solidity of empirical beliefs, or the rigor and thoroughness of empirical inquiry, generally.[21]

Scientists' spontaneous epistemology — the one that animates their work, regardless of what they may say when philosophizing — is thus a rough-and-ready *realism*: the goal of science is to discover (some aspects of) how things really are. More precisely,

1. The aim of science is to give a true (or approximately true) description of reality.

This goal is realizable, because:

2. Scientific theories are either true or false. Their truth (or falsity) is literal, not metaphorical; it does not depend in any way on us, or on how we test those theories, or on the structure of our minds, or on the society within which we live, and so on.
3. It is possible to have evidence for the truth (or falsity) of a theory. (It remains possible, however, that all the evidence supports some theory T, yet T is false.)[22]

The most powerful objections to the viability of scientific realism consist in various theses showing that theories are underdetermined by data.[23] In its most common formulation, the underdetermination thesis says that, for any finite (or even infinite) set of data, there are infinitely many mutually incompatible theories that are "compatible" with those data. This thesis, if not properly understood[24], can easily lead to radical conclusions. The biologist who believes that a disease is caused by a virus presumably does so on the basis of some "evidence" or some "data". Saying that a disease is caused by a virus presumably counts as a "theory" (e.g. it involves, implicitly, many counterfactual statements). But if there are really infinitely many distinct theories that are compatible with those "data", then we may legitimately wonder on what basis one can rationally choose between those theories.

In order to clarify the situation, it is important to understand how the underdetermination thesis is established; then its meaning and its limitations

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[21] Haack (1998, p. 94).

[22] This brief definition of realism is due to Brown (2001, p. 96).

[23] Often called the Duhem–Quine thesis. In what follows, we will refer to Quine's version (Quine 1980), which is much more radical than Duhem's. See also Chapter 6 above (pp. 189–190) for further discussion.

[24] Particularly concerning the meaning of the word "compatible". See Laudan (1990) for a more detailed discussion.

become much clearer. Here are some examples of how underdetermination works; one may claim that:

– The past did not exist: the universe was created five minutes ago along with all the documents and all our memories referring to the alleged past in their present state. Alternatively, it could have been created 100 or 1000 years ago.

– The stars do not exist: instead, there are spots on a distant sky that emit exactly the same signals as those we receive.

– All criminals ever put in jail were innocent. For each alleged criminal, explain away all testimony by a deliberate desire to harm the accused; declare that all evidence was fabricated by the police and that all confessions were obtained by force.[25]

Of course, all these "theses" may have to be elaborated, but the basic idea is clear: given any set of facts, just make up a story, no matter how *ad hoc*, to "account" for the facts without running into contradictions.[26]

It is important to realize that this is all there is to the general (Quinean) underdetermination thesis. Moreover, this thesis, although it played an important role in the refutation of the most extreme versions of logical positivism, is not very different from the observation that radical skepticism or even solipsism cannot be refuted: all our knowledge about the world is based on some sort of inference from the observed to the unobserved, and no such inference can be justified by deductive logic alone. However, it is clear that, in practice, nobody ever takes seriously such "theories" as those mentioned above, any more than they take seriously solipsism or radical skepticism. Let us call these "crazy theories"[27] (of course, it is not easy to say exactly what it means for a theory to be non-crazy). Note that these theories require no work: they can be formulated entirely *a priori*. On the other hand, the difficult problem, given some set of data, is to find even one non-crazy theory that accounts for them. Consider, for example, a police investigation about some crime: it is easy enough to invent a story that "accounts for the facts" in an *ad hoc* fashion (sometimes lawyers do just that); what is hard is to discover who really committed the crime and to obtain evidence demonstrating that

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[25] Of course, this latter situation, unlike the previous two, *does* occur frequently enough. But its occurrence or not depends on the particular case, while the underdetermination thesis is a *general* principle meant to apply to *all* cases.

[26] In the famous paper in which Quine sets forth the modern version of the underdetermination thesis, he even allows himself to change the meanings of words and the rules of logic, in order to show that any statement can be held true, "come what may" (Quine 1980, p. 43).

[27] Or, as the physicist David Mermin calls them, "Duhem–Quine monstrosities" (Mermin 1998).

beyond a reasonable doubt. Reflecting on this elementary example clarifies the meaning of the underdetermination thesis. Despite the existence of innumerable "crazy theories" concerning any given crime, it sometimes happens in practice that there is a unique theory (i.e. a unique story about who committed the crime and how) that is *plausible* and compatible with the known facts; in that case, one will say that the criminal has been discovered (with a high degree of confidence, albeit not with certainty). It may also happen that no plausible theory is found, or that we are unable to decide which one among several suspects is really guilty: in these cases, the underdetermination is real.[28]

One might next ask whether there exist more subtle forms of underdetermination than the one revealed by a Duhem–Quine type of argument. In order to analyze this question, let us consider the example of classical electromagnetism. This is a theory that describes how particles possessing a quantifiable property called "electric charge" produce "electromagnetic fields" that "propagate in vacuum" in a certain precise fashion and then "guide" the motion of charged particles when they encounter them.[29] Of

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[28] Closely related to undetermination is the problem of the theory-ladenness of observation (see pp. 185–187 above for an elementary introduction), which is often cited by relativists as providing grist for their mill. But it actually does nothing of the kind. Thomas Nagel offers an instructive example:

> Suppose I have the theory that a diet of hot fudge sundaes will enable me to lose a pound a day. If I eat only hot fudge sundaes and weigh myself every morning, my interpretation of the numbers on the scale is certainly dependent on a theory of mechanics that explains how the scale will respond when objects of different weights are placed on it. But it is not dependent on my dietary theories. If I concluded from the fact that the numbers keep getting higher that my intake of ice cream must be altering the laws of mechanics in my bathroom, it would be philosophical idiocy to defend the inference by appealing to Quine's dictum that all our statements about the external world face the tribunal of experience as a corporate body, rather than one by one. Certain revisions in response to the evidence are reasonable; others are pathological. (Nagel 1998, p. 35)

Though Quine's insistence that "any statement can be held true come what may" (Quine 1980, p. 43) can be read as an apologia for radical relativism, his discussion (pp. 43–44) suggests that this is *not* his intention, and that he agrees with Nagel that certain modifications of our belief systems in the face of "recalcitrant experiences" are much more reasonable than others. Moreover, in the foreword to the 1980 edition of his book, Quine backtracked from his earlier assertion that "the unit of empirical significance is the whole of science" (p. 42), and said (correctly in our view) that "empirical content is shared by the statements of science in clusters and cannot for the most part be sorted out among them. Practically the relevant cluster is indeed never the whole of science" (p. viii).

[29] We are referring here to Maxwell's equations describing how fields are produced by charges and how they propagate, and to the Lorentz force describing how the fields "guide" the particles.

course, no one ever "sees" directly an electromagnetic field or an electric charge. So, should one interpret this theory "realistically", and if so, what should it be taken to mean?

Classical electromagnetic theory is immensely well supported by precise experiments and forms the basis for a large part of modern technology. It is "confirmed" every time one of us switches on his or her computer and finds that it works as designed.[30] Does this overwhelming empirical support imply that there are "really" electric and magnetic fields propagating in vacuum? In support of the idea that there are, one could argue that electromagnetic theory postulates the existence of those fields and that there is no known non-crazy theory that accounts equally well for the same data; therefore it is reasonable to believe that electric and magnetic fields *really* exist.

But is it in fact true that there are no alternative non-crazy theories? Here is one possibility: Let us claim that there are no fields propagating "in vacuum", but that, rather, there are only "forces" acting directly between charged particles.[31] Of course, in order to preserve the empirical adequacy of the theory, one has to use exactly the same Maxwell–Lorentz system of equations as before (or a mathematically equivalent system). But one may interpret the fields as a mere "calculational device" allowing us to compute more easily the net effect of the "real" forces acting between charged particles.[32] Almost every physicist reading these lines will say that this is some kind of metaphysics or maybe even a play on words — that this "alternative theory" is really just standard electromagnetic theory in disguise. Now, although the precise meaning of "metaphysics" is hard to pin down[33], there is a vague sense in which, if we use exactly the same equations (or a mathematically equivalent set of equations) and make exactly the same predictions in the two theories, then they are really the *same* theory as far as "physics" is

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[30] When it fails to work as designed, this is, as all physicists know, the fault of the engineers and computer programmers.

[31] Since electromagnetic fields propagate at a finite speed, the forces introduced here, unlike those in Newtonian mechanics, would have to act in a non-instantaneous (i.e. delayed) manner.

[32] This attitude is reminiscent of that of Galileo's adversary Cardinal Bellarmino, who was willing to accept the Copernican system as a "calculational device" for predicting the motions of the planets; he was even willing to concede — though it was not then true, and only became true 50 years later with the development of Newtonian mechanics — the superior empirical adequacy of the Copernican system over the Ptolemaic system. He merely insisted that the Earth does not *really* move around the Sun.

[33] During the 1950s, Bertrand Russell observed: "The accusation of metaphysics has become in philosophy something like being a security risk in the public service.... The only definition I have found that fits all cases is: 'a philosophical opinion not held by the present author'." (Russell 1995 [1959], p. 164)

concerned, and the distinction between the two — if any — lies outside of its scope.

The same kind of observation can be made about most physical theories: In classical mechanics, are there really forces acting on particles, or are the particles instead following trajectories defined by variational principles? In general relativity, is space-time really curved, or are there, rather, fields that cause particles to move *as if* space-time were curved?[34] Let us call this kind of underdetermination "genuine", as opposed to the "crazy" underdeterminations of the usual Duhem–Quine thesis. By "genuine", we do not mean that these underdeterminations are necessarily worth losing sleep over, but simply that there is no rational way to choose (at least on empirical grounds alone) between the alternative theories — if indeed they should be regarded as different theories.

It is important to note the difference between the ways that the two kinds of underdetermination are established: the first can be established by pure reasoning, while the second depends (at least in part) on the concrete form of specific scientific theories. In fact, it is certainly an interesting (and very difficult) problem for philosophers of science to describe as precisely as possible, for a given scientific theory, the various inequivalent but natural "metaphysics" that can be associated with it.

But this is not yet the end of the story. There is another, much more serious, alternative to classical electromagnetism: namely, quantum electromagnetism (otherwise known as quantum electrodynamics, or QED for short). Indeed, QED has superseded classical electromagnetism as a fundamental description of reality; we now think of classical electromagnetism as being some kind of approximation to QED, valid for a more-or-less well-defined class of phenomena where quantum effects are negligible. This situation leaves some hope for the realist: it could be that the more fundamental theory (here QED) allows only one "natural" set of unobservable entities, whose

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[34] Poincaré much emphasized this type of "underdetermination": for instance, he stressed the fact that we cannot know whether the Earth "really" rotates (Poincaré 1904). Indeed, one can always choose a reference system in which the Earth is at rest and nonrotating. But it has to be realized that, if one makes such a choice, one must consider as "real" the inertial forces (e.g. the centrifugal and Coriolis forces) that "act" on distant stars and make them move faster than the speed of light. It is interesting to note that, when Poincaré made this proposition, it was interpreted by clerical forces (at the beginning of the twentieth century!) as vindicating the condemnation of Galileo by the Church (see Mawhin 1996 for a detailed historical discussion). But this attitude shows a deep misunderstanding. For the Church, the Earth was at rest in a much more absolute sense than the one suggested by Poincaré. In fact, Poincaré's viewpoint makes sense only within a framework (that of classical mechanics) created by Galileo, Newton and their successors.

existence would therefore be vindicated by the empirical successes of the theory. That may actually be the case, but it is not very likely: the deeper we probe into the nature of things, the *stranger* they tend to look.[35] Even in non-relativistic quantum mechanics, the status of "unobservable" entities, such as the wave function, is far from clear; and although it is risky to predict the future, it seems unlikely that a deeper theory, even an ultimate one, would have a unique interpretation in terms of unobservable entities.

There is a further problem for realism, and that is the problem of meaning. Before asking whether electromagnetic fields really exist, one might ask: What does the term "electromagnetic field" mean? A mathematical expression? But what does it mean for such an expression to exist in the physical world? Trying to answer that question immediately raises other questions about the status of mathematical objects, and about the correspondence between mathematical objects and the physical world.

Instrumentalism

The difficulties encountered by a hard-headed realist approach to science — and in particular to fundamental physics — suggest the adoption of a more modest attitude. Perhaps we should renounce the effort to describe the world "as it really is", and be content with seeking theories that are empirically adequate (and logically consistent, simple, etc.).

One example of the pragmatic attitude taken to absurd extremes is provided in a recent posting to the discussion group Scipolicy-L. The author is happy to defend science from postmodernist "deconstructions", provided only that scientists would refrain from making unjustified "metaphysical" assertions:

> The claim that laws of physics operate anywhere except in physics experiments ... seems to me *metaphysical* in the bad sense ...
>
> [T]he non-metaphysical interpretation of the laws of physics goes something like: Whenever we, as physicists, conduct such-and-such kind of experiment, the outcome we experience is such-and-such ...
>
> What the philosopher/hermeneuticist *should* try to convince scientists (and everyone else) of is that the laws of physics apply *only* to the domain of experimentation and the activity of physicists ...[36]

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[35] That is not surprising: the deeper we probe into the nature of things, the farther we stray from the intuitions about macroscopic objects (and about human psychology, etc.) that were sculpted into our brains by natural selection.

[36] Brad McCormick, posting to Scipolicy-L@yahoogroups.com, May 22, 2001, emphases in the original.

But if the laws of physics, inferred from laboratory experiments, have no validity outside the laboratory, why on earth would anyone bother doing those experiments in the first place? Experiments are not, after all, an end in themselves, like football or chess; they are, rather, a means to a higher end, namely obtaining information about the *universal* properties of the natural world. It is a far-from-obvious insight — hard won over the last 400 years — that systematic and controlled experimentation can yield knowledge about the world that would be difficult or impossible to extract from passive observation. And if Maxwell's equations hold only in physicists' labs, how can one plausibly *explain* (in a way that does not merely take it for granted) the transmission of this anti-metaphysical missive from the author's keyboard to the readers' screens?

Most self-described anti-realist philosophers of science would not, of course, go so far. They do not question that physics works outside the laboratory as well as inside; they only insist on a more modest interpretation of the claim that physics "works". Let us abandon "metaphysical" claims, they say, and stick to empirical adequacy. In particular, given the difficulties of realism in making precise the status of "unobservable" entities such as forces, fields and curved space-time, let us forget completely about those "metaphysical" entities, and formulate our physical theories solely in terms of observable quantities, since those are the only ones to which we have access anyway. Or alternatively, let us consider those entities to be mere "calculational devices" — convenient fictions — to which we must avoid attributing any physical reality. This cluster of related (but not identical) positions is often called *instrumentalism* (or *operationalism*). Various versions of this doctrine have been championed by Pierre Duhem, Ernst Mach and the logical positivists of the Vienna Circle (among others) and were widely accepted (in words if not necessarily in deeds) by physicists in the period circa 1890–1970.[37]

But this position also encounters severe difficulties. The first problem is that the notion of something being "observable" is far from clear. Some observations are indeed made with our unaided senses, but should one limit oneself to those? Can one use eyeglasses, magnifying glasses, telescopes or microscopes without feeling obliged to translate the results back into "pure" sense data? What about infrared cameras, electron microscopes and gamma-ray telescopes? Radar and sonar?[38] And even observations made with our

[37] See Weinberg (1992, pp. 174–184) for an insightful discussion.

[38] Perhaps bat instrumentalists are entitled to use sonar but not optical data, while for human instrumentalists it is the reverse.

unaided senses are more problematic than they appear at first. For example, when I "see" a glass on the table in front of me, I do not really see the glass: rather, my eye absorbs the electromagnetic waves reflected from the glass, and my brain *infers* the existence and position of a material object (along with some of its properties such as shape, size and color). This type of inference is not, in the end, so different from the more explicit inferences from "data" to "theory" made by scientists.[39]

The second, deeper problem with instrumentalism is that the meaning of the words used by scientists goes far beyond what is "observable". To take a simple example, should paleontologists be allowed to speak about dinosaurs? Presumably yes. But in what sense are dinosaurs "observable"? After all, everything we know about them is inferred from fossil data; only the fossils are "observed". These inferences are not, of course, arbitrary: they can be justified by evidence from biology (that all bones were once part of organisms) and geology (concerning the processes that transform bones into fossils). The point is, simply, that fossil evidence is evidence for the existence of *something other than itself*: namely, the fossils of dinosaur bones are evidence for the existence (at some time in the past) of dinosaurs. And the meaning of the word "dinosaur" is not easily expressible in a language that would refer only to fossils.[40]

Some instrumentalist philosophers of science are prepared to classify dinosaurs as "observable" on the grounds that, though *we* cannot observe them, they *would have been* observable to human beings had the the human species existed 100 million years ago. Now, anyone is free to define the word "observable" however he wishes; but there is no guarantee that the word, so defined, has any epistemological significance. In reality, neither dinosaurs nor electrons are ever observed directly; both are inferred from other observations, and the arguments supporting these two inferences are of comparable strength. It seems to us that, either one allows such inferences and accepts the probable reality (in some sense or other) of both dinosaurs and electrons, or else one rejects all such inferences and refuses to talk about either.[41] To be sure, the *meaning* of "electron" is far murkier than that

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[39] This line of argument was developed by Maxwell (1962).

[40] For example, assertions about dinosaurs' eating habits would have to be rephrased as assertions concerning the spatial correlation of certain types of fossils with certain other types of fossils. This seems unhelpful, to put it mildly.

[41] Jim Brown (private communication) has made the important point that even statements about "observable" phenomena are often inferred, and that

> Sometimes observation statements that are inferred are more convincing than when directly experienced. I recall reading a funny example from Clarence Darrow [the famous American populist lawyer]. He was defending a union that had been attacked

of "dinosaur": since we can form mental pictures of mid-size objects like dinosaurs, the meaning of the words referring to them is reasonably clear intuitively even if the objects are never directly observed, which is not necessarily the case for entities like electrons. That is why we are careful to assert only that electrons exist "in some sense or other", while admitting frankly our perplexity about what electrons *really* are.[42,43]

Finally, and most importantly, when a theory repeatedly makes *surprising* predictions (particularly of *novel* phenomena) that are subsequently confirmed, this is powerful evidence that the theory is "on the right track", i.e. that it is at least approximately correct and that its "unobservable" theoretical entities really do exist in some sense or other. For how else could one explain such "miraculous" predictions? If scientific theories were merely simple, logically coherent summaries of the existing empirical data, one could expect successful theories to give accurate predictions of the particular phenomena they were intended to summarize, as well as of phenomena strongly correlated with them — but *not* of totally unrelated phenomena. Thus, it is unsurprising that Ptolemaic astronomy was successful in predicting the motions of the known planets: for the theory was essentially a sophisticated curve-fitting to the past observations of the known planets, and the future motions of the planets are strongly correlated with their past motions.[44] The theory's empirical success does not, therefore, give any strong reason to believe that it is approximately correct or that its

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by company goons. One of the goons had bitten off the ear of a striker. The union was being prosecuted in court and Darrow was hoping to use the ear incident to defend the union. The key witness was on the stand. (I'm quoting from memory.)

Prosecutor: Did you see him bite the man's ear off?
Witness: No, I didn't.

At this point Darrow, reminiscing on the case, comments that the prosecutor had us beaten and should have dismissed the witness, but he foolishly pushed on:

Prosecutor: Then how do you know he bit the ear off?
Witness: I saw him spit it out.

[42] As noted by van Fraassen (1994, p. 268), realists tend to use arguments involving mid-size objects, while instrumentalists tend to argue their case by focusing on fundamental entities like forces or fields. But this is connected with the problem of meaning: if we say "X exists", we must know what "X" means, which is less obvious for fundamental entities than for mid-size objects.

[43] It is worth emphasizing, however, that we understand the *properties* of electrons far better than we understand the properties of dinosaurs. For example, we are able to predict the magnetic moment of the electron to 11 decimal places of accuracy (see below), but we don't know what color dinosaurs were, whether they were warm-blooded, how their hearts worked, etc. We thank Norm Levitt for this observation.

[44] This is because (as we now know) planetary motions are non-chaotic on time scales of less than a few million years.

theoretical entities (e.g. epicycles) really exist.[45] Newtonian mechanics, by contrast, was able not only to account for planetary motions in vastly simpler terms ($\mathbf{F} = m\mathbf{a}$ and the inverse-square law) and to achieve a unified theoretical understanding of both planetary and terrestrial motions; it was also able to predict the existence of *previously unobserved* planets, such as Neptune, found in 1846 where Le Verrier and Adams predicted it should be[46], and to predict the motion of *yet-to-be-launched* satellites. These facts — when taken together with all the other empirical confirmations of Newtonian mechanics — are, in our view, extremely strong evidence that Newtonian mechanics is getting *something* right about the world (but not, of course, that it is exactly correct or that its ontology is fundamental).[47]

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[45] Jim Brown (private communication) has pointed out that Ptolemaic astronomy is capable of predicting eclipses *without using, as input, any data on past eclipses* (the only data used are non-eclipse observations of the positions of the Sun and the Moon). Surely *this*, he argues, is a surprising prediction. We agree: it shows, in fact, that *one* aspect of Ptolemaic astronomy's theoretical framework — namely, that solar eclipses arise when the Moon occults the Sun — really *is* at least approximately correct; eclipses are indeed correlated with the non-eclipse motions of the Sun and the Moon in exactly the way that Ptolemaic theory asserts. But the Ptolemaic theory's predictions for planetary motions are unsurprising, because the theory does little more than summarize the data on planetary motions that went into its construction.

On the basis of similar historical examples, Psillos (1999) draws attention to the importance of *localizing* relations of evidential support, i.e. of determining "which parts of a theory are supported by the evidence at hand, or at any rate, which parts are better supported than others" (p. 125). He concludes that

> scientific realists need not accept a theory in its entirety. Instead, realism requires and suggests a *differentiated attitude to*, and *differentiated degrees of belief in*, the several constituents of a successful and mature scientific theory. The degree of belief one has in a theory is, in general, a function of the extent of its support by the available evidence. Since different parts of a theory can be supported to different degrees, realists should place their bets on the truth of a theory accordingly. (pp. 126–127, emphasis in the original)

[46] For a detailed history, see, for example, Grosser (1962) or Moore (1996, chapters 2 and 3). Please note that the validity of our observation is independent of whether Adams and Le Verrier correctly computed the Newtonian prediction for the position of Neptune or found it partly by accident (as seems to be the case). The key fact is that if one does make the correct calculations based on Newton's theory, then one indeed finds the actually observed position of Neptune.

[47] Let us stress that the key issue here is not whether the theory came chronologically before or after the observation — that is, after all, a contingent historical fact that ought to be epistemologically irrelevant — but the more subtle issue of the *logical* connection between the theory and the observation, i.e. whether the theory is "cooked up" to explain the observation or whether, by contrast, the prediction comes out as a natural but unexpected consequence of the theory. See footnote 40 in Chapter 6 above. We are grateful to the late Peter Lipton for drawing attention to the need for clarification on this point.

Here is an even more striking example: Quantum electrodynamics predicts that the magnetic moment of the electron (expressed in a well-defined unit which is unimportant for the present discussion) has the value

$$1.001\,159\,652\,201 \pm 0.000\,000\,000\,030$$

(where the "±" denotes the uncertainties in the theoretical computation, which involves several approximations), while a recent experiment gives the result

$$1.001\,159\,652\,188 \pm 0.000\,000\,000\,004$$

(where the "±" denotes the experimental uncertainties).[48] This 11-decimal-place agreement between theory and experiment — particularly when combined with thousands of other similar though less spectacular ones — would be utterly miraculous if quantum electrodynamics were not saying something at least approximately true about the world. In particular, the predictive success of quantum electrodynamics would be a miracle if electrons did not really exist in some sense or other.[49]

So, if we look critically at realism, we may be tempted to turn toward instrumentalism. But if we look critically at instrumentalism, we feel forced to return to a modest form of realism. What, then, should one do? Before coming to a possible solution, let us first consider radical alternatives.

Redefinitions of truth

When facing the problems caused by underdetermination, one may be tempted by a radical turn: What about abandoning the notion of "truth" as "correspondence with reality", and seeking instead an alternative notion of truth? There are at least two currently fashionable proposals of this kind: one is to define truth through utility or convenience, the other is to define

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[48] See Kinoshita (1995) for the theory, and Van Dyck *et al.* (1987) for the experiment. Crane (1968) provides a non-technical introduction to this problem. See also Lautrup and Zinkernagel (1999) for a very careful history, which shows that the agreement between theory and experiment is real. (One might worry that the experimental number was unduly influenced by the experimenters' knowledge of the theoretical prediction, or vice versa; but careful analysis of the history shows that this is not the case.)

[49] Once again, we say "in some sense or other" in order to emphasize that electrons, quarks, etc. may not belong to the fundamental ontology of the universe, but may only be — as we now know that Dalton's "atoms" are — approximations objectively valid at certain scales of size and energy. See the final section of this chapter for further elaboration of this point.

it through intersubjective agreement. The philosopher Richard Rorty offers examples of both:

> What people like Kuhn, Derrida and I believe is that it is pointless to ask whether there really are mountains or whether it is merely convenient for us to talk about mountains.[50]
>
> Philosophers on my side of the argument answer that objectivity is not a matter of corresponding to objects but a matter of getting together with other subjects — that there is nothing to objectivity except intersubjectivity.[51]

Similar views are expressed by some of the founders of the strong programme in the sociology of science:

> The relativist, like everyone else, is under the necessity to sort out beliefs, accepting some and rejecting others. He will naturally have preferences and these will typically coincide with those of others in his locality. The words 'true' and 'false' provide the idiom in which those evaluations are expressed, and the words 'rational' and 'irrational' will have a similar function.[52]

The best way to see that these redefinitions do not work is to apply them to simple concrete examples. For instance, it would certainly be useful to make people believe that if they drive drunk they will go to hell or die from

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[50] Rorty (1998, p. 72). See also the critiques by Nagel (1997, pp. 28–30) and Albert (1998); and see Haack (1997) for an entertaining contrast between the two radically different "pragmatist" philosophies of C.S. Peirce and of Rorty.

[51] Rorty (1998, pp. 71–72). In a now-infamous passage, Rorty went further and apparently advocated the view that truth is "[nothing] more than what our peers will, *ceteris paribus*, let us get away with saying" (1979, p. 176). As Plantinga (2000, p. 430) acerbically comments,

> [C]onsider the Chinese authorities who murdered those students at Tienanmen Square and then compounded their wickedness with bald-faced lies, claiming they'd done no such thing. From the present point of view, this is a most uncharitable way to think about the matter. For in denying that it ever happened, the authorities were merely trying to bring it about that their peers would let them get away with saying it had never happened, in which case it would have been *true* that it had never happened, in which case it would never have happened. So the charitable thought here, from a Rortian point of view, is that the Chinese authorities were only trying to bring it about that this terrible thing had never happened: and who can fault them for a thing like that?

Let us stress that we disagree with 90% of Plantinga's philosophy; but if he is so eloquently on target on this particular point, why not give him credit for it?

[52] Barnes and Bloor (1981, p. 27). See Chapter 6 above (pp. 203–211) for a critique.

cancer, but that would not make those statements true (at least on an intuitive understanding of the word "true"). Similarly, once upon a time, people agreed that the Earth was flat (or that blood was static, etc.), and we now know that they were wrong. So intersubjective agreement does not coincide with truth (again, understood intuitively).

Of course, we are using here an intuitive notion of truth, and a critic might demand a more "rigorous" definition. But the problem is that all definitions tend to be circular or else to rely on fundamental undefined terms that one either grasps intuitively or does not grasp at all. And truth falls naturally in the latter category.[53]

A more fundamental problem is that these redefinitions of "truth" do not even succeed, as they claim to, in supplanting the conventional "correspondence" notion. Take, for instance, utility: to say that something is useful (for some specified goal) is already an objective statement (it has to be *really* useful for the declared goal) that relies implicitly on the correspondence notion of truth. The same remark is even more obvious for intersubjective agreement: to say that (other) people think so and so is an objective statement describing part of the (social) world "as it is".[54]

Of course, positive arguments are sometimes given to support redefinitions of truth, as for instance the following somewhat subtle sophism:

> ... the only criterion we have for applying the word "true" is justification and justification is always relative to an audience. So it is also relative to that audience's lights — the purpose that such an audience wants served and the situation in which it finds itself.[55]

The beginning of the first sentence is correct, but it does not imply that truth is identical to justification. (One may well be rationally justified in believing something that turns out, on closer examination, to be false.[56]) Moreover,

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[53] After all, people who ask what "truth" means are not really in the same position as those who wonder what an octopus is or who Xenophon was.

[54] For a discussion of similar redefinitions of "truth", see Bertrand Russell's critique of the pragmatism of William James and John Dewey (Russell 1961, chapters 24 and 25, in particular p. 779).

[55] Rorty (1998, p. 4).

[56] For example, Hume (2000 [1748], section 10) cites approvingly the example of the person in India who, quite rationally, refused to believe that water can become solid during winter. As Hume points out,

> The operations of cold upon water are not gradual, according to the degrees of cold; but whenever it comes to the freezing point, the water passes in a moment, from the

what does it mean to say that justification is always relative to the purpose that an audience wants served? This introduces a subtle confusion between knowledge and values, by implicitly assuming that all knowledge depends on some "purpose", i.e. some non-cognitive goal. But what if the "audience" wants to find out how (some part of) the world really is? Rorty might reply that this goal is unattainable, as the following statement suggests: "A goal is something you can know you are getting closer to, or farther away from. But there is no way to know our distance from the truth, not even whether we are closer to it than our ancestors were."[57] But is this really so? Some of our ancestors thought that the Earth was flat. Don't we know better? Aren't we closer to the truth, in that respect at least?

The view proposed here is so implausible that one is forced to resort to some "charitable" interpretation. Perhaps Rorty means by "truth" something like the fundamental physical laws governing the entire universe, or an "absolute" truth discovered by pure thought (as in classical metaphysics); and it does make sense to be skeptical about our ability to discover truths of those kinds. But if this is what Rorty means, then he should say so explicitly, rather than making statements that allegedly apply to all possible knowledge. Or, alternatively, perhaps Rorty simply wants to reiterate the banal observation that all statements of fact (even about the non-flatness of the Earth) can be challenged by a consistent radical skeptic. But that is not a particularly new insight.

Cognitive relativism about truth

We will use the term "cognitive relativism about truth" to refer to any philosophy that claims that the truth or falsity of a statement is relative to an individual or to a social group.[58]

The first thing to notice about cognitive relativism is that this doctrine follows naturally if we accept a radical redefinition of truth. Clearly, if truth reduces to utility, then the "truth" of a proposition will depend on the

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> utmost liquidity to perfect hardness. Such an event, therefore, may be denominated *extraordinary*, and requires a pretty strong testimony, to render it credible to people in a warm climate ... (p. 86, italics in the original)

This example shows that rational inferences from the available evidence do not necessarily lead to true conclusions.

[57] Rorty (1998, pp. 3–4).

[58] We will consider only relativism about statements of fact (i.e. about what exists or is claimed to exist), and leave aside relativism about ethical or aesthetic judgments.

individual or social group for whom the proposition is alleged to be useful. Likewise, if truth reduces to intersubjective agreement, the "truth" of a proposition will depend on the particular group whose agreement is at issue. On the other hand, if we adopt the customary ("correspondence") notion of truth, then cognitive relativism is patently *false*: since a proposition is true to the extent that it reflects (some aspects of) the way the world is, its truth or falsity depends on the way the world is and not on the beliefs or other characteristics of any individual or group.

Since we have already discussed redefinitions of truth, there is not much to add, except that it makes no sense for ordinary scientists — whether they study Nature or society — to adopt, even implicitly, a cognitive relativist attitude. For cognitive relativism amounts to abandoning the goal of objective knowledge pursued by science. However, it seems that some historians and sociologists want to have it both ways: adopt a relativist attitude with respect to the natural sciences, and an objectivist (even naive realist) attitude with respect to the social sciences.[59] But that is inconsistent; after all, research in history, and in particular in the history of science, employs methods that are not radically different from those used in the natural sciences: studying documents, drawing the most rational inferences, making inductions based on the available data, and so forth. If arguments of this type in physics or biology did not allow us to arrive at reasonably reliable conclusions, what reason would there be to trust them in history or sociology? Why speak in a realist mode about historical categories, such as social classes, if it is an illusion to speak in a realist mode about scientific concepts (which are in fact much more precisely defined) such as electrons or DNA?

Towards a Reasonable Epistemology

Epistemological opportunism

Given that instrumentalism is not defensible when it is formulated as a rigid doctrine, and since redefining truth leads us from bad to worse, what should one do? A hint of one sensible response is provided by the following comment of Einstein:

> Science without epistemology is — insofar as it is thinkable at all — primitive and muddled. However, no sooner has the epistemologist, who is seeking a clear system, fought his way through such a system, than he

[59] See Chapter 6 above for relevant quotes from Kuhn, Feyerabend, Barnes–Bloor and Fourez, along with a more detailed critique.

> is inclined to interpret the thought-content of science in the sense of his system and to reject whatever does not fit into his system. The scientist, however, cannot afford to carry his striving for epistemological systematic that far.... He therefore must appear to the systematic epistemologist as an unscrupulous opportunist.[60]

So let us try epistemological opportunism. We are, in some sense, "screened" from reality (we have no immediate access to it, radical skepticism cannot be refuted, etc.). There are no absolutely secure foundations on which to base our knowledge. Nevertheless, we all assume implicitly that we can obtain some reasonably reliable knowledge of reality, at least in everyday life. Let us try to go farther, putting to work all the resources of our fallible and finite minds: observations, experiments, reasoning. And then let us see how far we can go. In fact, the most surprising thing, shown by the development of modern science, is how far we seem to be able to go.

Unless one is a solipsist or a radical skeptic — which nobody really is — one has to be a realist about *something*: about objects in everyday life, or about the past, dinosaurs, stars, viruses, whatever. But there is no natural border where one could somehow radically change one's basic attitude and become thoroughly instrumentalist or pragmatist (say, about atoms or quarks). There are many differences between quarks and chairs, both in the nature of the evidence supporting their existence and in the way we give meaning to those words, but they are basically differences of degree. Instrumentalists are right to point out that the meaning of statements involving unobservable entities (like "quark") is in part related to the implications of such statements for direct observations. But only in part: though it is difficult to say exactly how we give meaning to scientific expressions, it seems plausible that we do it by combining direct observations with mental pictures and mathematical formulations, and there is no good reason to restrict oneself to only one of these. Likewise, conventionalists like Poincaré are right to observe that some scientific "choices", like the preference for inertial over noninertial reference frames, are made for pragmatic rather than objective reasons. In all these senses, we have to be epistemological "opportunists". But a problem worse than the disease arises when any of these ideas are taken as rigid doctrines replacing "realism".

A friend of ours once said: "I am a naive realist. But I admit that knowledge is difficult." This is the root of the problem. Knowing how things really are is the goal of science; this goal is difficult to reach, but not impossible (at least for some parts of reality and to some degrees of approximation). If we

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[60] Einstein (1949, p. 684).

change the goal — if, for example, we seek instead a consensus, or (less radically) aim only at empirical adequacy — then of course things become much easier; but as Bertrand Russell observed in a similar context, this has all the advantages of theft over honest toil.

It is important to remember that scientific knowledge needs no "justification" from the outside. The justification for the objective validity of scientific theories (in the sense of being at least approximate truths about the world) lies in specific theoretical and empirical arguments. Of course, philosophers, historians or sociologists may be impressed by the successes of the natural sciences (as the logical positivists were) and seek to understand how science works. But there are two frequent mistakes to avoid: One is to think that, because some particular account fails (say, the logical-positivist one or the Popperian one), then some alternative account (e.g. the socio-historical one) *must work*. But that is an obvious fallacy; perhaps *no* existing account works.[61] The second, and more fundamental, mistake is to think that our inability to account in general terms for the success of science somehow makes scientific knowledge less reliable or less objective. That confuses accounting and justifying. After all, Einstein and Darwin gave arguments for their theories, and those arguments were far from being all erroneous. Therefore, even if Carnap's and Popper's epistemologies were entirely misguided, that would not begin to cast doubt on relativity theory or evolution.

Moreover, the underdetermination thesis, far from undermining scientific objectivity, actually makes the success of science all the more remarkable. Indeed, what is difficult is not to find a story that "fits the data", but to find even one *non-crazy* such story. How does one know that it is non-crazy? A combination of factors: its predictive power, its explanatory value, its breadth and simplicity, etc. Nothing in the (Quinean) underdetermination thesis tells us how to find inequivalent theories with some or all of these properties. In fact, there are vast domains in physics, chemistry and biology where there is only one[62] known non-crazy theory that accounts for the known facts and where many alternative theories have been tried and failed because their predictions contradicted experiments. In those domains, one can reasonably think that our present-day theories are at least approximately true, in some sense or other. An important (and difficult) problem for the philosophy of science is to clarify the meaning of "approximately true" and its

[61] See McGinn (1993, chapter 7) for the interesting suggestion that understanding our own knowledge-producing mechanisms simply lies outside the bound of what is biologically feasible for our limited minds.

[62] Modulo the "genuine" underdeterminations discussed earlier.

implications for the ontological status of unobservable theoretical entities. We do not claim to have a solution to this problem, but we would like to offer a few ideas that might prove useful.

The "renormalization-group view of the world"

The status of unobservable entities in fundamental physics can be clarified by considering the relationship between successive "levels" of theorization of the same physical object. For example, chairs appear to us in everyday life as solid objects, and water appears to us as a continuous fluid. Atomic theory, on the other hand, teaches us that both chairs and water are composed of atoms. The two levels of description thus have radically different ontologies. But atomic theory does not simply declare that our everyday intuitions are wrong. Quite the contrary: atomic theory *implies* that certain aggregations of atoms will act, on macroscopic scales, as hard solids (due to the very strong electrical repulsions between protons in the two objects) and that other aggregations of atoms will act as fluids.[63] Therefore, the nonfundamental ontology of everyday life (solids and fluids) can be seen as a kind of "coarse-grained" macroscopic approximation to the more fundamental microscopic ontology of quarks and electrons; indeed, the former should be (at least in principle) *derivable* as a logical consequence of the underlying more fundamental theory.

An analogous relation holds between successive well-confirmed physical theories in the same domain. For example, in Newtonian mechanics particles interact via forces acting instantaneously at a distance, while in general relativity particles (and fields) alter the geometry of space-time, which in turn influences the motion of other particles. Newtonian mechanics and general relativity make only slightly different predictions for the orbits of planets, but their fundamental ontologies are radically different. Nevertheless, Newtonian mechanics is in some sense derivable from general relativity as a low-velocity weak-field approximation, so its ontology is in some sense a "coarse-grained" version of the more fundamental general-relativistic ontology.[64]

Thoughtful philosophers and scientists have understood for centuries that all measurements have a finite accuracy, so that it is dangerous to infer from

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[63] Of course, the details of these implications have not yet been fully worked out — we are not yet able to predict quantitatively, directly from atomic theory, the hardness of a chair (or of steel) or the viscosity of water — but qualitatively the situation is reasonably well understood.

[64] We say "in some sense" because, once again, these derivations are difficult (if one tries to fill in all the details) and not *fully* understood today.

the empirical adequacy of a theory — e.g. the fact that, as of 1850, Newtonian mechanics accounted for all known planetary orbits to an extraordinary precision — that the theory is *exactly* correct. All one can reasonably assert is that the theory is probably *approximately* correct (to some specified precision) in the domain where it has been well tested, so that any subsequent theory will have to incorporate the old theory as a valid approximation in this domain. The foregoing considerations now indicate a further danger: not only may the older theory be approximate rather than exact in a quantitative sense; it may also get the fundamental ontology all wrong. But this does not mean that its ontology is *simply wrong*; rather, it means that what appears in the older theory to be a fundamental entity is, in reality, a non-fundamental entity derivable as a "coarse-grained" version of something deeper.[65,66]

It is reasonable to conjecture that the relationship between present-day well-confirmed theories and their future successors will be something like the relationship between past well-confirmed theories and their present-day successors. For example, all of modern atomic and elementary-particle physics is based on quantum field theory (including quantum electrodynamics and, more generally, the "standard model" of electromagnetic, weak and strong interactions); and these theories have been empirically verified in vast domains, sometimes to phenomenal accuracy.[67] Likewise, general relativity gives our best current understanding of gravitational phenomena (from baseballs to planets to the universe as a whole); and it too has been confirmed to impressive precision in wide domains. Nevertheless, we are reasonably sure that these two theories *cannot* both be *exactly* true, because their fundamental ontologies are mutually incompatible.[68] We hope that quantum

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[65] As pointed out by Weinberg in his very interesting critique of Kuhn: "If you have bought one of those T-shirts with Maxwell's equations on the front, you may have to worry about its going out of style, but not about its becoming false. We will go on teaching Maxwellian electrodynamics as long as there are scientists." (Weinberg 1998) Weinberg makes an important distinction between the "soft" and "hard" parts of scientific theories. The hard part — consisting basically in the equations themselves, their interpretation in operational terms, and the class of phenomena to which they apply — does not change when scientific revolutions occur. The soft part, on the other hand, which has to do with the basic ontology postulated by the theory, does tend to change.

[66] For an analysis of how the nineteenth-century caloric theory of heat — widely believed to be an embarrassing counterexample for scientific realists — fits perfectly within the framework of the modest realism being advocated here, see Psillos (1999, chapter 6) and Sokal (2004).

[67] See e.g. the discussion of the magnetic moment of the electron earlier in this chapter.

[68] The fields of general relativity encode the geometry of a smooth space-time manifold, while quantum mechanics implies that all fields undergo quantum fluctuations, which become

field theory and general relativity will some day be superseded by an as-yet-nonexistent theory of quantum gravity. Whether this process stops somewhere at some fundamental, "final" theory or whether there are theories "all the way down", no one knows.[69] Either way, it is reasonable to expect that the fundamental ontologies of both quantum field theory and general relativity will survive in future theories as non-fundamental "coarse-grained" ontologies valid in specific domains to specific degrees of accuracy.

These considerations can be summarized in a picture that is basic to most thinking in contemporary physics: let us call it the "renormalization-group view of the world", after the work in statistical mechanics and quantum field theory performed during the 1970s (but too technical to explain in detail here) that shows how to make rather precise the concept of one theory being a "coarse-grained" approximation of another.[70] In this view, reality is composed of a hierarchy of "scales", ranging from ____ to quarks to atoms to fluids and solids ... to stars to galaxies to ____ (with bipedal primates somewhere in-between). The theory on each scale emerges from the theory on the next-finer scale by ignoring some of the (irrelevant) details of the latter. And the ontology of the theory on each scale — in particular, its "unobservable" theoretical entities — can be understood, at least in principle, as arising from the "collective" or "emergent" effects of a more fundamental theory at a finer scale.

Since no existing theory purports to be a final theory, there is no reason to consider it as literally true or to worry too much about whether the entities it postulates "really exist". Or rather, when worrying about whether the unobservable entities of a given theory "really exist", it is important to distinguish existence *as a fundamental constituent of the universe* from existence *in some coarse-grained sense*. It is a reasonable guess that *none* of the theoretical entities in our present-day theories are truly fundamental, and that *all* of the theoretical entities in our present-day well-confirmed theories will maintain some status as derived entities in future theories.

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stronger at smaller scales. It follows that in a quantum theory where geometry is a dynamical field, space-time at very small scales *cannot* be a smooth manifold. Unfortunately, the *direct* contradiction between general relativity and quantum mechanics becomes evident only at scales of order 10^{-33} centimeters and smaller — i.e. sizes about 10^{25} times smaller than an atom — or, equivalently, at energies about 10^{16} times higher than that of the Superconducting Supercollider (R.I.P.). Clearly, this realm will have to be probed *indirectly* if it is to be probed at all.

[69] See Weinberg (1992) and Bohm (1984 [1957], chapter 5) for in-depth discussions of this issue, reaching different conclusions.

[70] For a non-technical introduction to the renormalization group, see Wilson (1979).

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PART III

Science and Culture

I mean by intellectual integrity the habit of deciding vexed questions in accordance with the evidence, or of leaving them undecided where the evidence is inconclusive. This virtue, though it is under-estimated by almost all adherents of any system of dogma, is to my mind of the very greatest social importance and far more likely to benefit the world than Christianity or any other system of organized beliefs.

— *Bertrand Russell*[*]

Whether we like it or not, science with its objectivity (however this might be compromised in certain instances) and its openness to validation and refutation, remains the one international language capable of providing objective knowledge of the world. And it is a language that all can use and share in and learn.... The wretched of the earth want science and the benefits of science. To deny them this is another kind of racism.

— *Robin Fox*[†]

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[*] Bertrand Russell, "Can religion cure our troubles?" [1954–55], in *The Collected Papers of Bertrand Russell*, edited by Kenneth Blackwell (Allen & Unwin, London–Boston, 1983), pp. 212–220, quote at p. 214.

[†] Robin Fox, "Anthropology and the 'teddy bear' picnic", *Society* **30**(1): 47–55 (November/December 1992), quote at p. 49.

8

Pseudoscience and postmodernism: Antagonists or fellow-travelers?*

> The human understanding is not composed of dry light, but is subject to influence from the will and the emotions, a fact that creates fanciful knowledge; man prefers to believe what he wants to be true.
>
> — *Francis Bacon, The New Organon, Aphorism 49*

In this chapter I propose to investigate the paradoxical relation between two broad categories of thought: *pseudoscience* and *postmodernism* (both will be defined more precisely in a moment). At first glance, pseudoscience and postmodernism would appear to be opposites: pseudoscience is characterized by extreme credulity, while postmodernism is characterized by extreme skepticism. More specifically, adherents of pseudoscience believe in theories or phenomena that mainstream science rejects as utterly implausible, while adherents of postmodernism withhold belief in theories that mainstream science considers to be established beyond any reasonable doubt.[1]

And yet, I will argue, there is, at least in some instances, a curious convergence between pseudoscience and postmodernism. On the one hand, advocates of pseudoscience — at least the most sophisticated among

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* Slightly revised version of an essay first published in *Archaeological Fantasies: How Pseudoarchaeology Misrepresents the Past and Misleads the Public*, edited by Garrett G. Fagan (Routledge, London–New York, 2006), pp. 286–361; and in French translation in book form as *Pseudosciences et postmodernisme: Adversaires ou compagnons de route?* (Odile Jacob, Paris, 2005). The French edition also contains a very interesting preface by Jean Bricmont.

[1] Or rather, postmodernists *profess* to withhold such belief. Whether they actually do so in practice — for example, when they are seriously ill and must decide which type of medicine to follow — is a different question.

them — sometimes fall back on postmodernist arguments when the reliability or credibility of their evidence is challenged. (This strategem is admittedly second-best from their point of view, but at least it manages to avert outright refutation.) On the other hand, postmodernists' professed skepticism is often deployed selectively, so that a disdain for the knowledge claims of modern science sometimes coexists with a sympathy for (if not outright belief in) one or more pseudosciences. The bulk of this essay will be devoted to illustrating these two complementary moves through examples drawn from various brands of pseudoscience. In the final section I will argue that this is not merely an academic exercise, but has serious real-world consequences.

Since the three key terms of this discussion — "science", "pseudoscience" and "postmodernism" — have been used with widely varying meanings, it is incumbent on me, before proceeding further, to clarify and delimit, as best I can, how I intend to use these terms.[2]

Note first that each of these terms has a triple denotation: it can be understood as referring to a body of thought, to the arguments or justifications that are offered in support of that body of thought, or to the community of advocates of (or adherents to) that body of thought. I shall continue this triple usage, while distinguishing the three aspects whenever necessary.

The word *science*, as commonly used, has at least four distinct meanings: it denotes an intellectual endeavor aimed at a rational understanding of the natural and social world; it denotes a corpus of currently accepted substantive knowledge; it denotes the community of scientists, with its mores and its social and economic structure; and, finally, it denotes applied science and technology. In this chapter I will be concentrating on the first two aspects, with some secondary references to the sociology of the scientific community; I will not address technology at all. Thus, by *science* I mean, first of all, a worldview giving primacy to reason and observation and a methodology aimed at acquiring accurate knowledge of the natural and social world. This methodology is characterized, above all else, by the *critical spirit*: namely, the commitment to the incessant testing of assertions through observations and/or experiments — the more stringent the tests, the better — and to revising or discarding those theories that fail the test.[3] One corollary of the critical spirit is *fallibilism*: the understanding that all our empirical knowledge

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[2] Let me emphasize that there is no one "right" definition of these (or any) terms. Rather, each author has the obligation to his readers to clarify, to the greatest extent possible, how *he* proposes to use the word.

[3] See Bricmont (2005) for an illuminating discussion of the critical/skeptical aspect of science.

is tentative, incomplete and open to revision in the light of new evidence or cogent new arguments (though, of course, the most well-established aspects of scientific knowledge are unlikely to be discarded entirely).

It is important to note that well-tested theories in the mature sciences are supported in general by a powerful web of interlocking evidence coming from a variety of sources; rarely does everything rest on one "crucial experiment". Moreover, the progress of science tends to link these theories into a unified framework, so that (for instance) biology has to be compatible with chemistry, and chemistry with physics.[4] Philosopher Susan Haack has illuminatingly analogized science to the problem of completing a crossword puzzle, in which any modification of one word will entail changes in interlocking words; in most cases the required changes will be fairly local, but in some cases it may be necessary to rework large parts of the puzzle.[5,6]

I stress that my use of the term "science" is not limited to the *natural* sciences, but includes investigations aimed at acquiring accurate knowledge of factual matters relating to *any* aspect of the world by using rational empirical methods analogous to those employed in the natural sciences.[7] Thus, "science" (as I use the term) is routinely practiced not only by physicists, chemists and biologists, but also by historians, detectives, plumbers and indeed all human beings in (some aspects of) our daily lives.[8,9] Likewise for the term "pseudoscience": the subject matter can be any aspect of the world. The distinction between science and pseudoscience does not concern the

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[4] For a good discussion of this point, see Weinberg (1992, especially chapters II and III).

[5] Haack (1993, 1998, 2003). These two situations correspond, of course, to historian of science Thomas Kuhn's (1970) notions of "normal science" and "revolutionary science", respectively. Let me stress that while this part of Kuhn's theory is fairly noncontroversial, the same cannot be said for the rest, particularly the alleged "incommensurability of paradigms", which has led many of Kuhn's followers to a full-fledged relativism. For a critique of Kuhn's ideas on incommensurability, see Maudlin (1996) and pp. 191–197 above.

[6] See Chapters 6 and 7 above for further details on my conception of science and scientific knowledge. For an excellent introduction to contemporary debates in the philosophy of science, see Brown (2001).

[7] Please note the limitation to questions of fact. I intentionally exclude from my purview questions of ethics, aesthetics, ultimate purpose, etc.

[8] The allusion to historians and detectives was employed previously by Haack (1993, p. 137): "there is no reason to think that [science] is in possession of a special method of inquiry unavailable to historians, detectives, and the rest of us". See also Haack (1998, pp. 96–97; 2003, pp. 18, 24, 95, 102 and *passim*).

[9] Of course, the fact that we all practice science from time to time does not mean that we all practice it equally well, or that we practice it equally well in all areas of our lives. See, for instance, note 264 below.

subject matter, but rather the quality of the methods employed and the reliability of the knowledge (or purported knowledge) obtained.

More precisely, I shall use the term *pseudoscience* to designate any body of thought (along with its associated justifications and advocates) that

(a) makes assertions about real or alleged phenomena and/or real or alleged causal relations that mainstream science justifiably considers to be utterly implausible, and

(b) attempts to support these assertions through types of argumentation or evidence that fall far short of the logical and evidentiary standards of mainstream science.

This definition implies, first of all, that pseudoscientists are not postmodernists: they make assertions about the natural or social world that they claim to be *true* in an objective sense. Note also that this definition of pseudoscience involves both sociological and epistemic criteria. On the one hand, the mainstream scientific community must reject the beliefs in question as utterly implausible; in addition, this rejection must be *rationally justified* on the basis of the currently available evidence. Ordinarily this rejection is based on the fact that

(i) the evidence adduced in support of the beliefs is spurious, grossly mishandled, or otherwise utterly unconvincing;

(ii) the beliefs in question imply numerous observational consequences that are radically at variance with well-established scientific data; and

(iii) the beliefs in question conflict irremediably with well-tested scientific theories within the domain where there is good reason to believe that those theories are valid.

Most often (though not always), pseudoscience also

(c) claims to be scientific, and even

(c′) claims to relate its assertions to genuine science, particularly cutting-edge scientific discoveries.

In this way, pseudoscience attempts to wrap itself in the mantle of genuine science, with the evident aim of capturing for itself some of the epistemic respect that the general public (hard-core postmodernists excluded!) ordinarily accords to "science". Moreover, pseudoscience usually exhibits *some* of the logical and sociological characteristics of genuine science, such as:

(d) It involves not a single isolated belief, but rather a complex and logically coherent system that "explains" a wide variety of phenomena (or alleged phenomena).

(e) Practitioners undergo an extensive process of training and credentialing.[10]

What pseudoscience utterly lacks, however, is the critical spirit and the robust empirical support that are characteristic of genuine science. Examples of pseudosciences are astrology, homeopathy, "creation science", Judaism, Christianity, Islam and Hinduism.[11,12]

The fact that one can distinguish (in most cases quite readily) between genuine science and pseudoscience does not mean, of course, that it is possible to draw a sharp line between them — much less a line based on rigid "demarcation criteria" such as those proposed by the philosopher Karl Popper.[13] Rather, one would do better to envisage a continuum (Figure 8.1) with well-established science (e.g. the idea that matter is composed of atoms) at one end, passing via cutting-edge science (e.g. neutrino oscillations) and mainstream but speculative science (e.g. string theory) — and then, much further along the way, through shoddy science (N rays, cold fusion) — and

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[10] I stress that points (c), (d) and (e) are *optional* aspects of "pseudoscience" in my definition. In particular, while (e) tends to hold for the grand schools of pseudoscience, it may not apply to all pseudosciences. For instance, Garrett Fagan has pointed out to me that pseudoarchaeology is most frequently a solo endeavor, not one in which "schools" are established.

[11] Numerous specific examples of pseudoscience are analyzed in the books of Gardner (1957), Radner and Radner (1982), Broch (1992), Park (2000), Feder (2002) and Shermer (2002). Several of these books also contain general discussions of the characteristics of science and pseudoscience; Radner and Radner (1982, chapter III) and Feder (2002, chapter 2) are particularly illuminating. See also Tuomela (1985, pp. 228–229). Feder (2002, chapter 1) also provides a very useful table of references to earlier skeptical analyses of various types of pseudoscience.

[12] Regarding Judaism, Christianity, Islam and Hinduism, I am referring, of course, to the corpus of factual assertions about the natural and human world that are contained in the traditional doctrine of each of these religions (or of each variant thereof). It goes without saying that some practitioners of these religions adhere to the religion primarily for ethical, cultural, social, familial or nostalgic reasons without accepting any significant part of their religion's professed doctrine concerning matters of purported fact. For further discussion of the radical methodological opposition between science and religion, see al-'Azm (1982), Bricmont (1999), Haack (2003, chapter 10) and Kitcher (2005). See also the Appendix at the end of this chapter; and see Chapter 9 below for a more detailed discussion.

[13] Popper's demarcation criteria are set forth in Popper (1959, 1989). For critiques, see Newton-Smith (1981), Kitcher (1982, pp. 42–50) and Laudan (1996, chapter 11) as well as pp. 182–189 above (among many others).

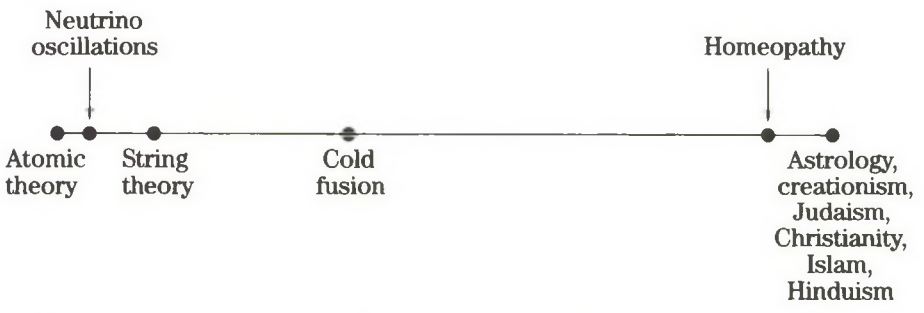

Figure 8.1. A very rough depiction of the continuum from genuine science to pseudoscience, based on the strength of the empirical evidence for or against the given theory and on the soundness of the methodology employed by the theory's advocates. This graph should be interpreted qualitatively, not quantitatively.

ending, after a long further journey, at pseudoscience. Though there is no precise location along this continuum where a line can be drawn, there is nevertheless a radical difference between the established natural sciences and the pseudosciences as regards both methodology and degree of empirical confirmation.[14,15,16]

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[14] The fact that temperature is a continuum does not imply that the words "hot" and "cold" are meaningless, or that there is no difference between boiling water and ice!

[15] Since the demise of Popper's attempts at drawing a sharp demarcation between genuine science and pseudoscience, philosophers seem largely to have abandoned the task of developing and evaluating criteria for distinguishing the two. [Some exceptions are Thagard (1988, chapter 9) and Tuomela (1985, section 10.IV).] This is a shame, because although it may be impossible to draw a sharp demarcation based on universal methodological rules, it may nevertheless be possible to develop criteria which, taken together, can help to locate theories along the continuum illustrated in Figure 8.1 (or, perhaps better, a multidimensional analogue). For example, some scientists have proposed criteria for distinguishing good science from shoddy science (e.g. Langmuir 1989); it seems to me that philosophers and historians of science could play a useful role by carefully analyzing the strengths and flaws of these criteria.

[16] Noretta Koertge has kindly drawn my attention to an article by Philip Kitcher (1984/85) which eloquently makes these same points. Speaking of the gap between genuine sciences such as evolutionary biology and pseudosciences such as "creation science", Kitcher writes (p. 170): "We can manage without a criterion of demarcation.... The issue is the location of various proposals on a continuum. To put the point briefly: There is excellent science, good science, mediocre science, poor science, [and] dreadful science ... "

Susan Haack (2003, p. 116) takes a similar point of view:

> [R]ather than criticizing work as "pseudo-scientific," it is always better to specify what, exactly, is wrong with it: that it is not honest or serious inquiry; that it rests on assumptions for which there is no good evidence, or which are too vague to be susceptible to evidential check; that it uses mathematical symbolism, or perhaps

The term "postmodernism" is even more diffuse: it has been used to cover an ill-defined galaxy of ideas in fields ranging from art and architecture to the social sciences and philosophy. I propose here to use the term *postmodernism* much more narrowly, to denote

> an intellectual current characterized by the more-or-less explicit rejection of the rationalist tradition of the Enlightenment, by theoretical discourses disconnected from any empirical test, and by a cognitive and cultural relativism that regards science as nothing more than a "narration", a "myth" or a social construction among many others.[17]

Thus, postmodernists reject the idea that assertions about the natural or social world can be objectively (and hence transculturally) true or false; rather, they insist that "truth" is relative to some social or cultural group.[18] Frequently they redefine the word "truth" to denote mere intersubjective agreement (within some specified social group) or practical utility (for some specified goal).[19] Postmodernists therefore tend to reject objectivity even as an ideal towards which to strive (however imperfectly): everything becomes dependent on one's subjective viewpoint, and moral or aesthetic values displace cognitive ones as the criterion for evaluating assertions of alleged fact.

Let me stress that not all the authors whom I term "postmodernist" would identify with that label, since they may use the term in a sense different from mine (which is of course their right). Conversely, some authors who term themselves "postmodernist" may not be postmodernist in my sense.[20] Finally, it should be noted that there exist many different currents within what I have called postmodernism, which interact only weakly. Thus, some

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> elaborate-looking apparatus, purely decoratively; etc.... [I]f we want to understand how creationism differs epistemologically from physical cosmology or evolutionary biology, we will do better to focus directly on questions of evidence and warrant, instead of fussing over whether creationism is bad science, or not science at all.

[17] Sokal and Bricmont (1998, p. 1).

[18] Alternatively, postmodernists may concede that statements can be objectively true or false, but insist that the criteria for judging whether a belief is *rationally justified* (relative to some specified set of evidence) are thoroughly culture-bound.

[19] For further discussion of redefinitions of truth, along with examples and a critique, see Chapter 7 above.

[20] For example, Griffin (1988), who advocates an "affirmative postmodernism" based on the "reenchantment of science", explicitly reaffirms that the goal of science is the search for truth, understood as correspondence with reality. He is thus *not* a postmodernist in the sense defined here. (In my opinion, Griffin's program is flawed by a series of gross misunderstandings about the content of modern science, which lead him give undue credence to crazy ideas like telepathy and clairvoyance; but relativism is not one of his sins.)

postmodernists (in my definition) rely heavily on Derrida and Heidegger, others more strongly on Foucault, others on constructivist sociology of science (Barnes, Bloor, Collins, Latour, ...), others on the feminist-constructivist subgroup (Haraway, Harding, Keller, ...), others on the postcolonial wing (Nandy, Alvares, Shiva, Sardar, ...).

In order to give a clearer idea of the types of views that I am here calling "postmodernist", it is perhaps useful to provide some examples. Consider the following assertions by prominent figures in the sociology of science:

> [T]he validity of theoretical propositions in the sciences is in no way affected by factual evidence.[21]
>
> The natural world has a small or non-existent role in the construction of scientific knowledge.[22]
>
> For the relativist [such as ourselves] there is no sense attached to the idea that some standards or beliefs are really rational as distinct from merely locally accepted as such.[23]
>
> Science legitimates itself by linking its discoveries with power, a connection which *determines* (not merely influences) what counts as reliable knowledge ... [24]

Assertions like these are in clear contradiction with the view of science I have set forth, i.e. as a fallible but partly successful attempt to obtain an objective (albeit approximate and incomplete) understanding of (some aspects of) the world. These statements exhibit, either explicitly or implicitly, the cognitive relativism and extreme social constructivism that are characteristic of the intellectual current I am calling "postmodernism".

Statements as clear-cut as those just cited are, however, rare in the academic postmodernist literature. More often one finds assertions that are

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[21] Gergen (1988, p. 37).

[22] Collins (1981, p. 3). Two qualifications need to be made: First, this statement is offered as part of Collins' introduction to a set of studies (edited by him) employing the relativist approach, and constitutes his summary of that approach; he does not *explicitly* endorse this view, though an endorsement seems implied by the context. Second, while Collins appears to intend this assertion as an empirical claim about the history of science, it is possible that he intends it neither as an empirical claim nor as a normative principle of epistemology, but rather as a methodological injunction to sociologists of science: namely, to act *as if* "the natural world ha[d] a small or non-existent role in the construction of scientific knowledge", or in other words to *ignore* ("bracket") whatever role the natural world may in fact play in the construction of scientific knowledge. See Bricmont and Sokal (2001, 2004b) for an argument that this approach is seriously deficient *as methodology* for sociologists of science.

[23] Barnes and Bloor (1981, p. 27), clarification added by me.

[24] Aronowitz (1988, p. 204), emphasis in the original.

ambiguous but can nevertheless be interpreted (and quite often *are* interpreted) as implying what the foregoing quotations make explicit: that science as I have defined it is an illusion, and that the purported objective knowledge provided by science is largely or entirely a social construction. For example:

> Despite their names, conservation laws are not inevitable facts of nature but constructions that foreground some experiences and marginalize others.... Almost without exception, conservation laws were formulated, developed, and experimentally tested by men. If conservation laws represent particular emphases and not inevitable facts, then people living in different kinds of bodies and identifying with different gender constructions might well have arrived at different models for [fluid] flow.[25]

> [G]iven their extensive training in sophisticated mathematical techniques, the preponderance of mathematics in particle physicists' accounts of reality is no more hard to explain than the fondness of ethnic groups for their native language. On the view advocated in this chapter, there is no obligation upon anyone framing a view of the world to take account of what twentieth-century science has to say.[26]

Let me emphasize once again that pseudoscientists are not, at least in the first instance, postmodernists: they make assertions about the natural or social world that they claim to be true in an objective sense; only with great reluctance will they fall back on the comparatively lame assertion that their "point of view" is "just as valid" as that of mainstream science. Indeed, some pseudoscientists are militantly anti-postmodernist. For instance, the leader of a major pseudoscientific cult recently issued an erudite proclamation criticizing

> different forms of agnosticism and relativism which have led philosophical research to lose its way in the shifting sands of widespread scepticism. Recent times have seen the rise to prominence of various doctrines which tend to devalue even the truths which had been judged certain. A legitimate plurality of positions has yielded to an undifferentiated

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[25] Hayles (1992, pp. 31–32). See Chapter 4 above for further discussion of Hayles' theses on fluid mechanics.

[26] Pickering (1984, p. 413). Can Pickering, who was initially trained as a physicist, really be unaware of four centuries' work demonstrating the extraordinary power of mathematics as a tool for formulating and solving problems in the physical (and, to a lesser extent, the biological) sciences? See Wigner (1960) for a prominent physicist's reflections on the "unreasonable effectiveness" of mathematics in the natural sciences.

> pluralism, based upon the assumption that all positions are equally valid, which is one of today's most widespread symptoms of the lack of confidence in truth. Even certain conceptions of life coming from the East betray this lack of confidence, denying truth its exclusive character and assuming that truth reveals itself equally in different doctrines, even if they contradict one another.[27]

Still, some pseudoscientists do employ postmodernist arguments, whether opportunistically or systematically. In the remainder of this essay I would like to give some examples of that use.

Let me stress in advance that I will not be concerned here with explaining in detail why astrology, homeopathy and the rest are in fact pseudoscience; that would take me too far afield. Nor will I address, except in passing, the important but difficult problems of understanding the psychological attractions of pseudoscience and the social factors affecting its spread.[28] Rather, my principal aim is to investigate the logical and sociological nexus between pseudoscience and postmodernism.

It goes without saying that none of my case studies should be treated as definitive — quite the contrary. I have no special expertise in any of the fields of study under discussion; I could easily have made mistakes. Moreover, my accounts are in no way claimed to be comprehensive. Rather, my aim is to point the attention of philosophers, sociologists and historians of science to a phenomenon that deserves a more detailed and rigorous investigation and analysis.

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[27] John Paul II (1998, p. 10). See also the Appendix at the end of this chapter, as well as Chapter 9 below.

[28] For a shrewd meditation on the former question, see Levitt (1999, especially pp. 12–22 and chapter 4). The latter question is indirectly addressed by Burnham (1987), in the context of a fascinating history of the popularization of science in the United States in the nineteenth and twentieth centuries.

For my own part, I have been struck by the fact that nearly all the pseudoscientific systems to be examined in this essay are based philosophically on *vitalism*: that is, the idea that living beings, and especially *human* beings, are endowed with some special quality ("life energy", *élan vital*, *prana*, *qi*) that transcends the ordinary laws of physics. Mainstream science has rejected vitalism since at least the 1930s, for a plethora of good reasons that have only become stronger with time (see e.g. Mayr 1982). But these good reasons are understood by only a tiny fraction of the populace, even in the industrialized countries where science is supposedly held in high esteem. Moreover — and perhaps much more importantly — the anti-vitalism characteristic of modern science is deeply unsettling emotionally to most (perhaps all) people, even to those who are not conventionally religious. See again Levitt (1999). Of course, none of these speculations pretend to any scientific rigor; careful empirical investigation by psychologists and sociologists is required.

Pseudoscience and postmodernism in nursing

New York Times readers on the morning of April 1, 1998 were treated to a delicious front-page story that was not an April Fool's joke:

> Two years ago, Emily Rosa of Loveland, Colo., designed and carried out an experiment that challenges a leading treatment in alternative medicine. Her study, reported today in The Journal of the American Medical Association, has thrown the field into tumult.
>
> Emily is 11 years old [9 at the time of the experiment]. She did the experiment for her fourth-grade science fair.[29]

The technique Emily tested is called Therapeutic Touch (TT) — a slight misnomer because practitioners do not actually touch the patient. Rather, they move their hands rhythmically over the patient's body, about 2–6 inches (5–15 cm) away, in an effort to "rebalance" the "human energy field" that they believe surrounds the patient.[30]

Emily designed a simple experiment to test whether Therapeutic Touch practitioners can really sense a "human energy field", as they claim. The practitioner and Emily were seated opposite each other at a table, separated by an opaque screen with two cutouts at its base, through which the practitioner placed her hands. A cloth towel was attached to the screen and draped over the practitioner's arms. Before each set of trials, the practitioner was given time to "center" or make any other mental preparations she deemed necessary. Emily then flipped a coin and placed her right hand 3–4 inches (8–10 cm) above one of the practitioner's hands, chosen according to the coin flip. The practitioner was asked to state which of her hands was closest to Emily's hand, and was given as much time as she wished in order to decide. In 280 trials involving 21 Therapeutic Touch practitioners, they succeeded

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[29] Kolata (1998, p. A1).

[30] There is an extensive literature on Therapeutic Touch, by both its advocates and its critics. In describing Therapeutic Touch and its alleged theoretical basis, I will draw on the advocates' own explanations wherever possible. See, for example, Krieger (1979, 1981, 1987, 1993, 2002), Borelli and Heidt (1981), Macrae (1988), Kunz (1995, pp. 211–288 and 307–326), Cowens and Monte (1996), Wager (1996), Fischer and Johnson (1999), Fontaine (2000, chapter 13), Freeman and Lawlis (2001, chapter 18) and Sayre-Adams and Wright (2001), among many others. For critiques, see Rosa *et al.* (1998) and the literature cited there, as well as the essays in Scheiber and Selby (2000).

in choosing the correct hand 44% of the time, slightly worse than random guessing.[31]

When I first heard about Emily's experiment, I admired her ingenuity but wondered whether anyone really took Therapeutic Touch seriously. How wrong I was! Therapeutic Touch is taught in more than 80 college and university schools of nursing in at least 70 countries, is practiced in at least 80 hospitals across North America, and is promoted by leading American nursing associations.[32] Its inventor claims to have trained more than 47,000 practitioners over a 26-year period, who have gone on to train many more.[33] At least 245 books or dissertations have been published that include "Therapeutic Touch" in the title, subject headings or table of contents.[34] All in all, Therapeutic Touch appears to have become one of the most widely practiced "holistic" nursing techniques.

How did a profession based in science come to promote mysticism and quackery? The story is more complex — and more worrisome — than I initially realized.[35]

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[31] For a more detailed description of the experiment and its statistical analysis, see Rosa *et al.* (1998). Of course, some aspects of Emily's experimental design can be criticized: for example, the sample sizes were small; there was no documentation of the practitioners' "qualifications" in TT; the immobile palms-up position of the practitioner is atypical of TT practice; controls were arguably inadequate. All of these features could easily be corrected if enough TT practitioners were to volunteer for a new study with a mutually agreed protocol. For some other recent experimental tests of TT, see Scheiber and Selby (2000, chapters 13–22).

[32] Supporters and critics of TT are in general agreement as to these basic facts: among the supporters, see e.g. Krieger (1987, p. 8; 1993, pp. 5, 187; 2002, p. 12), Fontaine (2000, p. 221), Freeman and Lawlis (2001, p. 493); among the critics, see e.g. Rosa *et al.* (1998, p. 1005), Stahlman (2000, pp. 37–39, 47–48), Glazer (2000b, p. 320). Nevertheless, these figures should be taken with a grain of salt, inasmuch as both advocates and detractors of Therapeutic Touch have an interest in exaggerating its incidence, albeit for different reasons.

[33] Kolata (1998, p. A20). If true, this is an astounding figure. Even if the course of study lasts only one week, it amounts to training a new class of 35 students each week, year in year out, for a quarter-century. According to a recent textbook of alternative medicine, "estimates of the total number of persons that have learned therapeutic touch now exceed 85,000" (Freeman and Lawlis 2001, p. 493).

[34] OCLC WorldCat, as of November 7, 2003. Available on-line at `http://newfirstsearch.oclc.org/`

[35] My account of pseudoscience and postmodernism in nursing is strongly indebted to the pioneering work of health journalist Sarah Glazer (2000a, 2000b). While I have added much new detail and documentation, the basic thread of the story is the one traced by Glazer.

Pseudoscience in nursing (I)

> **Experiential Exercise 5.** This exercise, "The Emperor's Clothes," is designed to test your perception of cues in the healee's energy field. I call the human energy field "the Emperor's Clothes" because, like the emperor's new clothes in the fairy tale of that name, the human energy field is invisible. To a bystander, the healer doing a Therapeutic Touch assessment seems to be attending to something that is invisible or imaginary.
>
> — *Dolores Krieger (1993, p. 32)*

Therapeutic Touch (TT) was invented in the early 1970s by Dolores Krieger, a professor of nursing at New York University, in collaboration with Dora Kunz, a noted clairvoyant and soon-to-be president of the Theosophical Society in America.[36,37] Krieger explains that

> Therapeutic Touch derives from, but is not the same as, the ancient art of the laying-on of hands.... Therapeutic Touch has no religious base; it is a conscious, intentional act; it is based on research findings; and Therapeutic Touch does not require a declaration of faith from the healee (patient) for it to be effective.[38]

She notes that

> The term *Therapeutic Touch* may in fact be a misnomer because, in practice, the healer need not make physical contact with the patient (healee). Much of the work done by the person playing the role of healer has as its primary focus the modulation of the healee's energy field rather than the touch or manipulation of his or her skin.[39]

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[36] Krieger (1979, pp. 4–13; 1981, pp. 138–147) provides a brief history of the development of Therapeutic Touch. See also Stahlman (2000) and Sarner (2002) for more detailed histories, written by critics.

[37] Kunz (1991, pp. 5–6) recalls that "Both my mother and grandmother had psychic abilities ... As for my clairvoyance, I suppose I began to become aware of it and to develop it when I was around six or seven years of age."

The Theosophical Society is a mystico-religious organization founded in 1875 by the celebrated psychic Helena Petrovna Blavatsky together with the lawyer Henry Steel Olcott. For a history, see Campbell (1980); additional information can be found in Carlson (1993) and Godwin (1994). Dora Kunz served as president of the American section from 1975 through 1987.

[38] Krieger (1981, p. 138). Freeman and Lawlis (2001, p. 495) confirm that "this process does not require that the patient consciously participate, nor is its effect dependent on the patient's belief in the intervention."

[39] Krieger (1993, p. 11), italics in the original.

More precisely,

> *Illness is an imbalance in an individual's energy field.* In Therapeutic Touch, the healer directs and modulates this energy field, using the sense of touch as a telereceptor ... You as the healer act as a human support system, your own healthy energy field providing the scaffolding to guide the repatterning of the healee's weakened and disrupted energy flow.[40]

The Therapeutic Touch process consists of five phases:

1. Centering oneself.
2. Making an assessment of the healee.
3. "Unruffling" the field.
4. The direction and modulation of energy.
5. Recognizing when it is time to stop.[41]

Krieger is vague about the precise nature of the "human energy field", but she does make clear that it is not merely electromagnetic.[42] According to Krieger,

> the human energy field [is] a complex of many interpenetrating fields whose properties dynamically interrelate in a pattern we recognize as human nature. This field functions like a transformer. These foci convert energy systems, or prana, into the kind of energies that make our psychophysiological being what it is. The foci or transformers themselves are chakras. Their primary functions are to collect, change and distribute the prana to the organs of our physical bodies. These foci form the matrix of the chemicophysical field and the psychodynamic field in the individual and set the stage for psychosomatic functioning.[43]

Indeed, energy fields are not limited to humans, as Krieger enjoins the reader to

> Take every opportunity to become sensitive to the living energy field. If you are unable to work on people under your present circumstances, assess the energy fields of your pets or other domestic animals, the trees in your neighborhood (particularly if they are coniferous or eucalyptus

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[40] Krieger (1993, pp. 12–13), italics in the original.

[41] Krieger (1979, p. 69).

[42] Krieger (1987, p. 7). Of course, many biological processes involve low-level electric and magnetic fields within the body; but these fields decay rapidly outside the body and in any case cannot be detected or significantly affected by human hands.

[43] Krieger (1987, p. 41).

> trees, which radiate an immense energy field relative to their size), or groups of flowers.[44]

Although the human energy field is as yet unmeasurable by instruments, almost anyone can learn, with sufficient practice, to sense it[45]:

> Most frequently, the cues you pick up in the healee's energy field during the assessment are one or a combination of the following:
> - Temperature differentials, such as a sense of heat or cold.
> - Pressure, or feelings of congestion in the energy flow.
> - Changes in or lack of synchronization in the intrinsic rhythmicity of the healee's energy field.
> - Localized weak electric shocks or tingly feelings as you move the energy centers in the palms of your hands through the healee's energy field.[46]

Indeed, regular practice of Therapeutic Touch often leads to increased proficiency in the use of other natural human faculties, such as telepathy[47]:

> From written accounts in my students' journals, indications of the use of telepathy can be perceived on the average of two-and-a-half weeks from the time they put the healing techniques into consistent practice.[48]

Healing through Therapeutic Touch occurs by "unruffling" and "rebalancing" the healee's energy field, thereby allowing for the resumption of a more natural energy flow, and by transferring energy in a directed fashion from healer to healee.[49] One prominent advocate of Therapeutic Touch explains the process as follows:

> In a state of health, the life energy flows freely in, through, and out of the organism in a balanced manner, nourishing all the organs of the body. In disease, the flow of the energy is obstructed, disordered, and/or depleted. Therapeutic Touch practitioners, having learned to attune to the universal field through a conscious intent, direct the life energy into the patients to enhance their vitality. The practitioners also help the patients assimilate the energy by releasing congestion and balancing areas where

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[44] Krieger (1993, p. 35).

[45] Krieger (1979, pp. 3, 57; 1993, p. 25).

[46] Krieger (1993, p. 46).

[47] Krieger (1979, pp. 70–71; 1987, chapter 5).

[48] Krieger (1987, p. 78).

[49] Krieger (1979, chapter 7; 1993, chapters 3 and 4).

> the flow has become disordered. Drawing upon the universal field, the practitioners do not become drained of their own energy but, on the contrary, are continually replenished.[50]

Krieger explains the mechanism in greater "scientific" detail, as follows:

> Human beings are open systems. They appear to be a nexus of all fields of which life partakes. That is, human beings are the energetic matrices of inorganic as well as organic fields, psychodynamic as well as conceptual fields (i.e., electromagnetic is only one interface of the whole complex). Human beings are therefore exquisitely sensitive to wave phenomena (i.e., energy). I perceive a healer to be an individual whose personal health gives him access to an overabundance of *prana* for the well-being of others. (Prana is a Sanskrit term for what we in the West think of as the organization of energy that underlies the life process.) Prana is concerned with the intrinsic rhythmicity of energy . . .
>
> Using deductive logic I re-examined my previous studies in the life sciences. It occurred to me that at the physical level, this projection of human energy during the healing act grounds itself in the ill person via electron transfer resonance.[51]

As a physicist, I am not impressed.[52]

Pseudoscience in nursing (II)

How seriously are Therapeutic Touch and other pseudoscientific "healing modalities" taken in the nursing profession? I cannot claim to have made a comprehensive study of this question, but I would like to present briefly one illustration.

In 1999 the American College of Nurse-Midwives devoted a special issue of its official organ, the *Journal of Nurse-Midwifery*, to the topic of "complementary and alternative therapies in women's health". An introductory editorial insisted strongly on the importance of evidence-based practice, including scientifically sound studies of safety and efficacy.[53]

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[50] Macrae (1988, p. 4).

[51] Krieger (1987, p. 7), italics in the original. See also Krieger (1981, p. 143).

[52] It is true (and obvious) that human beings are open systems, i.e. they interact with the world around them. Everything else in this quotation is nonsense, despite the purportedly scientific language. For what it's worth, "wave phenomena" and "energy" are not synonyms, nor does energy have any "intrinsic rhythmicity". "Electron transfer resonance" is not, to my knowledge, a standard term in either physics or chemistry.

[53] Raisler (1999, p. 190).

Fortunately, a few of the accompanying articles do live up to that declaration. One article provides a fairly cautious summary of the currently available evidence concerning the efficacy of complementary and alternative therapies, underlining the need for randomized and (where possible) double-blinded clinical trials.[54] Another article provides scientific information concerning the efficacy and safety of various herbal preparations claimed to induce labor.[55] A third reports a retrospective study aimed at testing whether evening primrose oil is effective in shortening labor or reducing the incidence of post-dates pregnancies (the results are negative).[56]

But the level of most of the remaining articles is abysmally low. Two articles present homeopathic doctrine[57] as fact, without the slightest critical analysis.[58] While admitting that "the mechanism to explain *how* homeopathy works has not been discovered"[59], both articles take for granted not only the efficacy of homeopathic remedies beyond the placebo effect, but also the validity of homeopathic teachings such as the vital force, the Law of Similars, and the Law of Potentization. A review of a book

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[54] Murphy, Kronenberg and Wade (1999).

[55] McFarlin, Gibson, O'Rear and Harman (1999).

[56] Dove and Johnson (1999).

[57] Homeopathy was developed by Samuel Hahnemann (1755–1843), and its basic principles remain largely unchanged to this day, despite radical advances in our understanding of physics, chemistry and biology that thoroughly undermine its alleged scientific basis. Its central tenets are the so-called Law of Similars, or "like cures like" (i.e. the claim that a disease can be cured by small doses of a substance that in larger doses produces symptoms similar to the disease itself); the so-called Law of Potentization, i.e. the claim that homeopathic remedies become *stronger* with each successive dilution, provided that they are shaken ("succussed"); and a vitalist theory of biology which holds that living beings are endowed with some special quality ("vital force") that transcends the ordinary laws of physics.

It is important to stress that homeopathy is *not* a species of herbal medicine. Plants contain a wide variety of substances, some of which can be biologically active (with either beneficial or harmful consequences, depending on the situation). Homeopathic remedies, by contrast, are pure water and starch: the alleged "active ingredient" is so highly diluted that in most cases *not a single molecule remains in the final product.*

[58] Castro (1999) and Brennan (1999). Castro begins (p. 280) by stating, without any qualifications, that "Homeopathy is an effective and scientific system of healing ... The homeopathic principles constitute a unified hypothesis whose validity is tested empirically: cured patients confirm the hypothesis."

[59] Brennan (1999, p. 292), emphasis in the original.

on "homeopathy for midwives", appearing in the same issue, is equally uncritical.[60]

Another article discusses the theory and practice of Therapeutic Touch, starting with uncritical presentation of Kunz's and Krieger's notions of the "human energy field" ("an ovoid of many-colored light interpenetrating and surrounding the physical body, and extending out from it to a distance of about twelve to eighteen inches") and Rogers' theory of Unitary Human Beings ("incorporating Bertalanffy's Systems Theory with quantum physics").[61] To its credit, this article also includes discussion of some skeptical studies, including Emily Rosa's famous experiment. The authors "compliment Ms. Rosa for attempting to conduct an experiment to detect energy fields", but assert that "the only reasonable conclusions that can be supported by the data is [*sic*] that a small group of practitioners of TT were unable to detect an energy field around one individual's hand".[62] They go on to cite two "qualitative" studies that take for granted the validity of Therapeutic Touch and report patients' "experiences" of their own energy fields[63], but they do not cite any positive evidence that "human energy fields" actually exist or that Therapeutic Touch practitioners can sense them. Nevertheless, they state unreservedly their belief that

> more definitive proof will come from the investigation of the process of TT, that is, the intentionality involved in the conscious desire to help or heal another. This task, however, may be as elusive as the ability to prove that prayer causes healing. In support of a more spiritual approach to the issue of energy transference, Zefron quoted an anonymous scientist who said, "... we have come to the conclusion that a vibration of very high intensity and extremely fine wave-length with tremendous healing power, caused by spiritual forces operating through the mind of man, is the next thing science expects to discover." It may possibly be the spiritual aspect of this energy exchange that remains so elusive.[64]

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[60] Krov (1999).

[61] Fischer and Johnson (1999, pp. 301, 302).

[62] Fischer and Johnson (1999, p. 304).

[63] For a devastating critique of one of these two studies, devoted to documenting "children's lived experiences of perceiving the human energy field", see Glazer (2000b, pp. 331–332).

[64] Fischer and Johnson (1999, pp. 306–307). It goes without saying that the claim of the "anonymous scientist" is nonsense.

Pseudoscience in nursing (III)

> [The] author can be excused of dishonesty only on the grounds that before deceiving others he has taken great pains to deceive himself.
>
> — *Peter Medawar (1961, p. 99)*

Tracking down the intellectual precursors of pseudoscience in nursing, one is soon led to the work of Martha E. Rogers (1914–1994), professor of nursing and Head of the Division of Nursing at New York University from 1954 through 1975.[65] In her 1970 book, *An Introduction to the Theoretical Basis of Nursing*, Rogers single-handedly "created a science that had never existed before", as one of her disciples modestly put it.[66] Here is how the founder of the Science of Unitary Human Beings explains her system as of 1986:

> Four concepts are postulated to be basic to the proposed system, namely: energy fields, openness, pattern, and four-dimensionality. These concepts are defined consistent with the general language and are given specificity according to the conceptual system under discussion.
>
> Energy fields are postulated to constitute the fundamental unit of both the living and the nonliving. *Field* is a unifying concept. *Energy* signifies the dynamic nature of the field. *Energy fields* are infinite. Two energy fields are identified: the human field and the environmental field. Specifically, human beings and environment *are* energy fields.[67]

After briefly conscripting relativity, quantum theory, probability, evolutionary theory and space exploration in support of the conclusion that "the closed-system, entropic model of the universe" is no longer tenable, Rogers goes on to explicate the last three of her basic concepts:

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[65] Malinski, Barrett and Phillips (1994) is a useful biography of Rogers edited by her disciples, which also contains extensive excerpts from her writings and a series of brief articles "saluting" her contributions to nursing and to science.

[66] Phillips (1994a, p. vii). Not only is Rogers "the 20th-century [Florence] Nightingale" (Fitzpatrick 1994, p. 322); she is also "a leader in the development of contemporary science" who has "made major contributions to science at large", extending far beyond nursing (Phillips 1994b, pp. 330, 335). Indeed, Rogerian scholarship "will revolutionize all views of the universe, similar to Einstein's theory of relativity" (Phillips 1997, p. 18).

[67] Rogers (1986, p. 4), emphasis in the original, reprinted in Malinski, Barrett and Phillips (1994, p. 234).

> In a universe of open systems, causality is not an option.... Energy fields are open — not a little bit or sometimes, but continuously. The human and environmental fields are integral with one another. Causality is invalid. Change is continuously innovative.
>
> *Pattern* is defined as the distinguishing characteristic of an energy field perceived as a single wave....
>
> Four-dimensionality characterizes the human and environmental fields. It is defined as a nonlinear domain without spatial or temporal attributes. All reality is postulated to be four-dimensional.[68]

An uncharitable reader (such as myself) might object that this pseudoscientific verbiage is perfectly meaningless.[69] But Rogers has an answer:

> Definitions increase in clarity and specificity as the conceptual system emerges. The unitary human being (human field) is defined as an irreducible, four-dimensional energy field identified by pattern and manifesting characteristics that are different from those of the parts and cannot be predicted from those of the parts. The environmental field is defined as an irreducible, four-dimensional energy field identified by pattern and manifesting characteristics that are different from those of the parts. Each environmental field is specific to its given human field. Both change continuously, mutually, and creatively. The human and environmental fields are infinite and integral with one another.[70]

With this lucid clarification in hand, we can push onwards from concepts to principles:

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[68] Rogers (1986, p. 5), emphasis in the original, reprinted in Malinski, Barrett and Phillips (1994, p. 235).

[69] For instance, "energy" and "field" both have precise (not metaphorical!) meanings in physics; but "energy field", a key term in Rogers' writings, is meaningless in physics. Of course, Rogers and her supporters might reply that they are not purporting to give these terms their standard meaning in physics, but are instead providing their own definitions. That would be fine in principle; the trouble is that Rogers' purported "definitions" are as meaningless as the terms allegedly being defined. For instance, Rogers says that "Four-dimensionality ... is defined as a nonlinear domain without spatial or temporal attributes." But she nowhere clarifies what she means here by "domain" (much less "domain without spatial or temporal attributes"); moreover, the mathematical adjective "nonlinear" is meaningless in this context. Every one of Rogers' "definitions" suffers from a similarly fatal vagueness. See also Raskin (2000, p. 34) for a patient dissection of Rogers' pseudoscience.

[70] Rogers (1986, p. 5), reprinted in Malinski, Barrett and Phillips (1994, p. 235).

Unifying principles and hypothetical generalizations derive from the conceptual system. The Principles of Homeodynamics are three in number and together postulate the nature and direction of change. These principles are set forth as follows:

PRINCIPLES OF HOMEODYNAMICS

Principle of Resonancy	The continuous change from lower to higher frequency wave patterns in human and environmental fields
Principle of Helicy	The continuous, innovative, probabilistic increasing diversity of human and environmental field patterns characterized by nonrepeating rhythmicities
Principle of Integrality	The continuous mutual human field and environmental field process[71]

In later years, Rogers continued to make improvements in her system, replacing "four-dimensional" with "multidimensional" and finally "pandimensional", while deleting "probability" in favor of "unpredictability".[72]

The Science of Unitary Human Beings makes numerous empirically testable predictions, for example:

> The principle of helicy subsumes within it the principles of reciprocy and synchrony, and postulates further explanatory and predictive dimensions of nursing's theoretical system. The principle of helicy connotes that the life process evolves unidirectionally in sequential stages along a curve which has the same general shape all along but which does not lie in a plane. Encompassed within this principle are the concepts of rhythmicality, negentropic evolutionary emergence, and the unitary nature of the man-environment relationship.
>
> ...
>
> The principle of helicy ... may be stated in symbolic form thus:

$$H = f\,S\text{-}T_1\,(M_1 \rightleftarrows E_1)\,\underset{\curvearrowright}{i}\,f\,S\text{-}T_2\,(M_2 \rightleftarrows E_2)\,\underset{\curvearrowright}{i}\,\text{—}f\,S\text{-}T_n\,(M_n \rightleftarrows E_n)$$

in which H stands for helicy

$\curvearrowright$ stands for the spiral of life

i stands for innovation

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[71] Rogers (1986, pp. 5–6), reprinted in Malinski, Barrett and Phillips (1994, p. 235).

[72] Rogers (1990, 1992). A useful overview of the evolution of Rogers' Science of Unitary Human Beings is given by Malinski (1994). See also Malinski (1986, pp. xiii–xix).

> and can be read as: "Helicy is a function of continuous innovative change growing out of the mutual interaction of man and environment along a spiralling longitudinal axis bound in space-time."[73]

Not to mention the following:

> Clairvoyance, for example, is rational in a four-dimensional human field in continuous mutual, simultaneous interaction with a four-dimensional environmental field. So too are such events as psychometry, therapeutic touch, telepathy, and a wide range of other phenomena. Within this conceptual system such behaviors become "normal" rather than "paranormal."[74]

> Unitary human and environmental rhythms find expression in the rhythmicities of the living–dying process. Just as aging is deemed developmental, so too is dying hypothesized to be developmental. The nature of the dying process and after-death phenomena have gained considerable public and professional interest in recent years.... A new approach to studying the dying process is provided by the conceptual system herein presented. The nature and continuity of field patterning subsequent to dying, while admittedly a difficult area to study, nonetheless is open to theoretical investigation.[75]

What is the rational reader to make of the Science of Unitary Human Beings? From a logical or empirical point of view, there is only one appropriate word: loony. From a stylistic point of view, Rogers' mumbo-jumbo is perhaps a cut or two above run-of-the-mill New Age fare, but is vastly inferior to the sophisticated charlatanry produced by virtuosos of the genre such as Jacques Lacan, Julia Kristeva, Gilles Deleuze, Félix Guattari and Paul Virilio.[76]

Despite this, Martha Rogers has attracted around herself a devoted cult of followers, who have edited books with titles like *Explorations of Martha*

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[73] Rogers (1970, pp. 99–101), reprinted in Malinski, Barrett and Phillips (1994, pp. 217–218). Please note that Rogers' "equation" is mathematically meaningless. Her use of symbols resembling (to a layperson's eye) a mathematical equation is nothing more than a crass attempt to give her ideas a veneer of "scientificity"; the "equation" in fact adds nothing to its verbal "translation" (which, alas, is also scientifically meaningless).

[74] Rogers (1980, p. 335), reprinted in Malinski, Barrett and Phillips (1994, p. 230).

[75] Rogers (1986, p. 8), reprinted in Malinski, Barrett and Phillips (1994, p. 237).

[76] See e.g. Sokal and Bricmont (1998, chapters 2, 3, 9 and 10).

Rogers' Science of Unitary Human Beings, *Visions of Rogers' Science-Based Nursing*, *Rogers' Scientific Art of Nursing Practice*, and *Patterns of Rogerian Knowing*.[77] Rogers' "visionary" work is kept alive by the Society of Rogerian Scholars, which publishes a thrice-yearly newsletter, the *Rogerian Nursing Science News*, and an annual scholarly journal, *Visions: The Journal of Rogerian Nursing Science*.

Most importantly, the influence of Rogers' ideas now extends far beyond her circle of immediate disciples, reaching into the mainstream of the nursing profession. Textbooks on nursing theory often devote a chapter, in utter seriousness, to the Science of Unitary Human Beings.[78] Rogers' work is cited frequently in the academic nursing literature: for instance, *An Introduction to the Theoretical Basis of Nursing* has been cited 289 times since its 1970 publication.[79] Student dissertations extend and apply her system: at least 91 dissertations (74 doctoral, 17 masters) were completed between 1977 and 2002 that have "Martha Rogers" or "Science of Unitary Human Beings" in the title or abstract.[80] And finally, in 1996, a mere two years after her death, Martha Rogers was inducted into the Hall of Fame of the American Nurses Association, the main professional group for nurses in the United States. Her citation begins and ends as follows:

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[77] Malinski (1986), Barrett (1990), Madrid and Barrett (1994), Madrid (1997). See also Rogers, Malinski and Young (1985), Sarter (1988), Lutjens (1991), Barrett and Malinski (1994).

[78] For example: Riehl-Sisca (1989), McQuiston and Webb (1995), Meleis (1997), Fawcett (2000), Young, Taylor and Renpenning (2001), George (2002), Marriner-Tomey and Alligood (2002), Alligood and Marriner-Tomey (2002). It is important to note that Rogers' Science of Unitary Human Beings is by no means the only pseudoscientific theoretical framework that has achieved prominence within the nursing profession. As one advocate of "alternative/complementary modalities" points out,

> there are several nursing theories that incorporate the concept of "human energy field" and "environmental energy field", specifically Rogers' Theory of Unitary Human Beings, Newman's Theory of Expanding Consciousness, and Parse's Theory of Human Becoming. All energy-based modalities are congruent with these theories. While Therapeutic Touch (TT) is a modality developed by and researched by nurses, other energy-based modalities such as Reiki and Healing Touch techniques are widely used by and taught to non-nurses. (Frisch 2001)

In fact, most of the textbooks cited above also have chapters on Newman's and Parse's theories.

[79] Science and Social Science Citation Indexes combined, as of November 7, 2003. Available at `http://isi4.isiknowledge.com/`

[80] Dissertation Abstracts, as of November 6, 2003. Available at `http://wwwlib.umi.com/dissertations/` It is likely that many masters' dissertations are missing from this database.

> Widely known for her discovery of the science of unitary human beings, Martha E. Rogers provided a framework for continued study and research, and influenced the development of a variety of modalities, including therapeutic touch....
>
> A proponent of rigorous scientific study, Rogers wrote three books that enriched the learning experience and influenced the direction of nursing research for countless students: *Educational Revolution in Nursing* (1961), *Reveille in Nursing* (1964), and *An Introduction to the Theoretical Basis of Nursing* (1970), the last of which introduced the four Rogerian Principles of Homeodynamics. Following her retirement in 1975, Rogers continued to teach at New York University, was a frequent presenter at scientific conferences throughout the world, and consistently worked to refine her conceptual system.... She was honored with numerous awards and citations for her sustained contributions to nursing and science.[81]

Postmodernist philosophy in nursing (I)

I propose now to analyze the writings of nursing pseudoscientists, in an effort to extract their (mostly implicit) epistemological premises. By what means, according to these theorists, can human beings arrive at reliable knowledge of the world? I shall attempt, in particular, to assess the extent to which the advocates of pseudoscience have resorted to postmodernist arguments. (In the next subsection I will focus on nursing theorists whose primary identification is with postmodernism, and assess the extent to which they have endorsed pseudoscience.)

The literature of "complementary and alternative nursing" is replete with contrasts between mainstream scientific medicine — which these authors criticize as mechanistic, reductionist and anti-human — and the evolving "holistic" paradigm.[82] For example:

> Biomedical or Western medicine ... is founded on the philosophical beliefs of René Descartes (1596–1650), that the mind and body are separate, and on Sir Isaac Newton's (1642–1727) principles of physics, that the universe is like a large mechanical clock where everything operates in a linear, sequential form. The mechanistic perspective of medicine views the human body as a series of body parts. It is a reductionistic approach in which the person is converted into increasingly smaller components:

[81] The full text of the citation is available at `http://nursingworld.org/hof/rogeme.htm` (accessed January 12, 2004).

[82] See Williams (1985) for a judicious and balanced overview of "holistic nursing".

> systems, organs, cells, and biochemicals. People are reduced to patients, patients are reduced to bodies, and bodies are reduced to machines.[83]

Of course, this is simplistic, to say the least. For what it's worth, Newtonian physics is perfectly capable of describing complex interactive systems that need not "operate in a linear, sequential form" (whatever that may mean).[84] Scientific reductionism, understood as the view that there are no autonomous principles of chemistry or biology that are not ultimately rooted in physics, in no way entails reductionism *as a methodology* for investigating the world: this may be an appropriate method for studying some phenomena and not for studying others.[85] Finally, science in no way enjoins doctors to ignore the emotional needs of their patients or to treat them as mere "bodies" and "machines". (Insurance companies may do so, however.)

Advocates of "holistic healing" also criticize mainstream science for ignoring alleged good evidence in favor of homeopathy, Therapeutic Touch, telepathy, healing by distant prayer, and other phenomena that are inconsistent with the modern scientific worldview. For example:

> When therapies such as acupuncture or homeopathy are observed to result in a physiologic or clinical response that cannot be explained by the biomedical model, many have tried to deny the results rather than modify the scientific model.... If people limit themselves to the five senses, they will never come to understand human energy fields, electromagnetic fields, thoughts as a form of energy, or the healing power of prayer.[86]

It is important to note that the foregoing critiques, radical and global though they may be, are aimed at the *content* of modern science, not at its epistemology or methodology. Indeed, advocates of "holistic healing" frequently buttress their case with appeals to scientific evidence of a perfectly

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[83] Fontaine (2000, pp. 4–5). Very similar comments are made by the editor of a recent textbook on "complementary and alternative medicine" (Micozzi 2001, p. 4).

[84] Note also that the allusion to Descartes is highly misguided. If modern science has any characteristic worldview, it is surely not Cartesian dualism, but rather materialist monism, i.e. "the view that there is essentially only one kind of 'reality,' one kind of material existence, governed by its unique and invariable set of laws or, if you prefer, regularities" and in particular that the mind "must be understood as a physical function of a physical body". Descartes' philosophy is more accurately understood as a dead end in the history of science, "a late, postmedieval attempt to rescue the world of thought from the monism toward which it was apparently heading". (Quotations from Levitt 1999, p. 19) Alas, this clarification is hardly likely to increase the fondness of "holists" for modern science.

[85] For a clear explanation of this point, see Weinberg (1992, chapter III; 1995).

[86] Fontaine (2000, p. 12).

traditional kind: experiments, observations, clinical trials, deductions from accepted theories, etc. The quality of this evidence is often ludicrously low, as is the cogency and precision of the reasoning accompanying it; that is why much of this literature can properly be characterized as pseudoscience. But it is not — or at least not yet — postmodernist.

Furthermore, despite the ritual denunciation of soulless modern science, holistic theorists also shamelessly wrap themselves in its mantle:

> Einstein said that all matter is energy, energy and matter are interchangeable, and all matter is connected at the subatomic level. No single entity could be affected without all connecting parts being affected. In this view, the universe is not a giant clock, but a living web. The human body is animated by an integrated energy called the *life force*. The life force sustains the physical body but is also a spiritual entity that is linked to a higher being or infinite source of energy.[87]

(Poor Albert must be turning over in his grave.)

> Tibetan Buddhists ... believe that thought is infinitely powerful and actually holds sway over matter. Quantum physics is increasingly lending credence to this notion, in that infinite energy can be an attribute of an infinitely short wave of vibration — that is, energy as ascribed to thought processes helps to make new understandings of mind-body interactions.[88]

(Ugh.) The modern-physics-justifies-New-Age-medicine argument is also proferred, in vastly more sophisticated form, by Larry Dossey, executive editor of the journal *Alternative Therapies in Health and Medicine* and author of numerous best-selling books on health and spirituality. Dossey repeatedly invokes quantum mechanics to argue that the mind is "nonlocal" and hence capable of telepathy, prophecy, and healing by prayer-at-a-distance.[89] This

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[87] Fontaine (2000, p. 6), emphasis in the original. The first sentence of this quote is a fairly accurate, though incredibly superficial, summary of certain aspects of special relativity (interchangeability of energy and matter) and quantum mechanics (interconnectedness in a certain limited sense). But to call the universe a "living web" is pure metaphor; and the last two sentences of this quote are a complete *non sequitur*. It goes without saying that modern physics provides no support whatsoever for the notion of "life force".

[88] Watson (1999, p. 106). The author is a Distinguished Professor of Nursing at the University of Colorado Health Sciences Center and former president of the National League for Nursing. For what it's worth, quantum physics does *not* lend any credence whatsoever to the bizarre notions proferred by Watson.

[89] Dossey's earliest work (1982, pp. 98–101, 122–134, 146–150, 194–196, 208–209, 233–234) invokes quantum mechanics, as interpreted in the extremely controversial speculations of

idea is picked up by the editors of a handbook on holistic nursing, who assert that

> Era III [nonlocal or transpersonal medicine], the newest and most advanced era, originated in science. Consciousness is said to be nonlocal in that it is not bound to individual bodies. The minds of individuals are spread throughout space and time; they are infinite, immortal, omnipresent, and, ultimately, one.[90]

Holistic theorists do, however, also criticize scientific methodology, with the clear aim of "moving the goal post" in studies of alternative treatments. For example, Karen Lee Fontaine asserts that the method of double-blind clinical trials

> is based on the assumption that single factors cause and reverse illness, and that these factors can be studied alone and out of context. Alternative medicine, however, believes that no single factor causes anything nor can a magic substance single-handedly reverse illness. Multiple factors contribute to illness, and multiple interventions work together to promote healing. The double-blind method is incapable of reconciling this degree of complexity and variation.[91]

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some physicists, to argue that human consciousness is a fundamental element in the ontology of the universe. In later books he elaborates on this theme, stressing the element of nonlocality — a rather technical, very important, but also extremely controversial aspect of quantum physics (see e.g. Mermin 1993 and Maudlin 1994) — from which he draws increasingly exotic conclusions about telepathy and kindred "phenomena": see Dossey (1989, pp. 153–186 and *passim*; 1993, pp. 84–85, 128, 155–156; 1999, pp. 26–27, 68; 2001, pp. 113–114, 189–191, 238–239). At one point, Dossey (1993, p. 85) observes correctly that quantum-mechanical nonlocality *cannot* be used to send messages — thereby demolishing his claimed physical basis for telepathy — but he then goes on to conjecture, bizarrely and erroneously, that "perhaps nonspecific prayer strategies do *not* violate physics' prohibition on sending messages nonlocally" (p. 85, emphasis in the original). For clearly explained critiques of "quantum medicine" and "quantum parapsychology", see Stalker and Glymour (1985a) and Gardner (1981).

[90] Dossey and Guzzetta (2000, p. 11). These notions are also incorporated into the *Core Curriculum for Holistic Nursing* developed by the American Holistic Nurses' Association (AHNA) and are enshrined in the Practice Examination Questions designed to help the reader prepare for the Holistic Nursing Certification (HNC) exam. See Dossey (1997, pp. 7–8, 249). Some parts of this Core Curriculum are quite bizarre. For example, in the chapter on "energetic healing", among the "knowledge competencies" required of the student are to "Describe two characteristics of an electromagnet", "Discuss the quantum theory of consciousness-created reality", "Compare a Fourier analyzer to the chakra system and L–C circuits to individual chakras", and "Describe one traditional portrayal of an aura" (Dossey 1997, chapter 7, p. 52).

[91] Fontaine (2000, p. 12).

These claims are false. Irrespective of whether the proposed treatment (a) consists of single or multiple interventions, and (b) is standardized or is tailored to the specific patient, it can be compared against a placebo or alternate treatment in a randomized and (in most cases) double-blind study.[92] Fontaine goes on to observe that

> Although major alternative medical systems may not have a great deal of quantitative research, they are generally *not* experimental. They rely on well-developed clinical observational skills and experience that is guided by their explanatory models.[93]

But the *inadequacies* of "well-developed clinical observational skills and experience" in providing reliable evidence of statistical causation are precisely what led medical researchers to develop randomized, double-blind studies in the first place. Fontaine does not explain how practitioners of alternative medicine manage to escape from these known inadequacies.[94] She concludes by saying that

> This text does not offer meticulous documentation for all claims which are made by the various therapies.... Successful alternative therapies, however, should not be withheld from the public while research is being debated.[96]

This of course begs the question of whether the therapies at issue *are* in fact successful — an assertion that can only be tested by rigorous research.[96]

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[92] To be sure, double-blinding is not always feasible or effective: the patient may be able to deduce from the drug's side effects whether he is in the experimental or control group; and for some interventions it may be physically impossible to devise "sham" interventions that maintain the double-blinding. The classic example of inability to blind is the path-breaking study, "Is coitus implicated in causing pregnancy?: A report of preliminary findings" (Liebovitch 1970–71).

[93] Fontaine (2000, p. 12), emphasis in the original.

[94] Fontaine (2000, p. 12) makes the valid observation that medical tests and procedures are not subject, under current American law, to the same rigorous evaluation that new drugs are required to undergo. But the proper remedy would be to close this loophole by requiring a higher standard of scientific evidence for all medical interventions, not to extend the loophole by lowering the standard of proof for "alternative" treatments (some of which are indeed drugs). Indeed, most "alternative" treatments are already exempt from regulation, either *de jure* or *de facto*.

[96] Fontaine (2000, p. 12).

[96] Even cruder versions of begging the question can be found in the writings of other advocates of "alternative healing practices". For instance:

> [T]he fact that cellular, organ, and whole-organism phenomena, as are reported in mice and people under the influence of *qigong* and other energy healing modalities,

These animadversions against double-blind clinical trials constitute blatant special pleading, but they are not *per se* postmodernist. At other moments, however, advocates of pseudoscience do engage in preemptive postmodernist rhetoric. Consider the following passage, in which Kuhn's alleged incommensurability of paradigms is implicitly invoked (in a radical form that even Kuhn — at least the later Kuhn — would very likely disavow):

> Scientific beliefs rest not just on facts but on paradigms.... A common yet seemingly almost invisible presumption is that "experts" of conventional medicine are entitled and qualified to pass judgment on the scientific and therapeutic merits of alternative therapies. Since the paradigm is quite different, they are not qualified.[97]

In other words, each paradigm is entitled to set up its own criteria for judging the scientific merits of proposed theories, and these judgments are declared (by fiat) immune from rational critique by adherents to another paradigm.[98,99]

Some prominent nursing pseudoscientists have endorsed even more explicit forms of postmodernist relativism. A telling example is provided

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have continued to attract patients and practitioners for literally thousands of years, must surely indicate that there is something of untold significance to be rediscovered. (Jobst 2002, p. 524)

Homeopathy is an effective and scientific system of healing ... The homeopathic principles constitute a unified hypothesis whose validity is tested empirically: cured patients confirm the hypothesis. (Castro 1999, p. 280)

[O]ur intuitive faculty is nothing other than a source of sound premises about the nature of reality.... [T]here exists within us a source of direct information about reality that can teach us all we need to know. (Weil 1998, pp. 151–152; see also p. vii)

See Beyerstein (1999, 2001) for an incisive analysis of some common errors of reasoning among advocates and users of alternative medicine; and see Relman (1998) for a detailed analysis and critique of the epistemology underlying the writings of Andrew Weil, the self-described "guru of alternative medicine".

[97] Fontaine (2000, p. 10).

[98] Similar arguments are offered by many advocates for (or sympathetic analysts of) "complementary and alternative medicine". See, for example, the essays of Cassidy and Watkins contained in Micozzi (2001), and the essays of Schaffner, Hufford, O'Connor, Wolpe and Tauber contained in Callahan (2002).

[99] For a summary and critique of Kuhn's ideas on the incommensurability of paradigms, see Chapter 6 above (pp. 191–197); and for a more detailed analysis, see Maudlin (1996).

by Dolores Krieger, co-inventor of Therapeutic Touch. Immediately after claiming that Therapeutic Touch "is based on rational theory derived from formal research that requires rigorous replication" — an affirmation that she deems necessary because "science is the reality that Western civilization accepts" — she goes on to emphasize that

> there is not only one reality, or even specified "alternate" realities, that satisfy all the conditions for reality among the many cultures of our global village, Earth. It is now recognized that the concept of multiple realities is valid; a particular view of reality is dependent only upon the particular facet of human consciousness that is permitted to operate at the time.[100,101]

Along similar lines, Jean Watson, Distinguished Professor of Nursing at the University of Colorado Health Sciences Center and former president of the National League for Nursing — and one of the major contemporary theorists of nursing pseudoscience[102] — avers that

> The art and science of nursing with its concern with caring-healing and health as a field of study, research and practice within its own paradigm is realizing that in this postmodern time, science, knowledge and even images of nursing, health, environment, person become one among many truth games.[103]

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[100] Krieger (1993, p. 6).

[101] Another example of extreme postmodernist relativism is provided in a recent textbook on complementary and alternative medicine: "[A]ll answers are right from within the logic of the model in use.... From this position, clinicians, researchers, or students ... can avoid becoming mired in determining which method is true because nothing is really true when all realities are constructed." (Cassidy 2001, p. 21) Similarly, a disciple of Martha Rogers states that "the Rogerian ontology does not distinguish between subjective and objective realities. Furthermore, pandimensionality recognizes multiple, even infinite, realities." (Butcher 1999, p. 113) Finally, another nursing theorist sympathetic to the "new paradigm" ideas of Rogers and her successors argues that "upon close examination of the ontologies, it is clear that core postmodern ideas, such as constructed realities, the centrality of meaning and interpretation, and valuing the multivocality of discourse, are also central to the new paradigm ontologies" (Cody 2000, p. 94).

[102] Watson's pseudoscientific theories can be found in Watson (1999). See also Watson and Smith (2002), in which Watson's Caring Science and Rogers' Science of Unitary Human Beings are "creatively synthesized" into a new Unitary Caring Science; and see the extensive interview with Watson published by Fawcett (2002).

[103] Watson (1995, p. 63).

Finally, the grander theorists of nursing pseudoscience — such as Martha Rogers and her successors — have built elaborate systems on a fog of verbiage reminiscent of, though vastly less sophisticated than, that of Deleuze and Guattari.[104] Their method, to the extent that one can be discerned, seems to be to *postulate* an abstract system and then "deduce" its consequences. In principle that procedure could be assimilated to the hypothetico-deductive approach characteristic of modern science, but the trouble is that the starting "principles" are so vague ("Field is a unifying concept. Energy signifies the dynamic nature of the field. Energy fields are infinite.") that there is no precise way of distinguishing valid from invalid "deductions", much less of deducing falsifiable empirical predictions. The whole exercise becomes, in the end, little more than an elaborate taxonomy of angels, replete with scholastic arguments as to whether those angels are "four-dimensional" or "multidimensional" or "pandimensional". This approach makes contact with another aspect of what I have called postmodernism, namely, theoretical discourses disconnected from any empirical test.

Postmodernist philosophy in nursing (II)

Postmodernist ideas originating in literary criticism, continental philosophy and feminist theory began to be influential among nursing theorists in the early 1990s.[105] Starting then, there appeared a surprising number of citations to Heidegger, Foucault, Derrida, Rorty and other "postmodernist" philosophers.[106]

Theoretical articles on postmodernism in nursing tend to recycle the same arguments and rhetoric as are found in postmodernist writings in the social sciences and literary theory. The argumentation tends to remain on an abstract philosophical or political plane, and rarely addresses concrete questions of nursing interventions or the methodology by which they should

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[104] For comparison, see the introduction to the University of Warwick conference devoted to "DeleuzeGuattari and Matter", cited in Levitt (1999, pp. 85–86). Or see Sokal and Bricmont (1998, chapter 9).

[105] The Cumulative Index to Nursing and Allied Health Literature (CINAHL) lists 131 articles using the words "postmodernis$" or "poststructural$" ($ = anything) in the title or abstract. The first of these articles appeared in 1989, but in the period 1989–94 they averaged only 2 per year; starting in 1995 they took off and averaged 14 per year, continuing up to the present. Data are as of December 10, 2003. See also the much larger number of articles cited in the next footnote. CINAHL is available on-line at `http://gateway.ovid.com/`

[106] CINAHL shows a whopping 663 articles that mention Foucault in the title, abstract or bibliography/cited references, Heidegger with 531, Rorty with 99, and Derrida with 81. Nearly all of these citations appeared in 1995 or after. Data are as of December 10, 2003.

be evaluated.[107] At the level of epistemology, some authors are fairly precise while others are maddeningly vague:

> Postmodernism is a rejection of the modern, post-Enlightenment concern with the rational and scientific.... [T]ruth is seen as problematic and not necessarily progressively accessible through scientific exploration or logical reasoning. Complexity and ambiguity are celebrated and inconsistencies, paradoxes and contradictions are not of concern ... [N]ursing ideas and nursing research are good if the stories they tell allow nurses and people in care to get on with their lives.[108]

> Such an ontological and epistemological shift [associated with postmodernism] invites and works with context, connections, relations, multiplicity, ambiguity, openness, indeterminacy, patterning, paradox, process, transcendence and mysteries of the human experience of being-in-the-world ... [109]

Though postmodernist nursing theorists seem in general reluctant to commit themselves concerning specific nursing interventions — particularly those claiming biological effects — a recent debate in the pages of the journal *Nursing Philosophy* brought some of these issues to the fore. An article by health journalist Sarah Glazer, criticizing both Therapeutic Touch and

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[107] See e.g. the essays in Omery, Kasper and Page (1995), Kikuchi, Simmons and Romyn (1996), and Thorne and Hayes (1997).

An extreme example of nursing postmodernism can be found in a recent article by Holmes *et al.* (2006), who assert that "the evidence-based movement in the health sciences is outrageously exclusionary and dangerously normative with regards to scientific knowledge" and as such "act[s] as a *fascist* structure" (p. 180, emphasis in the original). Referring to the international collaboration for evidence-based medicine organized by Scottish physician-epidemiologist Archie Cochrane (1909–1988), these authors assert that

> The classification of scientific evidence as proposed by the Cochrane Group thus constitutes not only a powerful mechanism of exclusion for some types of knowledge, it also acts as an organising structure for knowledge and a mechanism of ideological reinforcement for the dominant scientific paradigm. In that sense, it obeys a fascist logic. (p. 184)

The word "fascist" and its derivatives occur more than 25 times in this six-page article (though no precise definition is ever given). The authors might or might not be humbled to learn that "fascist" Cochrane served, while still a medical student, as a volunteer in the International Brigades during the Spanish Civil War, helping to defend the Spanish republic against the fascist uprising led by General Franco, and that he subsequently spent four years as a prisoner of war in Nazi Germany.

[108] Stevenson and Beech (2001, pp. 144–145, 149).

[109] Watson (1995, p. 61).

the postmodernist trend in nursing, was answered by Janice L. Thompson on behalf of postmodernism.[110] Thompson repeatedly protested (at least five times in four-and-a-half pages, by my count) that her view is not "antiscientific":

> Like most nurses who have been influenced by advanced study, I have considered the dilemmas of developing truth claims outside the discourses of science. No longer comfortably modern in my professional identity, I don't believe that there is *a* condition for 'right reason'. There are many. This plural view does not mean that I am nihilistic or antiscientific. It means that I recognize science as one among many way(s) to produce meaning and truth.[111]

Glazer responded that

> I do argue that the scientific method is the correct approach for evaluating factual claims about the world (e.g. 'Cigarette smoking is a cause of lung cancer', 'Energy fields exist that can be sensed by therapeutic touch practitioners'). Thompson and other nurses of the postmodern persuasion confuse moral with factual issues. Thompson repeatedly insists that she is not 'antiscientific'.... But one cannot believe in the scientific method and also believe in 'other ways', such as intuition, for evaluating *factual* claims like those of therapeutic touch.[112]

Thompson went on to assert, as did Fontaine, the alleged incommensurability of paradigms, linking it directly with therapeutic touch, shamanic healing and homeopathy:

> As a non-discursive practice, therapeutic touch, like shamanic healing, may elude our current epistemic 'paradigms'. Precisely for this reason, we should be careful about how and why we judge it.... [T]o argue for evidence-based practice means we must consider the questions 'What evidence?' and 'Whose evidence?'. These are the very questions that have been and will continue to be highly contested in the ongoing story of therapeutic touch. They are the questions that emerge when allopathic providers encounter the healing practices of homeopathic providers. When western physicians encounter the shamanic practices of folk healers from other cultures.... They are questions that always emerge when

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[110] Glazer (2000b), Thompson (2002), Glazer (2002).

[111] Thompson (2002, pp. 59–60), emphasis in the original.

[112] Glazer (2002, p. 64), emphasis in the original.

> *incommensurable* truth claims meet and the framework for adjudicating these differences eludes us.[113]

As Glazer observed in her rebuttal,

> I find it interesting that Professor Thompson doesn't address the central question of my article, which is why a highly suspect therapy known as therapeutic touch continues to be practised and embraced by nurses. After reading Thompson's critique, I am still not sure whether this is because she finds therapeutic touch to be an embarrassment to the profession or because she believes in it but is unwilling to defend it openly.[114]

At one point in her essay, however, Thompson descends from the abstract plane and addresses concrete nursing theories; curiously, this is also the only place in the article where her tone shifts from patient rebuttal to indignation. While pleading unfamiliarity with therapeutic touch, Thompson adds that

> I am familiar, however, with the work of Martha Rogers and I am offended by the characterization of her offered by an author who appears to have limited knowledge of Professor Rogers' studies. We may disagree with some of the applications that have been made in therapeutic touch, but we should at least acknowledge with respect the commitment of this intellectual who carefully studied the work of her mentors in theoretical physics. She was a widely read and very strong interdisciplinary scholar.[115]

As Glazer aptly comments, "One does not have to be a physicist to find Rogers' use of physics to justify therapeutic touch laughable."[116] But just for the record, let me state that Rogers does not exhibit the slightest knowledge of physics — not even at the level of the freshman survey course for non-scientists that I frequently teach. Rather, she borrows terms from physics and then throws them around without regard for their meaning.[117]

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[113] Thompson (2002, pp. 60–61), emphasis mine.

[114] Glazer (2002, p. 63).

[115] Thompson (2002, p. 60). See Dzurec (1989, p. 75) for another example of a postmodernist nursing theorist commenting favorably on Rogers' Science of Unitary Human Beings.

[116] Glazer (2002, p. 63).

[117] Rogers' grasp of basic physics is perhaps also illustrated by her enthusiastic and wholly uncritical endorsement of Immanuel Velikovsky's crackpot theories of astronomy (Rogers 1970, p. 12). For further analysis of Rogers' pseudo-physics, see Glazer (2002, p. 63) and Raskin (2000, p. 34).

Concluding remarks

In writing this account of pseudoscience and postmodernism in nursing, I have endeavored to immerse myself in the nursing literature, but my study makes no pretense of being comprehensive. Many questions still await careful quantitative (and of course also qualitative) investigation by sociologists and historians. How widespread is the teaching of pseudoscience in American nursing schools, and the practice of pseudoscience in American hospitals? In what way have these evolved over time? How popular is postmodernist philosophy among professors and students of nursing, both in its "high" form (Heidegger, Derrida, Foucault, . . .) and in its watered-down form (loose talk about social construction and a multiplicity of perspectives)? To what extent, and in what ways, do pseudoscience and postmodernism overlap (both intellectually and sociologically) in the nursing community? To what extent have these trends spread (or developed independently) outside the United States? What are the social and psychological forces underlying the development and spread of pseudoscience and postmodernism within the nursing profession?[118]

Hindu nationalist pseudoscience and postmodernism in India

In an important recent book, *Prophets Facing Backward: Postmodern Critiques of Science and Hindu Nationalism in India*, philosopher-sociologist of science Meera Nanda has recounted in dispiriting detail how postmodernist-oriented leftist Indian intellectuals have, since the early 1980s, unwittingly helped pave the way for the rise to power of right-wing Hindu nationalism — a politico-religious doctrine in which pseudoscience, passed off as real science, plays a central role. I propose here to summarize briefly Nanda's story, laying stress on the ideas put forth by the "postcolonial" theorists on the one hand and the Hindu nationalists on the other, analyzing their similarities and differences. Readers interested in a fuller account of the historical and political context are urged to consult Nanda's engrossing book.[119]

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[118] Preliminary analyses of this last question can be found in Glazer (2000b) and Kleiman (2002).

[119] Nanda (2003). See also the January–March 2005 issue of *Social Epistemology*, which is entirely devoted to a discussion of Nanda's book, comprising 10 review essays (some of them vituperatively negative) and a detailed response from Nanda.

Postmodernism in India

In July 1981, a group of Indian scientists and intellectuals published a "Statement on Scientific Temper", in which they lamented the persistence of illiteracy, superstition and religiously-grounded social hierarchies in a country that simultaneously boasted of world-class universities and the world's third-largest scientifically trained workforce. Noting that "the best Indian minds in the pre-independence times insistently propagated the need for the people to think independently and fearlessly, and to question traditional beliefs" — a ferment that led in time to "a critique of the colonial system [and] ... a powerful national movement for our liberation" — the statement regretted that at independence

> No systematic and sustained effort was made to work out, specifically and concretely, what needed to be done to build a society which is animated by a spirit of enquiry rather than passivity and acceptance. The result ... was accommodation, even compromise, with the forces of obscurantism and with the existing inegalitarian social and economic structures.[120]

Three decades later,

> There is a cancerous growth of superstition at all levels. Rituals of the most bizarre kind are frequently performed often with official patronage. Obscurantist social customs are followed even by those whose profession is the pursuit of scientific enquiry. Our entire educational system works in an atmosphere of conformity, non-questioning and obedience to authority.[121]

The statement's signatories urged the cultivation of rationalist and scientific habits of mind in the service of social justice:

> The spirit of inquiry and the acceptance of the right to question and be questioned are fundamental to Scientific Temper.... It leads to the realisation that events occur as a result of interplay of understandable and describable natural and social forces and not because someone, however great, so ordained them.... When the social structure and stratification prevent the application of rational and scientifically proven solutions, the role of Scientific Temper is to lay bare the anatomy of such social barriers.[122]

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[120] Haksar *et al.* (1981, p. 7).

[121] Haksar *et al.* (1981, p. 7).

[122] Haksar *et al.* (1981, pp. 8–9).

The idea was not new: decades earlier, Jawaharlal Nehru, the first Prime Minister of India, had lauded

> the adventurous and yet critical temper of science, the search for truth and new knowledge, the refusal to accept anything without testing and trial, the capacity to change previous conclusions in the face of new evidence, the reliance on observed fact and not on preconceived theory, [and] the hard discipline of the mind ... The scientific approach and temper are, or should be, a way of life, a process of thinking, a method of acting and associating with our fellow men.[123]

The Statement on Scientific Temper was an attempt to reclaim Nehru's Enlightenment vision in an unevenly modernizing India.[124]

But the Statement was immediately subjected to harsh attack from neo-Gandhian intellectuals, using what in later years would be called "post-modernist" arguments. The first shot was fired by Ashis Nandy, who disparaged the Statement as "ultra-positivist", "pseudo-empiricis[t]" and "a posthumous child of colonialism" and proceeded to launch a full-scale onslaught against modern science in all its aspects: technological, social and epistemological.[125] Assailing the complicity of scientists in both inter-state warfare and within-state oppression, Nandy observed (correctly) that "science today is big business" and (more dubiously) that "in some [unnamed] countries, more illness is now caused by the modern medical system than by natural causes"; all in all, he asserted, "science today is the main instrument of oppression in the world".[126] But the problem, according to Nandy, is not merely the misuse of science for oppressive ends; it is the scientific worldview itself. In the case of Galileo,

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[123] Nehru (1946, p. 523). Nehru's book was written in April–September 1944 in Ahmadnagar Fort prison, where he and other leaders of the Indian independence movement had been interned by the British since mid-1942.

[124] Indeed, since the 1960s a plethora of People's Science Movements have been active throughout India — numbering well over 100,000 members in total — under the banner of "science for social revolution", which includes promoting a scientific worldview "in order to demystify the religious legitimations of caste, patriarchy, and other sources of discrimination based on concepts of purity" (Nanda 2003, p. 220). For more information on these movements, see Zachariah and Sooryamoorthy (1994) and Isaac *et al.* (1997).

[125] Nandy (1981, pp. 16, 17).

[126] Nandy (1981, pp. 17, 16), commentary in brackets added by me.

> it was the Church which proved itself more open and sought to have plural images of the cosmos. Galileo, like the signatories to the statement, thought he knew the truth and he wanted to oust all other concepts of truth. The Church, though it might have gone about it foolishly and hamhandedly, objected to that part of the story.[127]

Asserting that the argument against astrology had already been "so badly mauled by Paul Feyderabend [*sic*] on scientific, normative and methodological grounds" that the details need not be rehashed, Nandy added that

> in a world where arbitrary authorities constantly deny one control over one's fate, a situation created partly by modern science and technology, astrology is for the poor a psychological defence; it is an attempt to find meaning for an oppressive present in a controllable future.... Everything said, astrology is a myth of the weak; modern science that of the strong.[128]

The bottom line, said Nandy, is that "We must learn to reject the claim to universality of science. *Science is no less determined by culture and society than any other human effort.*"[129] Nandy urged the development of a counter-consciousness

> which accepts science as only one of the many imperfect traditions of humankind and which allows the peripheries [of] the world to reclaim their human dignity and reaffirm ... various forms of traditions, religions and myths.[130]

Over the next decade, Nandy's attack on "Western" science was taken up by a cohort of "postcolonial" Indian intellectuals, in books and articles with titles like *Science, Hegemony and Violence* (edited by Nandy), *Science, Development and Violence* (written by Claude Alvares), and "Reductionist

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[127] Nandy (1981, p. 17).

[128] Nandy (1981, p. 17). Let me stress that my quarrel is only with the second sentence, which asserts the epistemic equality of astrology and modern science. The first sentence may well be an astute sociological observation (that is an empirical question that I am not competent to assess). But the following recent comment by Nandy (assuming that he has been accurately quoted) is worth noting: " 'Astrology hardly has any influence among the illiterate and poor in rural India,' said a sociologist, Asish [*sic*] Nandy. 'It's the urban educated, grappling with an increasingly complex and uncertain reality, who are in its thrall.' " (Rahman 2003)

[129] Nandy (1981, p. 18), emphasis in the original.

[130] Nandy (1981, p. 17).

Science as Epistemological Violence" (written by Vandana Shiva). These writings make three central claims:

- *Modern science is fundamentally violent and exploitative*, against both Nature and human beings. This violence does not result merely from the misuse of scientific knowledge through militarist, economically oppressive or ecologically unsound technology, but is inherent in the modern scientific worldview itself.
- *Modern science's claim to universality and objectivity is illusory.* Modern science is, in reality, nothing more or less than the ethno-science of the West; modern scientific "knowledge", far from being objective and universal, is permeated with Western values. Other ways of knowing are equally valid, and in some cases superior.
- *Each civilization has the right to create its own science*, in conformity with its own traditions.

It is not my purpose here to expound in detail the reasoning leading to these claims, much less to explain why I think this reasoning is grossly deficient.[131] Rather, I would simply like to illustrate, by means of a few quotations of representative passages, these three fundamental themes.

The most innovative aspect of the postcolonial Indian authors on science, compared to the Western postmodernists, is the shrill assertion that modern science is inherently violent.[132] For instance, Claude Alvares argues

> that both science and the technology based on it are fundamentally violent forms of handling the world, that violence is intrinsic to science, to its text, to its design and implementation.... There is no way in which the science of our times can be dissociated from its structure of violence.[133]

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[131] Suffice it to say that, like much postmodernist discussion of science, these claims are based on simplistic readings of controversial works in the philosophy of science (notably Kuhn and Feyerabend), combined with cavalier leaps of (il)logic about subtle issues like the role of epistemic and nonepistemic values in science, the theory-ladenness of observation, the epistemic status of scientific knowledge, the multiple aspects of reductionism, and the conceptual and socioeconomic relations between science and technology. For more detailed critiques of postmodernist and "postcolonial" claims in the philosophy of science, see Nanda (2003, chapters 5 and 6), Haack (1998, 2003) and Brown (2001); and see also Chapter 6 above.

[132] This theme can also be found in some Western authors, beginning with Carolyn Merchant (1980), albeit most often in a less extreme form.

[133] Alvares (1988, pp. 70–71). See also Alvares (1992, p. 64) for a similar statement.

Likewise, Ashis Nandy asserts that

> There is a direct correlation between the claims to absolute objectivity, inter-subjectivity, internal consistency, dispassion and value-neutrality, on the one hand, and violence, oppression, authoritarianism, killing uniformity and death of cultures, on the other.[134]

In fact, Nandy says, "modern science [is] the basic model of domination in our times and ... the ultimate justification for all institutionalized violence."[135] Vandana Shiva concurs that modern science is intrinsically violent, and locates the source of this alleged violence more specifically in scientific reductionism[136]:

> I argue that modern science is violent even in peaceful domains such as, for example, health care and agriculture ... The argument is based on the premise that modern science is quintessentially reductionist.... In order to prove itself superior to alternative modes of knowledge and be the only legitimate mode of knowing, reductionist science resorts to suppression and falsification of facts and thus commits violence against science itself ... [137]

Secondly, it is argued that modern science's claim to universality and objectivity is illusory. According to Claude Alvares,

> The claim of modern science to a universalism independent of culture (and cultures) is the first instance of its kind.... For all practical purposes, however, modern science is nothing more and nothing less than western science, a special category of ethno-science. In fact, its too readily assumed universalism has had disastrous consequences for other ethno-sciences.[138]

Ashis Nandy is even more explicit:

> We must learn to reject the claim to universality of science. *Science is no less determined by culture and society than any other human effort....*

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[134] Nandy (1981, p. 18).

[135] Nandy (1987b, p. 122).

[136] Unfortunately, Shiva rides roughshod over the crucial distinctions between different notions of reductionism. For a clear discussion of these different notions, see Weinberg (1992, chapter III; 1995).

[137] Shiva (1988, pp. 232–233). See also Shiva (1989, chapter 2).

[138] Alvares (1992, p. 150).

> *Modern science is one of the many traditions available to humankind. It is also one of the many traditions of science.* Unfortunately, like some of the semitic creeds, it claims to be the only truth outside all traditions. It is time for us to affirm that modern science has the right to praselytise [*sic*] but not to forcibly convert.[139]

Vandana Shiva likewise avers that modern science's "claim to truth" is "fraudulent", and adds that

> The fact-value dichotomy is a creation of modern, reductionist science which, while being an epistemic response to a particular set of values, claims to be independent of values. According to the received view, modern science is the discovery of the properties of nature in accordance with a 'scientific method' which generates 'objective', 'neutral', 'universal' knowledge. This view of modern science as a description of reality as it is, unprejudiced by value, can be rejected ... [S]cientific facts are determined by the social world of scientists, not by the natural world.[140]
>
> If reductionist science has displaced non-reductionist modes of knowing, it has done so not through cognitive competition, but through political support from the state ... The 'facts' of reductionist science are socially constructed categories which have the cultural markings of the western bourgeois, patriarchal system which is their context of discovery and justification.[141]

Finally, the postcolonial theorists seek to create "alternative" sciences on the foundations of traditional religions and values, as well as on the "folk" beliefs of the common people:

> *The common man has not only his traditional or folk science, he has his own philosophy of science.* It might be vague, implicit and non-professional but it is informed with the experience of suffering. Such folk sciences and folk philosophies must be taken seriously. In fact, we can hope to build an indigenous science only when such lost sciences and implicit philosophies are respectfully articulated by contemporary Indian scholars.[142]

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[139] Nandy (1981, p. 18), emphasis in the original.

[140] Shiva (1988, pp. 233–234, 237).

[141] Shiva (1989, pp. 24, 27).

[142] Nandy (1981, p. 18), emphasis in the original.

The proclaimed strategy is one of syncretism, i.e. incorporating selected elements from modern science while rejecting its worldview:

> The critical traditionalism I am talking about does not have to see modern science as alien to it, even though it may see it as alienating. It sees modern science as part of a new cognitive order which can be occasionally used for critical purposes within the earlier traditions. Such traditionalism uncompromisingly criticizes isolation and the over-concern with objectivity, but it never denies the creative possibilities of limited objectivity.... Such a tradition refuses to give primacy to the needs of pure cognition at the expense of totality of consciousness ... [143]

The precise content of the proposed "alternative" science is left vague, as are the criteria for deciding which elements from traditional beliefs and modern science are to be included and which discarded. Nevertheless, the urgency of a new science is stressed:

> The search for alternatives to reductionism is basically a political struggle which cuts across material and intellectual domains. The non-reductionist alternatives that people across the world are building together is a non-violent science that respects the integrity of nature and man and truth and seeks the liberation of the people ... [144]

> [O]ne day there will have to be post-modern societies and a post-modern consciousness, and those societies and that consciousness may choose to build not so much upon modernity as on the traditions of the non-modern or pre-modern world.[145]

But at the same time as postmodernist Indian intellectuals were singing the praises of "local knowledges" and "pre-modern traditions" against "colonialist Western science", other Indian intellectuals were making this encomium concrete.

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[143] Nandy (1987a, pp. 125, 124).

[144] Shiva (1988, p. 255).

[145] Nandy (1987a, p. xvii). See also the essay by Nandy and Visvanathan (1990), which is a paean to Theosophy, vitalist biology and Ayurvedic medicine as allegedly prescient critiques of modern scientific medicine ("a politically powerful knowledge system which shows immediate practical results in some areas but is intellectually, socially, and morally disorienting", p. 181). In lauding "cognitive resistance to the gross appetite of modern science" (p. 175), Nandy and Visvanathan go so far as to approvingly quote Gandhi: "to study European medicine is to deepen our slavery" (p. 174).

Hindu nationalism and "Vedic science"

> [T]he conclusions of modern science are the very conclusions the Vedanta reached ages ago; only, in modern science they are written in the language of matter.
>
> — *Swami Vivekananda (1970 [circa 1900], vol. 3, p. 185)*

> Many of the questions arising in Quantum Physics today had been anticipated by Swami Vivekananda.
>
> — *N.S. Rajaram (1998, p. 192)*

> [T]he Ṛgveda is a book of particle physics and cosmology.
>
> — *Raja Ram Mohan Roy (1998, p. xiii)*

On February 23, 2001, the University Grants Commission (UGC) — the central government body overseeing the funding of higher education in India — announced that

> there is an urgent need to rejuvenate the science of Vedic Astrology in India, to allow this scientific knowledge to reach to the society at large and to provide opportunities to get this important science even exported to the world ... [Accordingly,] the Commission decided to approve in principle [the] setting up of a few departments of Vedic Astrology in Indian universities ... leading to certificate diploma, under-graduate, post-graduate and Ph.D. degrees.[146]

The plan provoked a storm of protest from Indian scientists and rationalist intellectuals.[147] But what on earth prompted such a bizarre decision in the first place?

The answer, not surprisingly, is politics: more precisely, the Hindu nationalist politics of the Bharatiya Janata Party (BJP), which governed India

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[146] Government of India, Department of Education (2001). In the first year of the plan's operation, "the UGC selected 19 universities for providing exclusive teaching and training in the subject leading to undergraduate, postgraduate and doctoral degrees. During the financial year 2001–02, an amount of Rs. 2.71 crore [= 27.1 million rupees ≈ $600,000] was paid to 17 universities for setting up of these departments." (Government of India, Department of Education 2003, p. 132) Though this sum is modest, it is nearly double what was spent in the same year for upgrading/modernizing the computer centres at 59 Indian universities (*ibid.*, p. 145).

[147] See e.g. Ramachandran (2001), Balaram (2001) and Jayaraman (2001a, 2001b), among many others. In particular, Jayaraman (2001a) provides a detailed explanation of why astrology is a pseudoscience.

between March 1998 and May 2004. The BJP is the political expression of a multifaceted mass movement for *Hindutva*, or "Hindu-ness", "an ultranationalist and chauvinistic movement that seeks to modernize India by recovering the supposedly pristine Vedic-Hindu roots of Indian culture".[148] As part of its program for the Hinduization of Indian education, the BJP rewrote school history textbooks to excise the contributions of Muslims and other non-Hindus, and promoted university-level courses not only in Vedic Astrology (*Jyotir Vigyan*) but also in *karmakanda* (Hindu priestly rituals), *vastu shastra* (sacred architectural rules), "human consciousness and Yogic science", and "Vedic mathematics".[149]

Science plays a central role in Hindu nationalist ideology.[150] As Nanda explains,

> Hindu nationalists are obsessed with science. They are obsessed with science the way creation scientists are obsessed with science. They use the vocabulary of science to claim that the most sacred texts of Hinduism ... are, in fact, scientific treatises, expressing in a uniquely holistic and uniquely Hindu idiom, the findings of modern physics, biology, mathematics, and nearly all other branches of modern natural science.[151]

At the same time,

> Vedic science is supposed to lead to a better, a more whole natural science that will cure the reductionism and matter-spirit dualism of "Western" science. Vedic science apologists promise to "raise" the lower knowledge (*apāra vidya*) of "mere matter" provided by modern science by integrating it into the "higher knowledge" (*pāra vidya*) of the spirit disclosed by their own traditions.[152]

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[148] Nanda (2003, p. 4).

[149] See Menon and Rajalakshmi (1998), Pannikar (2001), Bidwai (2001) and Menon (2002) on the rewriting of history textbooks; Ramachadran (2001), citing the UGC guidelines, on *vastu shastra* and Vedic mathematics; Government of India, Department of Education (2003, pp. 134–135) on Yogic science; and Nanda (2003, pp. 73, 75–76) generally. See also Dani *et al.* (2001) for a scathing critique of "Vedic mathematics", signed by over a hundred Indian mathematicians, scientists and other academics, and Patnaik (2001) for a probing critique of the BJP educational policies.

[150] Another central aspect of Hindu nationalist ideology — not discussed here, for lack of competence on my part — is the tendentious rewriting of the early history and archaeology of South Asia. For a detailed analysis, see Witzel (2006).

[151] Nanda (2003, p. 65).

[152] Nanda (2003, p. 66). See, for instance, Frawley (1990, p. 117): "In the Vedic system knowledge is defined as both higher and lower or superior and inferior (para and apara). The lower

In this way, Hindu nationalists seek to legitimate as "scientific" not only such traditional practices as Vedic astrology, *vastu shastra* and Ayurvedic medicine but also the classical Hindu cosmology in which the human social hierarchy is determined by karma (moral or immoral deeds in previous lives). Furthermore, any aspects of modern science that challenge this cosmology — for instance, the modern understanding of biology that makes reincarnation unlikely, to put it mildly — are quietly ignored: "Modern science is being absorbed into an elite Brahminical-Vedantic form of Hinduism, without admitting any contradictions between the two, and thus, *without allowing any challenge to the latter's anti-naturalistic, anti-rational, and anti-democratic aspects.*"[153]

The intellectual method followed by the Hindutva ideologues is straightforward:

> [A]ny traditional Hindu idea or practice, however obscure and irrational it might have been through its history, gets the honorific of "science" if it bears any resemblance at all, however remote, to an idea that is valued (even for the wrong reasons) in the West. Thus, obscure references in the Vedas get reinterpreted as referring to nuclear physics. By staking a phony priority, modern science gets domesticated; it was always contained in India's "wisdom" anyway.[154]

The example was set by Swami Vivekananda (1863–1902), one of the founding fathers of modern neo-Hinduism:

> Today we find wonderful discoveries of modern science coming upon us like bolts from the blue, opening our eyes to marvels we never dreamt of. But many of these are only re-discoveries of what had been found ages ago. It was only the other day that modern science ... discovered that what it calls heat, magnetism, electricity, and so forth, are all convertible into one unit force ... But this has been done even in the Samhita ... [155]

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or inferior knowledge consists of the knowledge of the outer world.... All science is a form of the lower knowledge, as it is based on measurement and mathematics and the information which comes to us through the senses."

[153] Nanda (2003, p. 8), emphasis in the original.

[154] Nanda (2003, p. 72).

[155] Vivekananda (1970 [1897], vol. 3, pp. 398–399). This excerpt comes from a lecture on "The Vedanta" delivered at Lahore on November 12, 1897.

after which he goes on to expound Vedic cosmology:

> The unit from which [gravitation, electricity, magnetism and other forces] spring is called Prâna. Again, what is Prana? Prana is Spandana or vibration. When all this universe shall have resolved back into its primal state, what becomes of this infinite force? Do they think that it becomes extinct? Of course not. If it became extinct, what would be the cause of the next wave, because the motion is going in wave forms, rising, falling, rising again, falling again? ... At the end of a cycle, everything becomes finer and finer and is resolved back into the primal state from which it sprang ... And what becomes of all these forces, the Pranas? They are resolved back into the primal Prana, and this Prana becomes almost motionless — not entirely motionless; and that is what is described in the Vedic Sukta: "It vibrated without vibrations" — Ânidavâtam.[156]

And so on and so forth for pages on end — but without, alas, ever citing anything even vaguely resembling Maxwell's equations of electromagnetism.

Contemporary Hindu-nationalist intellectuals, many of whom are trained scientists and engineers, have brought this art to an even higher level of refinement. For instance, Subhash Kak, a professor of electrical and computer engineering at Louisiana State University and one of the leading intellectual luminaries of the Hindu-nationalist diaspora, claims to find "astronomical codes" in the *Rig Veda*'s descriptions of ritual fire altars, using a method that, as Nanda wryly observes, "is breathtakingly ad hoc and reads like numerology 101".[157] Even more ludicrously, Raja Ram Mohan Roy[158] asserts that "the Vedas are a coded book ... of particle physics and cosmology": thus, verses referring to wild and domestic animals are *really* alluding to fermions and bosons, respectively; passages recounting the destruction of black-skinned people are in fact "about annihilation of anti-matter"; and the phrase "ten-finger form" in the Puruṣa hymn gives us "compelling evidence of [the] universe being considered ten-dimensional in Vedic cosmology", just as in modern superstring theory.[159] As Nanda comments, this method "eras[es]

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[156] Vivekananda (1970 [1897], vol. 3, p. 399).

[157] Nanda (2003, p. 112). For details of Kak's calculations, see Kak (1994) and Feuerstein, Kak and Frawley (1995, pp. 201–208); and for a critique, see Plofker (1996), Witzel (2001, section 28) and Nanda (2003, pp. 112–114).

[158] A contemporary author, not to be confused with the early-nineteenth-century Indian reformer of the same name.

[159] Roy (1998, pp. xii–xiii, 115, 56, 30–31). Subhash Kak provides a foreword in which he lauds Roy's "audacious reinterpretation of [the] Vedic system of knowledge" (p. xv) and concludes: "Roy's book is a bold, new way of looking at Vedic physics. Since he is a pioneer, this

all distinctions between science and associative thinking, the latter being the hallmark of magic".[160]

But the goal of Hindutva is not simply to claim priority for the invention of modern science; rather, it is to insist that "Western" science is an *inferior* version of the true Vedic science:

> The gist of this argument, as it appears in Hindu nationalist writings on Vedic science, is simple — all that is dangerous and false in modern science comes from the Semitic monotheistic habit of dualistic and "reductionist" thinking, which separates the object from the subject, nature from consciousness, the known from the knower. All that is truly universal and true in modern science comes from the Hindu habit of "holistic" thinking, which has always seen the objects in nature and the human subjects not as separate entities but as different manifestations of the same universal consciousness. For the non-logocentric Hinduism, reality is not objective, but "omnijective", a co-construct of mind and matter together. While Western science treats nature as dead matter, Hindu sciences treat nature as a sacred abode of gods. Thus Hindutva scholars claim that traditions of yoga, transcendental meditation (TM) and Ayurveda are sciences of the future, for they bring matter in alignment with the "cosmic energy" that permeates all matter.[161]

Of course, if the *Rig Veda* really did contain modern astronomy and elementary-particle physics, one would then be obliged to ask, as Nanda does:

> How did the Vedic sages know all this physics? What was their method? Why don't we find any material evidence of observatories, or records of observations? Invariably, the answer one gets is that the Vedic sages "intuited," "experientially realized," or "directly perceived ... in a flash" the laws of nature by altering their consciousness through yogic meditation. *By knowing themselves, they came to know the world.*[162]

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is not the place to quibble with the details of his story. We celebrate the new path he has hewn through the bush of old scholarship. It is the task of future researchers to further sharpen and modify the ideas of Roy." (p. xviii)

[160] Nanda (2003, p. 115).

[161] Nanda (2004).

[162] Nanda (2003, p. 115), emphasis in the original. Subhash Kak, in his foreword to Roy's book, explicitly reiterates this ancient Vedic idea: "knowing oneself one can know the world!" (Roy 1998, p. xvi, exclamation in the original)

For instance, one advocate of the convergence of science and Vedanta asserts that

> Hindu spiritual doctrines have at the core certain profound insights into the nature of ultimate reality ... Hindu seers were telling us something that is not only meaningful but revelatory about the cosmos and consciousness.... Their assertions ... [arose] from experiential certitudes resulting from sustained experimentation with the subtlest centers of the inscrutable self. Their words and wisdom are to be taken, therefore, not simply as magnificent mythopoesy but as findings about the translucent aspects of the physical universe ... [163]

The method is explained in more detail in another influential Hindutva work:

> The Vedic worldview acknowledges that there is an intimate relationship between the cosmic, the terrestrial, and the spiritual, which is expressed in terms of equivalences. The idea of equivalence, which is fundamental to what has been called initiatic science, is that the universe is an interconnected system ... A related idea is that the macrocosm is mirrored in the microcosm ... [and that] the human being is a mirror image of the cosmos.... By *postulating* [emphasis mine – A.S.] interconnections and similarities across Nature, they [the Vedic thinkers] were able to use logic to reach extremely subtle conclusions about diverse aspects of reality.[164]

As Nanda points out, reasoning founded on purported but unproved

> correspondences and equivalences between different parts of creation is the very essence of magical practices ... [and] was as prevalent in pre-Reformation Europe as it is in India even today.... In the West, this magical view of the world peaked around the Renaissance, and began to decline with the Protestant Reformation and the rise of the mechanical philosophy in the seventeenth century. It saw a brief revival in theosophy

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[163] Raman (2002, pp. 89–90).

[164] Feuerstein, Kak and Frawley (1995, pp. 197–198, 227), emphasis added. As evidence for the claim that the human being is a mirror image of the cosmos, the authors adduce the following: "the Ayurvedic savants made the astonishing discovery that the number of bones in the human body equals the number of days in the year. They arrived at this number by counting the 308 bones of the newborn, 32 teeth, and 20 nails." (p. 197) Even more astonishing, it seems to me, is the discovery, by this method, that the year has exactly 308 + 32 + 20 = 360 days, not 365.25636 (sidereal orbit) as modern astronomers have hitherto naively believed. Feuerstein *et al.* also explain that the theory of correspondences and equivalences underlies the development of other important sciences, notably astrology (p. 211) and Ayurvedic medicine (pp. 212–216).

> and holistic schools of biology in the nineteenth and early twentieth centuries, especially in Germany. It is now a province of fringe occult groups in the West.[165]

But the advocates of Hindutva, when they bother to address this criticism at all, insist that this story is Eurocentric, and appeal implicitly to the alleged incommensurability of paradigms:

> Western scientific thought ... draws on the traditions of Greek rationalist thinking according to which only what is within the purview of the five senses is taken cognisance of.... Scientific methods ... follow some kind of closed scientific reasoning which insulates itself against facts that its methods cannot account for.... How else can they [scientists] dare dismiss Jyotisha [Vedic astrology] which sees a level of existence beyond the purview of the five senses?[166]

Another author goes so far as to assert that, in India, any contradiction between science and religion is impossible:

> The idea of '*contradiction*' is an imported one from the West in recent times by the Western-educated, since 'Modern Science' arbitrarily imagines that it only has the true knowledge and its methods are the only methods to gain knowledge, smacking of Semitic dogmatism in religion.[167]

What is needed, therefore, is the "decolonization of the Indian mind":

> The Hindu revivalist movement perceives itself as the cultural chapter of India's decolonization. This means that it tries to free the Indians from the colonial condition at the mental and cultural level, to complete the process of political and economic decolonization.[168]

And here we make contact with postmodernism and its critique of the transcultural objectivity of modern science. Indeed, some Hindutva ideologues make explicit use of "postmodernist" rhetoric:

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[165] Nanda (2003, p. 116).

[166] Vasudev (2001). The author is editor of *The Astrological Magazine*. This article appeared in *The Organiser*, an English-language publication of the Rashtriya Swayamsevak Sangh (RSS), the main radical Hindu-nationalist organization.

[167] Mukhyananda (1997, p. 94), italics in the original.

[168] Elst (2001, p. 10). The author is a prominent foreign sympathizer of Hindutva.

> We must keep in mind that equally valid alternative scientific formulations are possible — just as we have in medical science Allopathy, Homeopathy, Ayurveda, Unani, Acupuncture, etc. It is not justifiable to say that the Western reductionist and mechanistic scientific way of presentation is the only way.[169]

Others make superficial reference to contemporary philosophy of science in an attempt to make space for "other ways of knowing", such as Yogic introspection:

> According to the Yogic and Vedic system the scientific method is not entirely scientific; that is, it is not truly objective and cannot give us knowledge of reality.... The scientific method is based on making an assumption, inventing a theory, and then amassing data or making experiments to prove the theory. Whatever we assume we are bound to find facts to prove it ... [170]

(If this were true, then scientists would never have to revise their theories.)

> [Modern] science ... fails to take into account knowledge that is accessible through introspection and higher states of awareness as cultivated in the spiritual traditions [such as Hinduism].... Today we often tend to dismiss their knowledge systems, or worldviews, as mere myth. In doing so, we fail to acknowledge that in our push for objective knowledge we too utilize intellectual modes that are not always strictly rational, as has been shown by philosophers like Michael Polanyi and Paul Feyerabend.[171]

(No details of the argument are given; in particular, the authors fail to make the crucial distinction between the context of discovery and the context of

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[169] Mukhyananda (1997, p. 100).

[170] Frawley (1990, p. 20). It goes without saying that the scientific method involves amassing data or making experiments to *test* a theory (or various competing theories), not to *prove* it! Indeed, some philosophers (e.g. Popper) have argued that the essence of the scientific method is the attempt to *falsify* theories. Frawley attempts to justify his final rather extraordinary claim by arguing that "as Einstein noted, it is the theory that determines what the facts are and where to look for them" (p. 20). But this is a vulgarization of Einstein's view. It is indubitably true that *some* theoretical presuppositions are needed to translate raw sensory data into presumed facts about the world, but these theoretical presuppositions need not (and ought not!) include *the particular theory under test*; furthermore, these presuppositions can themselves be subjected, at least in part, to independent experimental tests where needed. For a brief discussion of what the theory-ladenness of observation does and does not entail, see Chapter 6 above (pp. 185–187).

[171] Feuerstein, Kak and Frawley (1995, p. 195).

justification.[172]) Vedic creationists Michael Cremo and Richard Thompson are even more explicit about their intellectual debts:

> We are not sociologists, but our approach in some ways resembles that taken by practitioners of the sociology of scientific knowledge (SSK), such as Steve Woolgar, Trevor Pinch, Michael Mulkay, Harry Collins, Bruno Latour, and Michael Lynch ... [namely that] Scientists' conclusions do not identically correspond to states and processes of an objective natural reality. Instead, such conclusions reflect the real social processes of scientists as much as, more than, or even rather than what goes on in nature.[173]

It is worth noting, however, that some advocates of Hindutva are explicitly non-relativist[174] and advocate the Vedas as the foundation for a universal science and religion:

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[172] In the idiosyncratic process of inventing scientific theories, all methods are in principle admissible — deduction, induction, analogy, intuition and even hallucination — and the only real criterion is pragmatic. On the other hand, the justification of theories must be rational; otherwise we would simply not be doing science.

[173] Cremo and Thompson (1993, p. xxiv). The authors of this 950-page tome are candid about their goals:

> [We] are members of the Bhaktivedanta Institute, a branch of the International Society for Krishna Consciousness that studies the relationship between modern science and the world view expressed in the Vedic literature. This institute was founded by our spiritual master, His Divine Grace A. C. Bhaktivedanta Swami Prabhupāda ... From the Vedic literature, we derive the idea that the human race is of great antiquity.... [W]e expressed the Vedic idea in the form of a theory that various humanlike and apelike beings have coexisted for a long time. (Cremo and Thompson 1993, p. xxxvi)

Seven hundred and fifty pages later, they conclude that, indeed, "anatomically modern humans have coexisted with other primates for tens of millions of years" (p. 750). Nanda comments that

> So far, this United States-based Vedic anti-Darwinism has not made significant inroads in India. Darwinism is not much of an issue in India, as it has never been able to displace the traditional Hindu cosmology in the first place. Creationism in India takes the form of giving a scientific gloss to the Hindu view of transmigration, karma, and cyclical time. (Nanda 2003, p. 119)

[174] "We have won through to the recognition that there is only one science — that the laws of science do not change relative to our varying opinions or beliefs, cultures, or customs.... Similarly, there is only one Truth, one Reality, to be discovered by humanity. There is not a distinct God, or Truth, for each of the world's religions, any more than there is a different Sun or Moon for astronomers of various nations." (Feuerstein, Kak and Frawley 1995, p. 278) Note also that Elst (2001, p. 8) decries postmodernism and claims to "restore objectivity".

> Today we are in need of a philosophy, science, and spirituality that are deep and broad enough to accommodate the emerging global civilization. In releasing our grip on merely local expressions of mind and culture, we inevitably are led back to considering, as did our ancestors, the infinite, eternal, impartite Reality.... This brings us face to face with the need to create a global spirituality that transcends all parochial religious modes of knowledge and experience.... The *Vedas* are the earliest available expression of the perennial philosophy, or universal spirituality.[175]

Regardless of their attitude toward postmodernist relativism, all ideologues of Hindutva concur on two key stances, both of which are asserted by fiat: first, that Yogic introspection, combined with ratiocination using the method of correspondences and equivalences, provides a valid method for obtaining reliable knowledge of the world; and second, that scientific knowledge, properly interpreted, cannot possibly conflict with Vedantic teachings.[176] In this way, Hindu nationalists aim to "domesticate" modern science, taking what suits them and ignoring or reinterpreting the rest, thereby immunizing the traditional Hindu cosmology from empirical critique. The conclusion is invariably the same: "*Modern Western science is partial science and not total science.* ... [T]he greater the advance in Science, the nearer it is coming to the Vedantic conclusions."[177] "[A]ccording to Vedic tradition, science and religion are not only compatible but essentially identical, because both endeavor to know the truth."[178]

Nanda concludes by pointing out that

> There is a deep irony in declaring the rationality found in the three-millennia old Vedic corpus to be at par with how today's natural scientists go about forming and testing hypotheses. If there is one thing that is distinctive about modern science it is that it has learnt to take refutations seriously. Notwithstanding the social interests that promote conformity with the ruling paradigms, and notwithstanding the personal investment of individual scientists in their pet theories, modern science owes its phenomenal success to the institutionalization of skepticism. Paradigms *do* change; old theories and old explanations *are* thrown

[175] Feuerstein, Kak and Frawley (1995, pp. 274–275), italics in the original.

[176] See e.g. Mukhyananda (1997, chapter 5) for a detailed statement. See also Frawley (1990, pp. 20–23) and Feuerstein, Kak and Frawley (1995, pp. 217–228, 272–285), among many others.

[177] Mukhyananda (1997, pp. 92, 104), emphasis in the original.

[178] Feuerstein, Kak and Frawley (1995, p. 279). By the same "logic", David Beckham's and my ways of playing soccer are not only compatible but essentially identical, because both of us endeavor to score goals.

> overboard, however reluctantly and belatedly, when confronted with better evidence, simpler theories, and more comprehensive and consilient explanations.[179]

Pseudoscience, by contrast, is content with recycling "ancient wisdom".

Postmodernism and Hindutva: A comparison

What are the similarities and differences between the ideas advocated by the left-wing "postcolonial" theorists and the right-wing ideologues of Hindutva?

There is one obvious difference: While the advocates of Hindutva are eager to claim modern science as their own, the "postcolonial" intellectuals denounce them for precisely this capitulation to "Western" ways of thinking. But the supposed capitulation is much less far-reaching than it seems: for, as Nanda stresses, Hindu nationalists "claim the Vedas to have presaged all the advances in modern science without admitting that, in fact, modern sciences challenge the metaphysical foundation of the Vedic view of the world".[180] Any findings of modern science that undermine the Vedic metaphysics are either discreetly ignored or else ascribed to Western materialist and monotheistic prejudices. In this way, Hindutva ideologues attempt to have their cake and eat it too.

A second, more subtle, difference concerns their respective attitudes toward the "clash of civilizations". Hindu nationalists believe unabashedly in the existence of an eternal "Hindu worldview" or "Hindu mind", which is inherently opposed to the "Western" (or "Judeo-Christian" or "Semitic") one. Postmodernists, by contrast, are sensitive to anything that smacks of "essentialism"; with some exceptions, they take great care "to define subalternity or marginality not in racial, gender or national identities, but in terms of 'oppositional consciousness' ... [or] the ability to speak".[181] But there is less difference here than meets the eye, for the postcolonial theorists advocate "a *strategic* use of positivist essentialism in a scrupulously visible

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[179] Nanda (2003, p. 121), emphasis in the original.

[180] Nanda (2003, p. 158).

[181] Nanda (2003, p. 156). Hard-core poststructuralists are particularly assiduous in avoiding any whiff of essentialism, but neo-Gandhians and ecofeminists are more ambiguous. An extreme example of neo-Gandhian essentialism is provided in an essay by Ashis Nandy and Shiv Visvanathan (1990, p. 158), who quote approvingly an author who says: "to put women to do men's work is as foolish as to set Beethoven or a Wagner to do engine driving".

political interest"[182], leading them to an attitude that is in practice not significantly different from that of the Hindu nationalists.[183]

On several key points the postcolonial theorists and the Hindutva intellectuals are in substantial (though not complete) agreement. First, they agree that political and economic decolonization must be supplemented by a thoroughgoing "decolonization of the mind". The postcolonialists, along with their postmodernist and social-constructivist supporters in the West, insist that modern science, despite its claims to objectivity, is nothing more than the ethno-science of the West, and they urge the development of "alternative sciences" based on the recovery of "local knowledges" and indigenous cultural traditions.[184] The Hindu nationalists concur, and add that decolonization of the Indian mind requires, in particular, "understanding science through Hindu categories. Echoing the postcolonial critiques of epistemic violence, Hindutva ideologues ... see any scientific assessment of the empirical claims made by the Vedic texts as a sign of mental colonialism and Western imperialism."[185] As Nanda points out, "it is the stress on the preservation of cultural difference — rather than its critical examination — that unites the postcolonialists with Hindutva."[186]

Furthermore, the postmodernists and postcolonialists deny the existence of universal standards of rationality and evidence; they insist that *all* sciences are ethno-sciences, and that each ethno-science must be evaluated according to the norms of its own cultural context. This view is, of course, a central tenet of much contemporary "science studies", particularly in its feminist, multiculturalist and postcolonial wings.[187] Advocates of Hindutva,

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[182] Spivak (1988, p. 13), emphasis in the original.

[183] See Nanda (2003, pp. 156–157) for a more detailed discussion.

[184] Among the Western supporters, Sandra Harding (1996, pp. 21–22) is typical in urging the coexistence of "many, different, and in some respects conflicting representations of nature"; she insists that this does not lead to relativism but rather to "a borderlands epistemology that values the distinctive understandings of nature that different cultures have resources to generate". She does not explain the criteria by which these distinctive understandings are to be reconciled when they conflict, as she admits they will.

[185] Nanda (2004).

[186] Meera Nanda, personal communication to the author, January 15, 2004.

[187] For a detailed discussion of this principle of "epistemic charity", see Nanda (2003, chapter 5). As Susan Haack (1999) observes,

> Proponents of the Higher Dismissiveness [i.e. postmodernists and postcolonialists] aren't always or unambiguously relativist, however; often they shift up and

by contrast, are divided on this question. Some tend towards cultural and intellectual nationalism, while others propound the universal validity of the Hindu worldview. Nearly all accept the validity of modern science as a partial description of the world, but they insist that Vedic science is infinitely superior to modern science, which it both subsumes and surpasses. (The hard-core postmodernists would not agree with this claim to superiority, but the more romantic postcolonials and ecofeminists might, for the reasons to be explained next.)

Finally, many (though not all) postmodernist and feminist critics of modern science lament in particular the disenchantment of Nature wrought by the scientific revolution of the seventeenth century, and argue that the "dualist" separation of spirit/God and matter, together with reductionist scientific methodology, are the source of "violence" against both Nature and women.[188] This theme plays a central role in the work of the Indian postcolonial commentators on science, especially Vandana Shiva. Indeed, the feminist, postcolonial and Hindu theorists all coincide in urging that the reductionist worldview of "Western" science be replaced by a more "holistic" outlook (though the details invariably remain vague). The Hindutva ideologues simply add that the interconnectedness of all things and the immanence of spirit within matter are central tenets of Vedic metaphysics, which is thus ideally suited to become the foundation of a new holistic science.[189]

It should not be supposed, however, that the Hindu nationalists simply appropriated the theses propounded by the postcolonial theorists. On the contrary, Nanda observes,

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> back between relativism and tribalism: between denying that it makes sense to think of epistemic standards as objectively better or worse, and claiming that *their* (nonwhite, non-Western, nonmasculinist, nonscientific, etc.) standards are superior. [italics in the original]

Haack goes on to note astutely that

> Shielded by this strategic ambiguity, they can duck accusations that their relativism is self-undermining, and at the same time evade the necessity of explaining what makes their, tribalist epistemic standards better.

[188] In the Western science-studies literature, assertions of this kind go back at least to Carolyn Merchant (1980).

[189] See Nanda (2003, pp. 95–103) for further discussion. As Nanda (2004) observes, "Most of the claims of superiority of 'holism' are unsubstantiated. On closer examination, they end up affirming pseudo-sciences involving disembodied spirit acting on matter through entirely unspecified mechanisms."

> the postcolonial critics of science and modernity ended up rediscovering the case for a uniquely Indian science that was already taken for granted in right-wing circles.... The right-wingers' relativistic defense of mysticism as science is not based principally on Kuhn and Feyerabend, but rather on more nationalistic principles, which bear the hallmarks of Johann Herder and Oswald Spengler: namely, the idea that each nation has a "cultural soul" and a "destiny" that leave its mark on all intellectual efforts, from music and painting to science. Substitute "paradigm" in place of "culture", and the right-wing was Kuhnian long before Kuhn.[190]

Nanda concludes that

> Each one of the three prongs of the Vedic science project — a critique of dualist science, the idea that standards of rationality are internal to cultures, and that the rationality of modern science is as socially embedded and culturally constructed as that of any other knowledge system — is a part of the central dogma of contemporary science studies, women's studies, and postcolonial studies ... The idea that there is nothing special about modern science that premodern, non-Western sciences need to learn from, and that what counts as reasonable and real varies with the cultural context, has become a part of the common sense of the postmodern academia. Defenders of Vedic science count upon this widespread and diffused attitude of cultural relativism to garner sympathy for their position.[191]

Concluding remarks

When all is said and done, the Hindutva ideologues' claims that modern science is contained in the Vedas are about as plausible as the contention of *The Bible Code*, a 1997 best-seller, that future events are encoded in the Old Testament.[192] It would be the stuff of comedy, were the context — destruction of the mosque at Ayodhya by Hindu mobs, repeated pogroms against Muslims and other religious minorities, the potential of nuclear confrontation between India and Pakistan — not so serious. As Nanda observes wearily about the fashion for "Vedic science": "Whatever good they might do

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[190] Meera Nanda, personal communication to the author, January 14, 2004.

[191] Nanda (2003, p. 122).

[192] *The Bible Code* (Drosnin 1997) was on the *New York Times* best-seller list (for non-fiction!) for 13 weeks in the period June–September 1997, at one point reaching #3. The original claims about the encoding of future events in the book of Genesis can be found in Witztum, Rips and Rosenberg (1994). For a careful refutation, see McKay, Bar-Natan, Bar-Hillel and Kalai (1999); see also the introduction by Kass (1999).

for national pride, such claims cannot cover up the fact that Indian people remain mired in a view of the world that is deeply irrational and objectively false."[193]

For lack of both space and competence, I have not dwelt on the historical and political context of Hindu nationalist ideology, but perhaps a few words are in order. Nanda makes a good case that contemporary Hindu nationalism is best viewed as an instance of "reactionary modernism", a term that she borrows from Jeffrey Herf's much-cited study of Nazi Germany's modernity without liberalism, i.e.

> the embrace of modern technology by German thinkers who rejected Enlightenment reason.... Before and after the Nazi seizure of power, an important current within conservative and subsequently Nazi ideology was a reconciliation between the antimodernist, romantic, and irrationalist ideas present in German nationalism and the most obvious manifestation of means-ends rationality, that is, modern technology. Reactionary modernism is an ideal typical construct.... [I]t incorporated modern technology into the cultural system of modern German nationalism, without diminishing the latter's romantic and antirational aspects.[194]

In a similar way, Nanda explains, Hindu nationalists seek "dharma and the bomb ... an era when India will have nuclear bombs in its silos and the Vedas in schools."[195] She further argues that

> the social conditions that led to this phenomenon in the Weimar Republic and the Third Reich — namely, "capitalist industrialization without a successful bourgeois revolution [and] weak traditions of political liberalism and the Enlightenment" — obtain [today] in many parts of the developing world, including India. In these conditions, the dangers of fascistic nightmares cannot be ignored.[196]

The "postcolonial" intellectuals do not, of course, support the chauvinist and intolerant aspects of Hindu nationalism, and they cannot be held responsible for its rise. But, as Nanda has shown, their denunciations of modern science and defenses of "local knowledges" played directly into the hands of the ideologues of Hindutva, by undermining any principled ground for opposition to Vedic pseudoscience and, more generally, to the Vedic worldview. "What reasons can they give against the supposed scientificity of Vedic

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[193] Nanda (2003, p. 72).

[194] Herf (1984, pp. 1–2).

[195] Nanda (2003, p. 37; see also pp. 39–42).

[196] Nanda (2003, p. 7), citing in part Herf (1984, p. 6).

astrology? Can they hold on[to] their relativist view of all sciences as social constructs and yet challenge the scientisation of the Vedas that is going on in the theories of Vedic physics or Vedic creationism?"[197]

The bottom line is that abstract philosophical debates can have real-life consequences. Nanda tells the following story about the recent craze for *vastu shastra*, the ancient Vedic rules governing the construction of buildings in alignment with the cosmic "life-force":

> N.T. Rama Rao, the late chief minister of the southern state of Andhra Pradesh, sought the help of a traditional *Vastu Shastri* to help him out of some political rough weather, and was told that his troubles would vanish if he entered his office from an east-facing gate. But on the east side of his office there was a slum through which his car could not pass. [So he] ordered the slum to be demolished.[198]

Nanda observes that

> If the Indian left were as active in the people's science movement as it used to be, it would have led an agitation not only against the demolition of people's homes, but also against the superstition that was used to justify it.... A left movement that was not so busy establishing "respect" for non-Western knowledge would never have allowed the power-wielders to hide behind indigenous "experts."[199]

This is but a minor example; the crux of the matter is that

> while the Western postmodernists could at least take the hegemony of modern, mostly liberal, ideas for granted, the postcolonial critics were condemning modernity even before it had a chance to take root in the lives of their societies....
>
> Under the circumstances of an incomplete modernity that prevail in India, the postmodern-style total critique of modernity amounts to a grand betrayal of the intellectuals of their vocation. This betrayal is in part responsible for the growth of reactionary modernity that we are witnessing in India under the sway of Hindu nationalist parties. With self-consciously left-wing humanists embracing a nativist and anti-rationalist agenda made respectable by highfaluting postmodern theory, there is hardly any organized resistance left to the Hindu nationalists. This is not to deny that the left and secular intellectuals are carrying out a valiant

[197] Nanda (2004).

[198] Nanda (1997, p. 82).

[199] Nanda (1997, p. 82).

> struggle against the Hindu nationalist policies of cultural indoctrination and ethnic cleansing. But what is missing is the existence of a well-articulated secular worldview which has the power to mobilize popular opinion, and which is not afraid to challenge the purported "wisdom" of popular traditions.... The new social movements of the secular, left-wing intellectuals in India run the risk of fighting a merely strategic war against the religious right, while losing the battle for the hearts and minds of the masses.[200]

Some moderate examples

> Whether the accused in a murder trial is or is not guilty depends on the assessment of old-fashioned positivist evidence, if such evidence is available. Any innocent readers who find themselves in the dock will do well to appeal to it. It is the lawyers for the guilty ones who fall back on post-modern lines of defence.
>
> — *Eric Hobsbawm, On History (1997, p. viii)*

I would like now to present briefly a few additional instances in which the advocates of shoddy research have resorted to postmodernist arguments (either when the reliability of their evidence was challenged, or else preemptively). Unlike the examples analyzed in the preceding sections, which dealt with the far end of Figure 8.1 — astrology, Therapeutic Touch and the like — here we will be discussing more-or-less mainstream research in the natural or social sciences that somewhere took a wrong turn. Of course, in science it is no sin to propose a theory that turns out, on closer examination, to be wrong (I myself have done so on countless occasions). The only sin is to cling stubbornly to one's theory when the evidence against it becomes so strong that any fair-minded person would concede the mistake and move on. Alas, this is an ancient and enduring sin, to which even the best scientists are far from immune.[201] What is perhaps novel, however, is the way that

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[200] Nanda (2003, p. 28).

[201] Nearly four centuries ago, Francis Bacon observed that

> Men fall in love with particular pieces of knowledge and thoughts: either because they believe themselves to be their authors and inventors; or because they have put a great deal of labour into them, and have got very used to them.

And again:

> Once a man's understanding has settled on something (either because it is an accepted belief or because it pleases him), it draws everything else also to

postmodernist arguments have lately been invoked, in some circles at least, to rationalize this sin.

Radical environmentalism

Geographer Martin Lewis, in an article entitled "Radical environmental philosophy and the assault on reason", has shown how some exponents of radical environmentalism have turned to postmodernism as a way of rescuing favored theories whose empirical support had become shaky. I would like here to sketch Lewis' argument in abbreviated and admittedly oversimplified form; the reader is referred to the original article for supporting evidence as well as for many important subtleties.

Lewis' critique is concerned with a school of thought that he calls "radical environmental philosophy", or "ecoradicalism" for short. "Most ecoradicals believe that human beings existed for millennia in a state of environmental grace as merely one species among a myriad in a balanced, harmonious global ecosystem."[202] But the industrial revolution shattered this equilibrium, bringing us today to the brink of environmental collapse. "The task for ecophilosophy", Lewis summarizes, "is to explain how such a total rupture could have occurred, and more importantly, to show how balance might be restored in time to save the planet from annihilation.... The key error is often assumed to lie in the ideological realm, particularly in concepts about nature and the human position within it"[203], though ecoradical theorists differ about the precise location of this central intellectual misstep. "For many radical ecophilosophers, the great error was nothing less than the glorification of reason that began in Europe in the early modern era and that culminated in modern scientific methodology."[204] Others push the pivotal error

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support and agree with it. And if it encounters a larger number of more powerful countervailing examples, it either fails to notice them, or disregards them, or makes fine distinctions to dismiss and reject them, and all this with much dangerous prejudice, to preserve the authority of its first conceptions.

See Bacon 2000 [1620], p. 46 (Aphorism 54) and p. 43 (Aphorism 46). Luckily, the social organization of the modern scientific community — which in most cases allows for reasonably open debate, in which even the ideas of great scientists can be challenged — ensures that the scientific community *as a whole* is more objective than any of its individual members. For further discussion of this point, see Haack (1998, pp. 97–99 and 104–109).

[202] Lewis (1996, p. 210).

[203] Lewis (1996, p. 210).

[204] Lewis (1996, p. 211). This view was notably promulgated by Carolyn Merchant (1980) and has since become the conventional wisdom not only among radical environmentalists but

back to Plato, to the book of Genesis, or even to the Neolithic emergence of agriculture.

Lewis stresses that

> The ecoradical attack on reason and science was initiated within a framework of reasoned debate. Historical evidence was examined, and plausible linkages were hypothesized among developments in philosophy, science, technology, and economics ... Ecophilosophers also sought confirmation of their vision of premodern ecological harmony from the archeological and anthropological record. Moreover, they attempted to ground their entire framework in the science of ecology.[205]

The trouble, Lewis goes on to note, is that "more careful consideration of the same lines of argument has since discredited the principal concepts of ecoradical philosophy. The roots of modern society are far more entangled and multistranded than they would have it, and the premodern world is now known to have been far less ecologically and socially benign."[206] For instance,

> Torture of animals, male oppression of females, and outright (local) ecological devastation may not have been universal conditions, but they were common enough everywhere. Even if we revert to the upper Paleolithic ... much evidence suggests that human beings at this time were responsible for the extinction of dozens of species of large mammals.[207]

Finally, "even the science of ecology has failed the Greens, for it now emphasizes continuous flux and patchy distribution patterns, rather than the stability of coherent ecosystems that once underwrote the vision of harmonious relations between people and nature."[208]

Not, of course, that these discrepancies between theory and evidence will shake those who hold ecoradical beliefs with a religious zeal. But for those

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also among many feminists. For similar views, see Easlea (1981), Shiva (1989) and Plumwood (1993, 2002), among many others.

[205] Lewis (1996, p. 217).

[206] Lewis (1996, pp. 217–218).

[207] Lewis (1996, p. 215). The currently available evidence is inconclusive as to whether the Paleolithic extinctions of large mammals in the Americas and Australia were caused by human hunting, by climatic and environmental changes, or by some combination of the two (see e.g. Bogucki 1999, pp. 102–104). I thank Arne Jarrick for drawing my attention to this issue.

[208] Lewis (1996, p. 218).

environmentalist thinkers of a more scholarly bent, such potential difficulties cannot simply be ignored; some rejoinder is required. And it is here that postmodernism can come to the rescue, by "annul[ing] the inconvenient requirement of empirical confirmation". Indeed, the very notion of empirical evidence can be regarded

> merely as a social construct that society's power holders use to maintain and justify their positions. Stories of the human past invented by an active ecoradical imagination ... can thus be argued to have just as much legitimacy as the reconstructions of professional archeologists and other "scientists" trapped within the confines of objectivist discourse. If anything, they have more validity because of their moral authority; in the postmodernists' world, ethics are not to be separated from matters of "fact." By the same criteria, the problems implicit in the new ecology can simply be ignored. Ecologists are merely constructing their own stories about nature, and those currently being told in the scientific journals may be regarded as suspect, for they could potentially be used to justify a modernist agenda of human-imposed environmental change.[209]

For example, feminist ecophilosopher Carolyn Merchant avers that

> Science is not a process of discovering ultimate truths of nature, but a social construction that changes over time. The assumptions accepted by its practitioners are value-laden and reflect their places in both history and society ... Ecology is likewise a socially constructed science whose basic assumptions and conclusions change in accordance with social priorities and socially accepted metaphors.[210]

Indeed, geographer David Demeritt goes so far as to urge that "environmental historians and other Green critics should end their search for foundational authority, be it in science or elsewhere, and appeal instead to diverse moral, political, and aesthetic criteria to arbitrate between particular representations of nature in particular situations." Demeritt "does not rule out appropriations from ecological science or other fields of knowledge where they prove useful and convincing", but stresses that "ultimately, environmental narratives are not legitimated in the lofty heights of foundational

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[209] Lewis (1996, p. 218).

[210] Merchant (1992, p. 236).

epistemology but in the more approachable and more contested realm of public discourse."[211] The net result, as Paul Gross and Norman Levitt point out, is that "in practical terms, this leaves the radical theorist free to accept what flatters his worldview and to reject what does not."[212]

More careful investigation is needed, I think, in order to determine the extent to which postmodernist and social-constructivist ideas have found a foothold among the theorists of radical environmentalism. I do not claim that the handful of examples that Lewis and I have uncovered prove much. Furthermore, as Lewis correctly cautions,

> it would be a serious error to conclude that postmodernism and ecoradical philosophy share identical concerns, much less that the two movements have somehow merged. Most environmental philosophers strongly mistrust the mainstream Derridean/Foucauldian schools of postmodernism ... Extreme postmodernism is far too relativistic and skeptical for Greens. Whereas poststructuralists condemn the search for the "transcendental signified" as a pointless quest, ecoradicals not only want to isolate the "transcendental signified" in the form of nature, but propose literally to worship it.... Waving aside the pastiche, superficiality, and cool skepticism of the scholarly *avant garde*, most ecoradicals rather seek a reassertion of religious or quasi-religious values founded upon a spiritualized ecology.[213]

Their resort to postmodernist reasoning is, at most, episodic and opportunistic.

Lewis concludes that

> By spreading the message that science is no more reliable than shamanism, and especially by arguing that reason itself is the ultimate source of our environmental crisis, Green philosophers do little to enhance the public's ability to think clearly about the world and its very real problems. Earth-spirit worship may be psychologically beneficial for certain individuals, but at a societal level it is symptomatic of a dangerous tendency toward escapism.[214]

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[211] Demeritt (1994, p. 22).

[212] Gross and Levitt (1994, p. 165).

[213] Lewis (1996, p. 219).

[214] Lewis (1996, p. 220).

History

The Swedish historian Arne Jarrick has observed that even postmodernist historians are not consistent relativists: they would reject without difficulty (at least in private) a belief in witches and trolls, or in American creationists' account of the origin of the human species. Furthermore, when they engage in empirical research — as at least the more moderate postmodernists do — they, no less than any other historian, gather evidence and attempt to defend their interpretations with rational arguments. Nevertheless,

> even if most historians in their daily tasks work as if it were possible to get to grips with real circumstances in the past, post-modern rhetoric still contributes to a kind of irresponsibility in thought and work in those situations where it is advantageous to be irresponsible.... If it is not possible to demonstrate the validity of your own hypothesis, you can always rest on the thought that historical research is nevertheless a form of story, of fiction. If you cannot read something expected from the material, it is always possible to inscribe it there, as, after all, that is what post-modern historians consider that everyone is doing: writing themselves and their time into the text. Perhaps bending the truth a little does not matter, as the truth nevertheless does not exist ... [215]

Along the same lines, the British historian Eric Hobsbawm has eloquently decried

> the rise of "postmodernist" intellectual fashions in Western universities, particularly in departments of literature and anthropology, which imply that all "facts" claiming objective existence are simply intellectual constructions. In short, that there is no clear difference between fact and fiction. But there is, and for historians, even for the most militantly antipositivist ones among us, the ability to distinguish between the two is absolutely fundamental. We cannot invent our facts.... Either the present Turkish government, which denies the attempted genocide of the Armenians in 1915, is right or it is not.[216]

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[215] Jarrick (2003).

[216] Hobsbawm (1993, p. 63), reprinted in Hobsbawm (1997, p. 6).

Hobsbawm goes on to show how rigorous historical work can refute the fictions propounded by reactionary nationalists in India, Israel, the Balkans and elsewhere, and how the postmodernist attitude disarms us in the face of these threats.

Over the past decade there has been much discussion, among theoretically inclined historians, of the pros and cons of postmodernist ideas (broadly defined) in historiography.[217] In addition, several historians have published case studies in which they critically analyze the handling of evidence by their postmodernist-oriented colleagues.[218] As I am not a trained historian, I am not competent to take sides on the substantive controversies of historical interpretation being discussed. But if the critics are correct, Jarrick's fears are borne out, and postmodernist rhetoric can indeed serve as a smokescreen for sloppy research and dubious interpretation.

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[217] Some relevant essays are collected in Jenkins (1997). Among the vast literature on postmodernism in historiography, Evans (1997) and Zagorin (1999) give particularly illuminating and judicious analyses; both of them also provide extensive references to earlier commentary. See also the reply to Zagorin by Jenkins (2000), and the rejoinder by Zagorin (2000).

The books of Appleby, Hunt and Jacob (1994) and Windschuttle (1997) are also of considerable interest, though they suffer, in my view, from curiously complementary flaws. Appleby–Hunt–Jacob are unfortunately somewhat superficial and confused in their treatment of the epistemology of science (chapter 5), which leads them to concede too much to weak critiques of science; they are consequently too soft on postmodernism (though they do begin and end their book by arguing strongly for the importance of truth in historical research). Windschuttle's discussion of the philosophy of science (chapter 7) is more detailed and solid, but it ultimately founders on his untenable claim that science seeks (and in some cases attains) not just well-founded objective knowledge but *certainty*. As a result, he gives short shrift to some legitimate ideas (e.g. moderate versions of the theory-ladenness of observation) that cast doubt on some traditional philosophies of science (e.g. logical positivism, Popperian falsificationism) but in no way undermine the objectivity of the scientific enterprise. For my own views on these matters, see Chapters 6 and 7 above.

[218] Particularly fascinating is the monograph of Spitzer (1996), who demonstrates that even hard-core postmodernists (e.g. Derrida) will put aside their declared philosophy and argue on the basis of *facts* (which they accuse their opponents of *distorting* or *misrepresenting*) when issues they consider important are at stake.

There is an extensive literature critically analyzing Foucault's histories of madness, medicine, incarceration and ideas: see, for example, Huppert (1974), Midelfort (1980, 1990, 1994, 1999), Megill (1987), Porter (1987, 1990), Gordon (1990), Scull (1990, 1992), Gutting (1994a, 1994b) and Jones and Porter (1994) for a variety of viewpoints.

Several chapters of Windschuttle (1997) are devoted to detailed analyses of case studies of postmodernist-oriented history, often to devastating effect (at least as regards the history of the Pacific). See also Hobsbawm (1990), Spiegel (2000) and Jarrick (2003) for analyses of specific instances of postmodernist-influenced historical work.

Postmodernists' selective skepticism

It might appear bizarre, at first sight, that postmodernists, who pride themselves on their skepticism toward even the most well-established principles of mainstream science, should sometimes display sympathy for — or even belief in — one or more pseudosciences. After all, many of their skeptical arguments — the theory-ladenness of observation, for instance, or the alleged non-referentiality of language — are *universal* in nature: if valid, they apply to astrology or homeopathy no less than to Maxwell's electromagnetic theory. But on reflection, postmodernists' sympathy for pseudoscience seems less odd. Scientific method, for those who adopt it, serves principally as a *filter* for distinguishing true propositions from false ones, plausible ones from implausible, and more generally for evaluating propositions and theories according to the degree of *rational warrant* that they enjoy in the light of the currently available evidence. Remove or weaken that filter — for example, by denying that there can *ever* be any reasonably objective way to evaluate rational warrant — and you don't only let mainstream science flow out; you also let pseudoscience flow in. Furthermore, once cognitive considerations are demoted from their central role in evaluating theories, then social, political and psychological considerations can move to center stage. In this way, we are led to look favorably on those theories that seem to support our political or personal goals, or whose advocates gain our sympathy in one way or another; we cast a skeptical gaze on theories that we deem politically incorrect (or simply unpleasant) or whose proponents seem unsympathetic.[219] And we deploy the postmodernist arguments — universal though they may logically be — only (or principally) in the case of the latter.

The authors to be considered in this section are not, for the most part, hard-core postmodernists. It would be fairer to call their attitude "postmodernism lite". Still, their strong social constructivism accords reasonably well with my definition of postmodernism as

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[219] Feminist postmodernist Kelly Oliver (1989, p. 146) has explicitly advocated this sort of politicization of science:

> ... in order to be revolutionary, feminist theory cannot claim to describe what exists, or, "natural facts." Rather, feminist theories should be political tools, strategies for overcoming oppression in specific concrete situations. The goal, then, of feminist theory, should be to develop *strategic* theories — not true theories, not false theories, but strategic theories. [emphasis in the original]

But even if we put aside the obvious scientific and moral objections to this version of postmodernist doctrine, we are still left with the perennial problem of self-refutation: How can one know whether or not a theory is "strategic", except by asking whether it is *truly, objectively* efficacious in promoting one's declared political goals? The problems of truth and objectivity cannot be evaded so easily.

> an intellectual current characterized by the more-or-less explicit rejection of the rationalist tradition of the Enlightenment, by theoretical discourses disconnected from any empirical test, and by a cognitive and cultural relativism that regards science as nothing more than a "narration", a "myth" or a social construction among many others.

If pressed, these authors might deny claiming that science is *nothing more* than one story among many others; they might even concede that modern science is the best tool yet developed for predicting and controlling the natural world; but they would strenuously avoid conceding that scientific theories might be closer to the *truth* than their nonscientific competitors, or even that they might enjoy a stronger *rational warrant*.[220] Indeed, many of these authors would strenuously deny that transculturally valid evaluations of rational warrant are even possible.

Let me be frank at the outset: my (admittedly incomplete) research turned up many fewer examples of postmodernists expressing unequivocal support for pseudoscience than I expected at first to find. I will, therefore, have to modify my initial hypothesis as a result of the evidence collected! I propose to begin by presenting the unambiguous cases; next I will present the more equivocal cases; and finally, I will attempt to provide some analysis of the findings.

Postmodernists on pseudoscience (I)

Some (admittedly lesser-known) postmodernists have given explicit endorsements of pseudoscience. For instance, Richard E. Palmer, in an article on "postmodernity and hermeneutics", asserts that

> Instances of telepathy or faith healing are incomprehensible within the framework of naturalist assumptions, and it is almost comical to see the absurd lengths to which the empirically minded will go to deny them.... While it is not feasible here to enter into cases, one may mention a few recent works that ... give a veritable catalog of instances that suggest agencies beyond the ken of naturalism.... The career of Edgar Cayce, the remarkable psychic, raises many questions about telepathy, perception of illness and great distances, the intuitive prescription of treatment, and so on.[221]

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[220] For further discussion of this point, along with examples from the science-studies literature, see Bricmont and Sokal (2000, pp. 376–377).

[221] Palmer (1977, p. 376).

Palmer adds that "the works of [Erich] von Däniken offer an interesting challenge to the prevailing evolutionary concepts."[222] Likewise, Gary Lee Downey and Juan Rogers, in an article on "the politics of theorizing in a postmodern academy", propose

> to shift the explicit goals of academic theorizing from producing authoritative, truthful knowledge to producing knowledges that inform popular theorizing in desirable ways.... [T]his strategy encourages one to view people as doing science in their everyday lives *all the time*.... Such practices might also include well-established and highly organized forms of alternative science, such as alternative medicines, astrology, parapsychology, and various New Age sciences.[223]

Among well-known postmodernists (in my definition), I have found only two instances of explicit endorsement of pseudoscience. Feminist philosopher Sandra Harding has repeated uncritically a series of assertions from the book *Blacks in Science*, edited by Ivan van Sertima: in so doing, she has swallowed whole some whoppers of Afrocentric pseudoscience along with some genuine facts about African contributions to technology and medicine.[224] For example, Harding states as fact that

> In West Africa between 1200 and 1400, the Dogon reported the rings of Saturn, the moons of Jupiter, and the spiral structure of the Milky Way galaxy ... They also knew that a small star, invisible to the naked eye, had an eliptical [*sic*] orbit around the star Sirius that took fifty years to complete.[225]

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[222] Palmer (1977, p. 377). For a sober (but ultimately caustic) evaluation of von Däniken's theories on ancient extraterrestrial visitors, see Feder (2002, chapter 9).

[223] Downey and Rogers (1995, pp. 275, 276), emphasis mine.

[224] Van Sertima (1983). Among the genuine facts are an 1879 eyewitness account of a Caesarean section in Uganda, at a time when successful Caesarean sections in Europe were still rare (Davies 1959); and a 2000-year tradition of steel-making in Tanzania (Schmidt and Avery 1978; but see also Rehder 1986 and Avery and Schmidt 1986).

[225] Harding (1991, p. 223). In a subsequent article, Harding moves the alleged discoveries back more than a thousand years: "[M]any of the observations that Galileo's telescope made possible were known to the Dogon peoples of West Africa more than 1500 years earlier: either they had invented some sort of telescope, or they had extraordinary eyesight." (Harding 1994, p. 309)

These assertions are taken from a pair of articles by Hunter Havelin Adams III, where they are supported by ludicrously weak evidence; indeed, they are easily refuted.[226] As archaeologist Kenneth Feder observes, "The ancient and modern peoples of Africa represent some of the great cultural achievements of humankind and there is no need to exaggerate their intellectual contributions to the world."[227]

Along similar lines, Vandana Shiva, in her zeal to discredit "modern western patriarchal science" and to vindicate both "ancient Indian traditions" and "women's indigenous knowledge"[228], has endorsed some rather startling superstitions. For instance, she provides the following paean to what might be termed "botanical astrology":

> Sacred seed is perceived as a microcosm of the macrocosm with *navdanya* [nine seeds] symbolizing the Navagraha. The influences of planets and climate are seen as essential to plant productivity. In contrast, HYVs [high-yield varieties] break links with all seasonal climatic and cosmic cycles.... On the grand scale [biodiversity] involves a relationship between planets and plants, between cosmic harmony and agricultural harmony captured in *navdanya*.[229]

In addition, Shiva has endorsed the work of Indian botanist J.C. Bose (1858–1937), who claimed to have established the existence of consciousness in plants.[230] Though these aspects of Bose's work have long been discredited, it is worth noting that "he remains a hero of the Vedic science tradition", according to Meera Nanda.[231]

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[226] Adams (1983a, 1983b). For a refutation, see Ortiz de Montellano (1996, pp. 566 and 570n32).

[227] Feder (2002, p. 120).

[228] Shiva (1989, p. 58) and Mies and Shiva (1993, chapter 11). It goes without saying that ancient traditions and modern indigenous beliefs should not be assumed, *a priori*, to be pure superstition; some of them may indeed constitute perfectly valid — indeed, perfectly *scientific* — knowledge of the local ecosystem. I merely insist that all the relevant empirical evidence needs to be weighed rationally, without prejudice or romanticism.

[229] Mies and Shiva (1993, pp. 169, 171). The chapter from which this quotation comes was authored by Shiva.

[230] Shiva (1989, p. 59).

[231] Nanda (2003, p. 107). See Dasgupta (1999) for a biography of J.C. Bose; and see Jitatmananda (1993) for a celebration of Bose's theories by a partisan of Vedanta.

Postmodernists on pseudoscience (II)

There are numerous instances in which relativist-constructivist sociologists, without explicitly endorsing astrology, telepathy or other pseudosciences, have criticized the mainstream scientific community for giving short shrift to the alleged good evidence in favor of those theories. For example, Stanley Aronowitz writes that

> Rejected or marginal sciences such as parapsychology, the study of clairvoyance ... are just a few examples of the evidence that the scientific "community" as a site of power determines what counts as legitimate intellectual knowledge, even when the results of the marginalized sciences are obtained by traditional methods.[232]

Along similar lines, Barry Barnes, David Bloor and John Henry, in their textbook on the sociology of science, write that

> Astrology ... and homoeopathy ... remain firmly saddled with the label of pseudo-sciences in spite of recent work which seems to some to call for a reassessment (Gauquelin, 1984; Benveniste, 1988).
>
> Michel Gauquelin's statistical evidence in support of astrology would perhaps be a serious embarrassment to scientists if they were not so good at ignoring it. But one day it could conceivably come to be accommodated as a triumph of the scientific method. Gauquelin's work seems to imply the existence of forces and interactions unrecognized by current scientific theory and yet it is based on methodological principles and empirical evidence which have so far stood up to sceptical challenge.[233]

Though these passages do not indicate unequivocal support for clairvoyance or astrology, they do demonstrate a tolerant (and even cautiously favorable) attitude towards these theories, as well as a failure to comprehend the vast gulf between the established natural sciences and the pseudosciences as regards both methodology and degree of empirical confirmation. As physicist David Mermin noted in his review of the Barnes–Bloor–Henry book,

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[232] Aronowitz (1996, p. 191). Bizarrely, in this list of "rejected or marginal sciences" Aronowitz also includes "ecological and evolutionary biology" — a fact that would surely be news to most biologists.

[233] Barnes, Bloor and Henry (1996, p. 141). Here they are referring to data collected by Michel Gauquelin in support of the astrological theory that there is a "Mars effect" affecting the destiny of sports champions. See Benski *et al.* (1996) for a critical and detailed factual examination of the "Mars effect".

> BBH's gloss on astrology — 'the existence of forces and interactions unrecognized by current scientific theory' (BBH, 141) — fails adequately to convey the truly spectacular degree to which compelling evidence in support of astrology would require a massive radical reconstruction of our current understanding of the world.[234]

(A similar remark can be made for homeopathic claims, though the reconstruction might be somewhat less radical in this case.) Mermin goes on to note that

> An important motive behind rejecting such claims without any attempt at replication, unmentioned by BBH but clearly recognized by those doing the rejecting, is the gross inefficiency of investing extensive time and resources in an attempt to refute overwhelmingly improbable claims. For similar reasons, one turns down an offer, rendered on the spot, to purchase the Brooklyn Bridge for five dollars, without making a trip to the courthouse to confirm the conjectured non-existence of the claimed deed of ownership.[235]

Postmodernists on pseudoscience (III)

In the work of relativist-constructivist practitioners of "science studies" and "cultural studies of science", one frequent theme is the study of dissident or marginalized communities, such as those of parapsychology or alternative medicine.[236] On the one hand, the methodological (and in some cases also epistemological) relativism that is virtually axiomatic in science-studies circles precludes any rational evaluation of the scientific evidence pertaining to the factual questions under debate.[237] On the other hand, this methodological relativism allows the authors' sympathy for the "marginalized" — or distaste for mainstream science — to determine their intellectual stance.

For instance, cultural-studies exponent Andrew Ross has published an impressionistic ethnography of New Age interventions into science and

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[234] Mermin (1998, p. 642).

[235] Mermin (1998, p. 642).

[236] For some early examples, see the essays collected in Nowotny and Rose (1979) and Wallis (1979).

[237] It is very important to distinguish between methodological relativism and various forms of philosophical relativism. Roughly speaking, methodological relativism is the precept that "the sociologist or historian should act as though the beliefs about reality of any competing

technology, in which sometimes astute sociological observations are combined with an overarching lack of interest in whether the theories in question are true or even plausible. Ross leads the reader through a panoply of New Age enthusiasms — bioenergetics, crystal healing, magnet therapy, brain machines and channeling, to name only a few — with a wry mixture of sympathy, bemusement and detachment. Though Ross does not say so explicitly, the reader gets the distinct impression that he is skeptical about many of the New Agers' factual claims; but his explicit criticisms concern only the socio-economic and political aspects of New Age "science" (commercialism, individualism, desire to become part of "respectable" science), not the utter implausibility of the theories.[238] Furthermore, when discussing the intellectual luminaries of New Age (Karl Pribram, David Bohm and others), Ross becomes more respectful:

> It is from modern brain science, however, that New Agers have drawn the most competent explanatory models for a new cosmology with science as its sustaining core.... Once the brain's ecology is understood as holographic, the principles of isomorphism and synchronicity, from brain to brain, come into play. Sensory reality appears as a relatively stable representation, but is projected holographically from a point that is, in principle, beyond time and space. If the universe itself becomes a master hologram, all of reality can then be recovered from its smallest portion; each brain incorporates the universe's information. Holism is thereby established at all the implicate levels of experience.[239]

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groups being investigated are not caused by reality itself", while epistemological relativism is the claim that "one social group's way of justifying its knowledge is [always] as good as another's" and ontological relativism is the claim that "reality itself is different" for different social groups (Collins 2001, p. 184; see also Bricmont and Sokal 2001, p. 244n4). In the 1980s, statements implying epistemological relativism were fairly common in the science-studies literature; but nowadays most sociologists of science stress that they advocate only methodological relativism, not ontological or epistemological relativism. What they fail to do, however, is to give a cogent argument in favor of methodological relativism; the appropriateness of a relativist methodology for sociologists of knowledge is largely taken for granted. By contrast, Bricmont and I (2001, 2004b) have argued that methodological relativism is unjustifiable *unless* one adheres to some form of philosophical relativism. For a detailed debate of this issue, see the various essays collected in Labinger and Collins (2001).

[238] On Ross' approach, see especially Ross (1991, pp. 8–9 and 27–28). To his credit, Ross does address the question of scientific accuracy at least in passing (p. 29): "I do not believe that New Age culture has produced anything like a more consistently accurate account of the world than rationalist science."

[239] Ross (1991, p. 41).

In Ross' view, this paradigm has the advantage that

> It not only establishes a permanent, fluid ground for intersubjective communication, but also allows for a more socially equitable overall distribution of energy than the *karmic* universe of retributions and rewards. Just as a formalist might argue that the politics of atom-smashing somehow equates to an attack on the centered Cartesian subject, so holism's proponents see the unified holographic field of perceiver and perceived as a leveling critique of the privileges of subjectivism. Such a field accommodates "mystic experience" not as a contingent or aberrant encounter but as a rational apprehension of the conscious holo-movement of sensory reality.[240]

(Come again?) In a footnote, Ross cites approvingly Rupert Sheldrake's eccentric notion of "morphogenetic fields ... operating on a subquantum level, linking every pattern in the universe."[241]

Along similar lines to Ross, but in a more professional manner, anthropologist-sociologist of science David Hess has produced a fascinating book-length ethnography of Spiritism in Brazil, placing it in the context of Brazilian religious syncretism (principally Yoruba and Catholic). Hess provides a series of case studies of what he calls "Spiritist scientific thought", but without once (as far as I can tell) asking whether the doctrines in question merit, on epistemic grounds, to be called "science". Indeed, he explicitly rules that question out of bounds:

> I am making no claim that one or another of the discourses discussed here is more or less scientific than any other, nor even that the phenomena labeled "paranormal" have obtained the status of scientific facts; instead, I put in brackets the question of the scientific status of Spiritist thought as "true" or "false", and I use the claims of scientificity (or lack thereof) in order to get at issues of cultural values and ideological meaning.[242]

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[240] Ross (1991, p. 42).

[241] Ross (1991, p. 253n20). It should be noted, however, that Ross also makes an astute and cogent criticism of Fritjof Capra's *The Tao of Physics*:

> For those who want scientists to make their work more accountable to the nonexpert, Capra's analogy [between physicists and Zen students] is, in every respect, a step in the wrong direction. Far from demystifying the work of science, it elevates the scientific vocation beyond the status it already enjoys as a secularized Western priesthood. Ordinary language and everyday rationality are revealed as inadequate, archaic, and therefore redundant media of communication. When the words of the physicist begin to sound like a koan, the aim of explicating science in the vernacular to a nonexpert audience has been abandoned. (Ross 1991, p. 44)

[242] Hess (1991, pp. 54–55).

Hess refers in passing to the mainstream medical community's disapproval of Spiritist cures, but only in sociological terms, as "boundary-work" by the orthodoxy to contain heterodox competitors; at no point does he inquire into the objective evidence concerning the efficacy of different therapies, or even acknowledge that the question exists. The same strict methodological relativism governs Hess' subsequent book on New Agers, parapsychologists and skeptics in the United States.[243] The net effect of this forced "neutrality" is to give unearned credence to pseudoscience.

Sociologist of science Steve Fuller is more explicit than Ross or Hess in advocating the demotion of science from its position of epistemic hegemony (a program that he terms the "secularization of science"). Noting the little progress made thus far in this direction by sociologists of science, he says: "[I]t may turn out that more effective vehicles for the secularization of science will be found among the customized knowledges promoted by such New Age movements as homopathic [*sic*] medicine, parapsychology, dianetics, and (*mirabile dictu!*) Creation science."[244]

Discussing the controversy over teaching creationism alongside evolution in American public-school science classes, Fuller makes the sensible pedagogical observation that "Given that two thirds of those who believe in evolution also believe that it reflects a divine intelligence, it would seem that such ex cathedra dismissals [of theological ideas] fail to engage the average student's intellectual starting point."[245] But far from taking this as an opportunity to challenge students' prejudices and to teach the critical analysis of evidence, Fuller urges that students' prejudices be comforted wherever possible:

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[243] Hess (1993). At one point, Hess does let his relativism slip: he admits that "the skeptically minded *rightly* reject the scientific solidity of much New Age discourse and practice" (Hess 1993, p. 175, emphasis mine). But this is a rare lapse.

It is worth noting that, despite his methodological relativism, Hess makes what is in my view a sensible psychological/sociological observation:

> A large number of sincere people are exploring alternative approaches to questions of personal meaning, spirituality, healing, and paranormal experience in general. To the skeptic, their quest *may* [emphasis mine] ultimately rest on a delusion, but debunking is hardly likely to be an effective rhetorical device for their rationalist project of getting the Other to recognize what appears to the skeptic as mistaken or magical thinking. Instead, if skeptics were to understand the world more from the perspective of their Others, then their attempts to educate and enlighten them might be more successful. (Hess 1993, pp. 158–159)

[244] Fuller (1996, p. 47), italics in the original.

[245] Fuller (1996, p. 49).

> [F]rom a Creationist standpoint, just because some important findings and perspectives in environmental science were originally developed under the rubric of Darwinian evolution, it does not follow that those findings and perspectives cannot be understood or appropriated without the Darwinian framework. In order to protect students' freedom of inquiry, teachers should try, whenever possible, to show that similar results can be reached holding alternative theoretical presuppositions.[246]

What this suggestion really protects is not students' freedom of inquiry, but rather parents' freedom to insulate their children *from* inquiry.[247]

A few pages later, Fuller predicts that

> As governments continue to let market demand drive science policy ... scientific teams in search of funding will need to adapt their research goals to the interests of potential investors. This, in turn, will bring them closer to the kind of customized knowledge production that is characteristic of New Age movements: that is, they will gradually lose the universalist gloss of knowledge per se and become knowledge for specific constituencies.[248]

Fuller's prediction may, alas, come to pass; but he sloughs over the question of whether homeopathy, parapsychology and dianetics are *really* knowledge

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[246] Fuller (1996, pp. 48–49).

[247] **Note added for this edition:** Fuller has recently taken his alliance with Creationism to extremes that even his sociologist colleagues find embarrassing, by testifying publicly in favor of Intelligent Design in the celebrated Dover, Pennsylvania court case. Alas, Fuller's "expert" testimony seems to have backfired. Judge John E. Jones III's landmark decision that Intelligent Design (ID) is religion, not science, relied heavily on the ID advocates' own witnesses, including Fuller:

> ID aspires to change the ground rules of science to make room for religion, specifically, beliefs consonant with a particular version of Christianity.... Defendants' expert witness ID proponents confirmed that the existence of a supernatural designer is a hallmark of ID.... Professor Steven William Fuller testified that it is ID's project to change the ground rules of science to include the supernatural. (Kitzmiller v. Dover Area School District 2005, pp. 37–39)

Later in his decision, Judge Jones explicitly rejected the notion that ID should be taught to high-school students "as an affirmative action program, as advocated by Professor Fuller, for a view that has been unable to gain a foothold within the scientific establishment.... Science cannot be defined differently for Dover students than it is defined in the scientific community ..." (p. 89).

[248] Fuller (1996, p. 50).

(i.e. rationally justified true belief) or merely *purported* knowledge. Advertisers and cynics might not care about the difference, but consumers and rationalists should.

Concluding remarks

Among academic intellectuals whose primary commitment is to postmodernism (broadly defined), only a tiny handful appear to exhibit, at least in public, any significant attraction to pseudoscience. Occasionally, it is true, they make favorable comments about homeopathy, astrology or parapsychology; but this seems, in most cases, simply a calculated attempt to *épater les scientifiques*, not a sincere assertion of their own belief. The confluence of postmodernism with pseudoscience seems, rather, to be strongest among those whose primary commitment is to one or another brand of pseudoscience, be it Hindutva or Therapeutic Touch. For these people, postmodernism supplies a ready-made ideology that they can use opportunistically to ward off the critiques of rationalists.

There is, however, one situation in which postmodernists seem more readily to give unequivocal endorsement of pseudoscience: namely, when the theories in question appear to support their intellectual and/or political goals. For instance, Sandra Harding has proposed to remake science along feminist and multicultural lines, asserting that the new science will be more "strongly objective" than existing science.[249] Her uncritical recitation of Afrocentric pseudo-history forms part of an effort to show that "Western" science has unjustly neglected discoveries made by Africans — a thesis that, to the extent it is true, would provide some support for her philosophical and political project. Clearly, Harding's motivation in endorsing pseudoscience is not any attraction to pseudoscience *per se*, but simply opportunism and intellectual laziness (traits that, alas, are not the monopoly of any academic or political faction). As Gross and Levitt comment, harshly but under the circumstances not unjustifiably,

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[249] Harding (1991, 1993, 1994, 1996, 1998). The idea that increasing the cultural and gender diversity of the scientific profession could, *in some cases* and *to some extent*, lead to more objective science (in addition to being a worthy social goal in its own right) ought not be rejected out of hand; in my view it has some validity, most obviously in the social sciences and areas closely related to them (e.g. primatology) but conceivably also elsewhere. On the other hand, it also seems to me that the relevance of these considerations to the bulk of the natural sciences has been vastly overrated by some feminist and multiculturalist theorists. For moderate views on this question, see e.g. Wylie (1992) and Brown (2001, pp. 89, 184–187 and 201–205).

> In the gospel according to Harding, skepticism is to be reserved exclusively for scientific work done by white males and backed by the methodologies of scientific orthodoxy. "Strong objectivity" turns out to be another name for pathetic gullibility.[250]

Likewise, Vandana Shiva's endorsement of traditional Indian pseudoscience is motivated by her political and cultural sympathies, not by an objective analysis of the empirical evidence. These incidents provide at least some confirmation for my fear that postmodernist doctrine leads its adherents to look favorably on those theories that seem to support their political goals, while casting a skeptical gaze on theories that they deem politically pernicious.

Does it matter?

> The concept of "truth" as something dependent upon facts largely outside human control has been one of the ways in which philosophy hitherto has inculcated the necessary element of humility. When this check upon pride is removed, a further step is taken on the road towards a certain kind of madness — the intoxication of power which invaded philosophy with Fichte, and to which modern men, whether philosophers or not, are prone. I am persuaded that this intoxication is the greatest danger of our time, and that any philosophy which, however unintentionally, contributes to it is increasing the danger of vast social disaster.
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> — *Bertrand Russell (1961a, p. 782)*

Does it matter if some people believe in homeopathy or Therapeutic Touch? Perhaps not a great deal. I personally am irked when the purveyors of quackery (many of whom are now large corporations) succeed in lightening the wallets of the gullible; but in this scam, unlike most consumer frauds, the victim is a willing participant in his own victimization. My libertarian instincts urge a hands-off attitude toward pseudoscientific acts between consenting adults.[251]

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[250] Gross and Levitt (1994, p. 212).

[251] A far more serious ethical question is raised when *children* are endangered on account of their parents' pseudoscientific beliefs (often but not always religiously based). In this case I have no hesitation in insisting that the state impose the scientifically indicated best treatment, and if necessary undertake criminal prosecution for child abuse (or, in cases of avoidable death, negligent manslaughter) against recalcitrant parents and their accomplices. For a

Likewise, does it matter if some people — mostly, let's face it, academics — believe that truth is an illusion, that science is merely a species of myth, and that standards for judging rationality and correspondence with reality are thoroughly culture-bound? Once again, perhaps not a great deal: far more pernicious doctrines abound in human society, and anyway, intellectuals' influence on the world outside the ivory tower is much smaller than we frequently flatter ourselves into thinking.

In the preceding two paragraphs I have — as the reader will no doubt have guessed — bent over backwards to be tolerant, perhaps to the extent of obscuring my real views.[252] Thus, I am indeed mildly disconcerted by a society in which 50% of the adult populace believes in extrasensory perception, 42% in haunted houses, 41% in possession by the devil, 36% in telepathy, 32% in clairvoyance, 28% in astrology, 15% in channeling, and 45% in the literal truth of the creation story of Genesis.[253] But I am far more profoundly

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preliminary quantitative investigation of the incidence of this type of child abuse in the United States, resulting in the death of the child, see Asser and Swan (1998). For related statistical information concerning preventable illness short of death, see Salmon *et al.* (1999) and Feikin *et al.* (2000). Concerning the ethical and legal issues, see American Academy of Pediatrics (1997), Dwyer (2000) and Merrick (2003).

[252] For instance, I have not mentioned the real danger when people with curable illnesses are diverted from effective treatments. And I have been worried enough about the harmful cultural effects of postmodernism to co-author a book criticizing it (Sokal and Bricmont 1998).

[253] All data are from Gallup polls taken in the United States in 2001. Concerning "ESP or extrasensory perception", 50% "believe in", 20% "are not sure about", and 27% "don't believe in" (the remainder have "no opinion"). "That houses can be haunted": 42–16–41. "That people on Earth are sometimes possessed by the devil": 41–16–41. "Telepathy, or communication between minds without using the traditional five senses": 36–26–35. "Clairvoyance, or the power of the mind to know the past and predict the future": 32–23–45. "Astrology, or the position of the stars and planets can affect people's lives": 28–18–52. "Channeling, or allowing a 'spirit-being' to temporarily assume control of a human body during a trance": 15–21–62. See Gallup (2002, pp. 136–138).

Concerning creationism, the exact question was: "Which of the following statements comes closest to your views on the origin and development of human beings — human beings have developed over millions of years from less advanced forms of life, but God guided this process; human beings have developed over millions of years from less advanced forms of life, but God had no part in this process; or God created human beings pretty much in their present form at one time within the last 10,000 years or so?" The results were 37% developed with God, 12% developed without God, 45% God created in present form (the remainder have "no opinion"). These results have been essentially stable for at least the past 20 years. See Gallup (2002, pp. 52–54); and for slightly more recent data, see footnote 5 in Chapter 9 below. A Gallup poll from 1982 also gave breakdowns by sex, race, education, region, age, income, religion, and community size. Differences by sex, race, region, income and (surprisingly) religion were rather small (perhaps because evangelical Protestants and liberal Protestants were lumped

worried by a society in which 21–32% believe that the Iraqi government under Saddam Hussein was directly involved in the attacks of September 11, 2001, 43–52% think that U.S. troops in Iraq have found clear evidence that Saddam Hussein was working closely with al-Qaeda, and 15–34% think that U.S. troops have found Iraqi weapons of mass destruction.[254] And if I am concerned about public belief in clairvoyance and the like, it is largely because of my suspicion that credulity in minor matters prepares the mind for credulity in matters of greater import — and, conversely, that the kind of critical thinking useful for distinguishing science from pseudoscience might also be of some use in distinguishing truths in affairs of state from lies.[255] (Not a panacea, mind you, but just *of some use.*)

As historian of science Gerald Holton has observed, both pseudoscience and postmodernism — and the Romantic rebellion against science and reason that often links them together — become most dangerous when

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together). By far the largest difference was by education: only 24% of college graduates supported creationism, compared to 49% of high-school graduates and 52% of those with a grade-school education. See Gallup (1983, pp. 208–214).

[254] Kull *et al.* (2003, pp. 3–5 and 2004, pp. 3–5), reporting results of a series of PIPA/Knowledge Networks polls taken in the United States between February 2003 and March 2004.

Concerning Iraq and September 11, respondents were offered four choices: "Iraq was directly involved in carrying out the September 11th attacks"; "Iraq gave substantial support to al-Qaeda, but was not involved in the September 11th attacks"; "A few al-Qaeda individuals visited Iraq or had contact with Iraqi officials"; "There was no connection at all". The results averaged 21%, 35%, 30%, 8%, respectively, and have been quite stable (plus or minus only a few percent) over the whole period from February 2003 to March 2004. In an August 2003 *Washington Post* poll, respondents were asked: "How likely is it that Saddam Hussein was personally involved in the September 11th attacks?" 32% answered "very likely", 37% "somewhat likely", 12% "not very likely", 3% "not at all likely".

Concerning Saddam Hussein and al-Qaeda, respondents were asked: "Is it your impression that the U.S. has or has not found clear evidence in Iraq that Saddam Hussein was working closely with the al-Qaeda terrorist organization?" Between June 2003 and March 2004, the results have varied in a narrow band from 43–52% yes, averaging to 48%.

Concerning weapons of mass destruction, respondents were asked: "Since the war with Iraq ended, is it your impression that the U.S. has or has not found Iraqi weapons of mass destruction?" The results have shown a gradual decline over time, from 34% in May 2003 to 15% in March 2004.

N.B.: I am writing this in July 2007. I do not exclude the possibility that U.S. troops might at some future date discover weapons of mass destruction (other than their own) in Iraq. But that could not retrospectively legitimate the belief that U.S. troops have *already* found such weapons.

[255] The degree of validity (if any) of this conjecture is an empirical question, which merits careful investigation by psychologists, sociologists and educational researchers.

they are conjoined to political movements, such as National Socialism in Germany or Hindu nationalism in India.[256] In the West, it is unlikely that either New Age spiritualism or academic postmodernism will, in the foreseeable future, acquire significant political weight. Christian fundamentalism remains, despite ups and downs, a powerful political force in the United States, but one that has been contained, thus far at least, by a countervailing legal tradition of separation between church and state. In large parts of the developing world, by contrast, profound social and economic dislocations coexist with a strong popular religiosity and weak (or nonexistent) traditions of liberalism and secularism. In these circumstances, religiously-inspired reactionary modernism is a permanent threat or, in some countries, an ongoing reality.

According to one prominent postmodernist epistemologist (echoing the ideas of dozens of others),

> [T]here has never been a science without presuppositions, one that is "objective" and free of values and worldview.... That Newton's system conquered the world was not the result of its internal truth content and value or of its persuasive power, but rather an aftereffect of the political hegemony that the British acquired in that era and that grew to an Empire.[257]

This thinker derides the objectivity of science in terms virtually identical to those of the Indian "postcolonial" theorists:

> The case is simply this, that an idea born of the Enlightenment — that is, an idea of Western civilization, bearing the marks of a limited period — has set itself up as an absolute and declared itself a criterion applicable to all peoples and at all times. Here we have an example of Western imperialism, a bold assertion of supremacy.[258]

On this basis, he concludes that

> Decisions grounded on a race-based worldview determine the basic form — the principle or elemental phenomenon — upon which a science is founded.... [A] German can look at and understand Nature only according to his racial character.[259]

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[256] Holton (2000).

[257] Krieck (1942, pp. 9, 13). I thank Gerald Holton and Gerhard Sonnert for translating this quotation and the next two.

[258] Krieck (1936, p. 31), as translated in Holton (2000, p. 340).

[259] Krieck (1942, pp. 13, 19). Ironically, a nearly identical assertion is made by Afrocentrist author Hunter Havelin Adams III (1983a, p. 32): "[S]cience cannot always spring from

The postmodernist in question is Ernst Krieck, notorious Nazi ideologue and rector of the University of Heidelberg in 1937–38.[260]

I am not, of course, claiming that all postmodernists are Nazis, far from it. I am not even claiming that postmodernist ideas are in some way "proto-Nazi". My claim is, rather, that postmodernism — like most philosophical ideas — has no inherent political coloration at all, and can be used for a variety of purposes. In particular, postmodernism's attack on universalism and objectivity and its defense of "local knowledges" fit particularly well with nationalist ideologies of all stripes. Most contemporary postmodernists are politically progressive intellectuals, sincerely concerned with the fate of the poor and the downtrodden. But ideas have a way of escaping from the intentions of their creators.

Of course, if a theory is supported by cogent reasoning or persuasive empirical evidence, then it is unfair to criticize it on the grounds that it may lead, in some people's hands, to bad consequences; rather, it is the misuse of a valid idea that should be criticized instead. But if a doctrine is based on sloppy reasoning — as I believe postmodernism is[261] — then it is not out of place to observe that it can *also* have pernicious consequences.

Though intellectuals tend to overestimate their impact on the larger culture, it is nevertheless true that the ideas — even the most abstruse

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a universal or culturally independent base. It must be consistent with the essentials of its people's 'common sense.' " Alas, postmodernism makes strange bedfellows.

[260] Gerhard Sonnert and Gerald Holton have kindly provided me the following brief biography of Krieck:

> Ernst Krieck (1882–1946) was a fierce ideologist and voluble writer, Nazi since the early 1920s, but originally a teacher in a primary school (*Volksschule*). On 1 April 1934 he was appointed to the chair of Pedagogy and Philosophy at the University of Heidelberg; his subsequent rise was, at first, irresistible. In mid-1935, upon the dismissal of the philosopher Ernst Hoffmann, Krieck became co-head of the Philosophical Seminar, together with Karl Jaspers. On 30 September 1937, Jaspers was pushed out as having "Jewish connections", leaving Krieck as the sole head. Concurrently, in January 1937, Krieck was made rector (= president) of the University of Heidelberg. He remained as rector only until 1 October 1938, having submitted his resignation because his views on anthropology had annoyed Alfred Rosenberg. Krieck remained in the chair of Pedagogy and Philosophy, and wrote numerous books on National Socialist education.

[261] The degree of validity of postmodernist ideas is, of course, a vast issue that goes far beyond the scope of this essay. It becomes particularly thorny because of the great diversity of ideas that go under the name of "postmodernism" (even within my rather restrictive definition). Some of my views on these matters can be found in Chapters 6 and 7 above, as well as in Sokal and Bricmont (1998, chapter 12). See also Haack (1998, 2003), Brown (2001) and Nanda (2003) for cogent critiques of postmodernist philosophical doctrines.

ones — taught and debated within universities have, over time, cultural effects beyond academia. For instance, postmodernist theorizing has had real effects "on the ground" in India, and those effects have not been uniformly positive, to put it mildly. Bertrand Russell (in the epigraph to this section) undoubtedly exaggerated when he denounced the perverse social consequences of confusion and subjectivism, but his fears were not entirely unfounded.

In this chapter I have given examples of explicit convergence between pseudoscience and postmodernism: cases in which pseudoscientists resorted to postmodernist arguments, or in which postmodernists defended pseudoscience. To be honest, my (admittedly incomplete) research has turned up fewer instances of explicit convergence than I had initially expected to find.

But perhaps the most serious nexus between postmodernism and pseudoscience is one that I have not investigated here at all — one that is less explicit, and harder to pin down, but more insidious. To the extent that postmodernist ideas are widely disseminated in the culture, even in watered-down form, they create a climate in which the incentives promoting the rigorous analysis of evidence are undermined.[262] After all, doing real science is difficult. Why bother investing the time to seriously learn physics, biology and statistics if it's all, in the end, just a matter of opinion anyway? One paradigm against another, your paradigm against mine. (Or in the more fashionable argot, "one among many truth games".) It's a lot quicker, and more exhilarating as well, to erect a revolutionary system based on verbal manipulation of phrases culled from vulgarizations of popularizations of relativity and quantum physics. Why bother studying David Bohm (1951, 1952) when it's far more exciting, and a hell of a lot easier, to read David Bohm (1980)? Why bother learning about non-commuting operators, when you can get all the quantum mechanics you need from Fritjof Capra?

There are also powerful psychological motivations impelling pseudoscience, which postmodernism reinforces. As Francis Bacon recognized nearly four centuries ago, "man prefers to believe what he wants to be true".[263] Logic and empirical science, on the other hand, intrude on human

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[262] For an entertaining account of the proliferation of various types of woolly thinking in modern public life, see Wheen (2004).

[263] Bacon (2000 [1620], Aphorism 49, p. 44).

freedom, or at least on our fantasies of it: the universe may or may not turn out to conform to our desires. Indeed, one aspect of the transition from childhood to adulthood involves learning to relinquish pleasant but false beliefs — in Santa Claus, for instance — and, more generally, to distinguish between our desires and reality. But this is a difficult process, and none of us, scientists included, achieves it perfectly.[264] Natural selection equipped the human brain with propensities toward accurate perception and reasoning in those areas of life that were relevant to our ancestors' survival and mating; but there was no selective pressure toward accuracy in cosmology, and there may even have been selective pressure against it.[265] Science is an extremely recent (relative to our species' lifetime) cultural innovation that has allowed humans to overcome some of our innate propensities toward wishful thinking and to harness our intellectual capacities towards ends light-years distant (literally) from life on the Pleistocene African savannah. It is utterly extraordinary how effective that innovation has proven, in a mere 400 years, in generating accurate knowledge of the world, from quarks to quasars; indeed, that success would have to be reckoned a near-miracle, if we did not already take it for granted. But the scientific attitude toward the world — the "scientific temper", as our colleagues in India so elegantly put it — is still very much a minority taste, even in the advanced industrialized countries where the technological products of science are ubiquitous. In many ways science cuts against the grain of human psychology, both in its methods and in its results; pseudoscience may well be more "natural" for our species. To maintain a scientific outlook requires a constant intellectual and emotional struggle against wishful, teleological and anthropomorphic thinking, misjudgments of probability, correlation and causation, perception of nonexistent patterns, and the tendency to seek confirmation rather than refutation of our favorite theories.[266]

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[264] For example, it is embarrassing nowadays to read what some eminent British scientists were writing in the 1930s about the new socialist commonwealth then being constructed under Stalin. Clearly, these authors' powerful and legitimate desires for a more just society overrode their trained scientific skepticism.

[265] See Miller (2000, pp. 262–265, 420–425) for the intriguing (though insufficiently fleshed-out) suggestion that the human propensity for creative but not necessarily factually accurate ideologies — as exemplified by the near-universality of religion in human society — may arise, at least in part, from sexual selection. See also Boyer (2001) and Atran (2002) for detailed analyses of religion through the lens of evolutionary psychology. I thank Helena Cronin for very interesting discussions on this issue.

[266] Ideas similar to those in the preceding two paragraphs have been put forth by Levitt (1999, especially chapters 2, 4 and 14) and Wolpert (1993, chapter 1). Please note that there is

Postmodernism did not create pseudoscience, and in most cases does not explicitly promote it. But by weakening the perceived intellectual and moral foundation for scientific thought, postmodernism abets pseudoscience and heightens the "ocean of insanity upon which the little barque of human reason insecurely floats".[267]

Appendix: Religion as pseudoscience

> The attempt to efface the features of the struggle between religion and science is nothing but a hopeless effort to defend religion.
>
> — *Sadiq al-'Azm (1982, p. 116)*

Some readers will no doubt be offended by my description of the Pope as "the leader of a major pseudoscientific cult". Others will concede the accuracy of the description but consider it unnecessarily aggressive. I beg to differ on both counts.

Few people would, I presume, take umbrage were I to term Heaven's Gate a "pseudoscientific cult" or call the gods of Olympus a "myth"; these would simply be considered accurate descriptions of the epistemic status of the beliefs in question.[268] But adherents of Heaven's Gate are few and socially marginal, while believers in the Greek gods are long dead. Judaism, Christianity, Islam and Hinduism, by contrast, number millions of adherents around the world — hundreds of millions in the case of the latter three — and wield significant (though by no means unchallenged) political, economic and social power in many countries. As a consequence, honest talk about the epistemic status of the dominant religions (e.g. Christianity in the West) is generally considered bad manners at best, blasphemous at worst. Nevertheless, to include these religions in a discussion of pseudoscience is in

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no contradiction between this emphasis on the *psychological* impediments to accurate reasoning and the contention that, as a *logical* matter, the scientific method is nothing more or less than the deepest (to date) refinement of the rational attitude in everyday life (pp. 178 ff. and Chapter 7 above).

[267] The phrase is due to Bertrand Russell (1961b, p. 531), who was speaking of nationalist and religious passions.

[268] For those who may not remember: Heaven's Gate was a group, based in Southern California, who believed that a spaceship travelling behind (or alongside) the comet Hale–Bopp would transport their liberated souls to heaven; 39 members committed mass suicide in March 1997. For a history, see Daniels (1999, chapter 12); and for a fascinating "inside" ethnography, written before the mass suicide, see Balch (1995).

no way "aggressive"; it is simply to refuse the double standard that mandates favored treatment for some pseudosciences over others. Indeed, an unbiased count would probably show that Christianity, Islam and Hinduism are *the most widely practiced* pseudosciences in the world today, far above homeopathy or astrology. And in their fundamentalist versions they are the most dangerous as well.

In saying this so openly, I realize that I am in the minority. Even most liberals and agnostics nowadays take a dim view of blunt talk about religion, except to denounce the excesses of fundamentalism. After all, the battles of the eighteenth and nineteenth centuries between the Church and secular liberals were largely resolved in favor of the latter; religion in the West has largely abandoned its pretensions at political influence, except on matters of sexual morality and (in areas of the United States where fundamentalists are strong) education. As a consequence, nonbelievers have reached a *modus vivendi* with organized religion: you agree to stay out of politics (more or less); we, in turn, will refrain from publicly questioning your theology and from attacking the remnants of your temporal privileges (e.g. state subsidies in Europe, exemptions from taxes and regulation in the United States[269]). Why bother criticizing ideas that are so inoffensive? Indeed, the liberal churches do much social good (e.g. in the civil rights and anti-war movements in the United States, and liberation theology in Latin America) and serve as an ethical counterweight to the untrammeled power of money.

A similar *modus vivendi* has been reached between the scientific community and the non-fundamentalist churches. The modern scientific worldview, if one is to be honest about it, leads naturally to atheism — or at the very least to an innocuous deism or pan-spiritualism that is incompatible with the tenets of all the traditional religions — but few scientists dare to say so publicly.[270,271] Rather, it is religious fundamentalists who make this (valid)

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[269] See Henriques (2006a–e) and especially Hamilton (2005).

[270] Some prominent exceptions are Dawkins (1987, 2003, 2006), Weinberg (1992), Levitt (1999) and Bricmont (1999).

[271] The empirical data on scientists' religious beliefs are mixed. A recent survey shows that approximately 39% of U.S. scientists believe in "a God to whom one may pray in expectation of receiving an answer", while 45% disbelieve and 15% have no definite opinion (Larson and Witham 1997). On the other hand, among members of the National Academy of Sciences, belief dropped to 7%, with 72% disbelieving and 21% agnostic (Larson and Witham 1998). See also Iannaccone *et al.* (1998) and Brown (2003) for different viewpoints on the available evidence.

accusation about "atheistic science"; scientists, by contrast, generally take pains to reassure the public that science and religion, properly understood, need not come into conflict. This is no doubt shrewd politics, especially in the United States, where the majority of people take their religion quite seriously; some scientists have labored to convince themselves (and the rest of us) that it is intellectually honest as well.[272] But the arguments do not hold water.[273]

Look back at my definition of pseudoscience and ask honestly whether the traditional religions fit:

(a) It makes assertions about real or alleged phenomena and/or real or alleged causal relations that mainstream science justifiably considers to be utterly implausible.

(b) It attempts to support these assertions through types of argumentation or evidence that fall far short of the logical and evidentiary standards of mainstream science.

(c) Most often (though not always), pseudoscience claims to be scientific, and even

(c′) claims to relate its assertions to genuine science, particularly cutting-edge scientific discoveries.

(d) It involves not a single isolated belief, but rather a complex and logically coherent system that "explains" a wide variety of phenomena (or alleged phenomena).

(e) Practitioners undergo an extensive process of training and credentialing.

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[272] Most such arguments come, of course, from believers: see, for example, Barbour (1990), Peacocke (1990) and Polkinghorne (1991). A theologically more modest version is offered by physicist Freeman Dyson (2000), who describes himself as "a practicing Christian but not a believing Christian" (Dyson 2002, p. 6). A different argument in favor of the compatibility of science and religion — the so-called "non-overlapping magisteria" (NOMA) — comes from paleontologist Stephen Jay Gould (1999), who calls himself an "agnostic" (p. 8) but who could perhaps more accurately be described as "an atheist bending over backwards far beyond the call of duty or sense" (Dawkins 2003, p. 252n89).

[273] See Bricmont (1999) for a brief but devastating critique of four variants of the idea that science and religion are compatible; and see Dawkins (2003, pp. 146–151) for a briefer but equally devastating critique of several of these variants. See also Kitcher (2005) for a more detailed account of the multifaceted incompatibility between science and religion.

Items (a), (b), (d) and (e) describe the traditional religions so perfectly that it hardly needs further explanation.[274] Items (c) and (c′) are less common in the traditional religions, but are becoming increasingly frequent in recent years among the more sophisticated advocates of religious ideas.[275]

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[274] Well, I *thought* that this point was so obvious that no further explanation was needed! But since some readers of an early draft of this essay requested elaboration of points (a) and (b), let me try to provide it briefly:

Examples of (a) include alleged "miracles" of all types — both the ancient miracles recounted in the holy books and those purportedly occurring in modern life — and more generally, all the interventions by God(s), saints, angels and sundry supernatural beings (e.g. in response to prayer) that, by definition, involve suspension or temporary modification of the ordinary laws of physics and biology.

Examples of (b) include alleged eyewitness observations taken at face value, without being subjected to the critical scrutiny that is routinely practiced by historians, jurors and indeed all human beings in our daily lives; alleged historical accounts taken at face value, without being subjected to the cross-checking of evidence that is routinely practiced by historians and archaeologists; and alleged accounts of miracle cures, healing by prayer, etc. taken at face value, without being subjected to the statistical tests routinely employed by medical researchers and epidemiologists.

[275] Particularly noteworthy in this regard are the activities of the John Templeton Foundation, which has an endowment of approximately $1.1 billion (see Horgan 2006) and which makes grants (over 100 per year) to promote

> work in which both science and religion are taken seriously in the quest to more fully understand reality. What can research tell us about God, about the nature of divine action in the world, about meaning and purpose? What spiritual insight can be gained from the way in which science unveils aspects of nature and of human creativity?

Special attention is given to subsidizing college courses in Science and Religion, which are diverse in detail but uniformly aimed at showing that science and religion are compatible (see Wertheim 1995 for a report by a supporter). In addition, the Foundation awards an annual Templeton Prize for Progress Toward Research or Discoveries about Spiritual Realities, valued at almost $1.5 million, which according to a Foundation press release "is the world's largest monetary annual award given to an individual":

> [T]his award is intended to encourage the concepts that resources and manpower are needed to accelerate progress in spiritual discoveries, which can help humans to learn over 100 fold more about divinity.... The Prize is intended to help people see the infinity of the Universal Spirit still creating the galaxies and all living things and the variety of ways in which the Creator is revealing himself to different people.

Recent recipients include physicist (and Anglican priest/theologian) John Polkinghorne, biochemist (and Anglican priest/theologian) Arthur Peacocke, physicist (and Christian theologian) Ian Barbour, and physicists Paul Davies, Freeman Dyson, George Ellis, Charles

After all, when we say of a pseudoscientific cult — Therapeutic Touch, for instance, or Lacanian psychoanalysis — that it has become "virtually a new religion" or that its adherents "defend its doctrines with a quasi-religious fervor", we mean these comments as epistemic judgments, and we mean them pejoratively. Should doctrines that *admit* to being religions be treated any differently?

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I would also like to thank the Interlibrary Loan office at NYU's Bobst Library for efficiently processing my innumerable requests.

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Townes and John Barrow. [Quotations and information come from Templeton Foundation (2003).]

For a detailed statement of the Templeton credo, see Templeton and Herrmann (1989). For critiques of the Templeton Foundation's activities by scientists and others sharing a scientific worldview, see Krauss (1999), MacIlwain (2000), Brown (2000) and Horgan (2006). For an amusing (but perfectly cogent) critique of the Templeton Foundation's wishy-washy theology from the perspective of Christian fundamentalism, see Grigg (2002) and Herrmann (2002).

Playing a similar (but possibly less lavish) role in the French-speaking world is the Université Interdisciplinaire de Paris (UIP), which is not in fact a university, but rather an association that organizes conferences on science and religion and publishes a journal, *Convergences*. For further information on the UIP, along with a sharp critique, see Dubessy and Lecointre (2001).

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9

Religion, politics and survival*

> None of us, I think, in the mid-'70s ... would have thought we'd be devoting so much mental space now to confront religion. We thought that matter had long been closed.
>
> — *Ian McEwan (2006)*

The apparent resurgence, over the past few decades, of religion as a political force — in the United States, in India, in Latin America, and of course throughout the Muslim world — has obliged all of us, believers and nonbelievers alike, to pay renewed attention to religion both as an intellectual system and as a socio-political phenomenon (taking due care to distinguish the two aspects). In this chapter I wish to address some of these issues through a critical analysis of two recent books — Sam Harris' best-selling *The End of Faith* and Michael Lerner's little-known *Spirit Matters* — that I consider important in their very different ways (though also deeply flawed).[1] Together these books raise urgent questions that no one concerned with the survival of the human race in the twenty-first century can afford to ignore.

The two books are written, it should be said at the outset, from diametrically opposite perspectives. Harris, a doctoral candidate in neuroscience, is an atheist and makes no bones about it. Lerner, editor of *Tikkun* magazine and a well-known rabbi and progressive activist, affirms a belief in God (albeit not one that religious traditionalists would recognize) and calls for an Emancipatory Spirituality.

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* This essay was originally commissioned by the journal *Science & Society*, but it ended up being more than seven times their maximum allowed length! It is being published for the first time here.

[1] In choosing the book-review format I am heeding the timeless advice of American poet James Russell Lowell (1819–1891):

> Nature fits all her children with something to do,
> He who would write and can't write, can surely review.

The strengths and weaknesses of the two books are likewise complementary. Harris is strong on epistemology, but his treatment of politics is unsatisfying. Lerner's epistemology is unbearably sloppy (or so at least it seems to me), but his book is brimming with insights into the psychodynamics of everyday life under capitalism and its effects on people's political choices. Lerner implores liberals and leftists to avoid condescension toward followers of the religious right and to examine our own often-elitist attitudes. In the wake of the 2004 American elections, this is important advice.[2]

I propose here, not to examine every aspect of these two books, but rather to focus on the central philosophical and political issues that they raise.[3] Philosophically, the most crucial problem — the one that must come before all else — concerns the epistemic status of religious ideas. Politically, one key strategic question for atheist or strongly skeptical leftists is: How can we relate to social groups whose material interests and, indeed, ethical concerns seem consistent with left politics, but who are intellectually and emotionally attached to some sort of religious orthodoxy? How do we talk to and work with such people, without dissimulation, hypocrisy or condescension? This issue arose in the civil rights movement of the 1950s and 60s and again in the Central America solidarity movement of the 1980s, but is posed in far more acute form today.

Harris sets out his thesis with commendable clarity:

> Our situation is this: most of the people in this world believe that the Creator of the universe has written a book. We have the misfortune of having many such books on hand, each making an exclusive claim as to its infallibility. (p. 13)

Regrettably, "these rival belief systems are all equally uncontaminated by evidence" (p. 15). To make matters worse,

> People tend to organize themselves into factions according to which of these incompatible claims they accept ... [T]he central tenet of every religious tradition is that all others are mere repositories of error or, at best, dangerously incomplete. Intolerance is thus intrinsic to every

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[2] The wisdom of this advice is in no way diminished by the results of the 2006 midterm elections, in which the voters administered a perhaps-temporary rebuke to a Republican Party enmeshed in war and scandals, to the fortuitous benefit of a largely-undeserving Democratic Party.

[3] In particular, I shall mostly ignore Harris' surprising (for a self-proclaimed rationalist) advocacy of mysticism. But see note 23 below.

> creed.... Give people divergent, irreconcilable, and untestable notions about what happens after death, and then oblige them to live together with limited resources. The result is just what we see: an unending cycle of murder and cease-fire. (pp. 13, 26)

But beliefs that heretofore "merely" instigated an interminable series of local bloodbaths are rapidly becoming a threat to the survival of the human race as a whole:

> We are fast approaching a time when the manufacture of weapons of mass destruction will be a trivial undertaking; the requisite information and technology are now seeping into every corner of our world.... Given the power of our technology, we can see at a glance that aspiring martyrs will not make good neighbors in the future. (pp. 47–48)

Harris concludes that

> Words like "God" and "Allah" must go the way of "Apollo" and "Baal," or they will unmake our world. (p. 14)

One novelty of Harris' book is its sharp critique of religious moderates — as well as irenic-minded nonbelievers such as the late Stephen Jay Gould (more on him later) — for the negative role they play by inhibiting honest debate about evidence (or its lack) and "faith".

> The concessions we have made to religious faith — to the idea that belief can be sanctified by something other than *evidence* — have rendered us unable to name, much less address, one of the most pervasive causes of conflict in our world. (p. 29)

Harris contends that

> the greatest problem confronting civilization is not merely religious extremism; rather, it is the larger set of cultural and intellectual accommodations we have made to faith itself. Religious moderates are, in large part, responsible for the religious conflict in our world, because their beliefs provide the context in which scriptural literalism and religious violence can never be adequately opposed. (p. 45)

In order to analyze Harris' arguments, a few distinctions are perhaps in order. For starters, religious doctrines typically have two components: a factual part, consisting of a set of claims about the universe and its history; and an ethical part, consisting of a set of prescriptions about how to live. In addition, all religions make, at least implicitly, epistemological claims concerning

the methods by which humans can obtain reasonably reliable knowledge of factual or ethical matters. These three aspects of each religion obviously need to be evaluated separately.

Furthermore, when discussing any set of ideas, it is important to distinguish between the intrinsic merit of those ideas, the objective role they play in the world, and the subjective reasons for which various people defend or attack them.[4]

So, let's start with the intrinsic merit of the factual doctrines asserted by the world's major religions. Here Harris pulls no punches: he castigates the religious worldview both for its dogmatic reliance on "faith" rather than evidence and for the utter implausibility of its doctrines in the light of the evidence we do have.

> We have names for people who have many beliefs for which there is no rational justification. When their beliefs are extremely common we call them "religious"; otherwise, they are likely to be called "mad," "psychotic," or "delusional."... And yet, it is merely an accident of history that it is considered normal in our society to believe that the Creator of the universe can hear your thoughts, while it is demonstrative of mental illness to believe that he is communicating with you by having the rain tap in Morse code on your bedroom window. (p. 72)

To exemplify the looniness of mainstream religious doctrine, we need not go so far as to consider the 45–53% of Americans who think that the universe and all life forms in it were created over a six-day period approximately 5,800 years ago[5] (about "2,500 years *after* the Babylonians and Sumerians learned to brew beer", Harris observes wryly). Rather, it suffices to examine a central dogma of the Roman Catholic faith:

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[4] Unfortunately, much discussion of religion fails to make the elementary distinctions set forth in the preceding two paragraphs. A fairly typical example of this type of intellectual sloppiness can be found in Kristof (2006). Another, alas, is Lerner (2006b).

[5] Gallup poll taken in the United States in 2004. The exact question was: "Which of the following statements comes closest to your views on the origin and development of human beings? — Human beings have developed over millions of years from less advanced forms of life, but God guided this process. Human beings have developed over millions of years from less advanced forms of life, but God had no part in this process. God created human beings pretty much in their present form at one time within the last 10,000 years or so." The results were 38% developed with God, 13% developed without God, 45% God created in present form (the remainder have "no opinion"). These results have been essentially stable for at least the past 20 years.

In a 2005 Gallup poll, the last option was reworded as "God created human beings in their present form exactly the way the Bible describes it." Curiously, this *stronger* formulation

> I likewise profess that ... the body and the blood, together with the soul and the divinity, of our Lord Jesus Christ is truly, really, and substantially present in the most holy sacrament of the Eucharist, and that there is a change of the whole substance of the bread into the body, and of the whole substance of the wine into blood ... [6]

Harris comments caustically that

> Jesus Christ — who, as it turns out, was born of a virgin, cheated death, and rose bodily into the heavens — can now be eaten in the form of a cracker. A few Latin words spoken over your favorite Burgundy, and you can drink his blood as well. Is there any doubt that a lone subscriber to these beliefs would be considered mad? (p. 73)[7]

But humans collectively are capable of feats and folly that far surpass any of us alone.

Elsewhere, Harris suggests an instructive experiment:

> To see how much our culture currently partakes of the irrationality of our enemies, just substitute the name of your favorite Olympian for "God" whenever this word appears in public discourse. Imagine President Bush addressing the National Prayer Breakfast in these terms: "Behind all of

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received *greater* assent: the results were 31% developed with God, 12% developed without God, 53% God created exactly as the Bible describes it.

These two polls, as well as earlier polls on the same subject, are available on-line at `http://web.lexis-nexis.com/universe/form/academic/s_roper.html`

[6] This is an extract from the Tridentine Profession of Faith, proclaimed by Pope Pius IV (1564) and reiterated by the Church, albeit in slightly varying phrasing, many times since. Most recently, Pope John Paul II (2003) has restated the importance of the transubstantiation doctrine to Catholic teaching: "The Church draws her life from the Eucharist. This truth does not simply express a daily experience of faith, but recapitulates *the heart of the mystery of the Church*." (italics in the original) He goes on to praise "the perennially valid teaching of the Council of Trent" (1551), at which the transubstantiation dogma was reaffirmed in the face of Protestant doubt, as well as a 1968 apostolic letter of Pope Paul VI, who wrote that "Every theological explanation ... , in order to be in accord with Catholic faith, must firmly maintain that *in objective reality*, independently of our mind, the bread and wine have ceased to exist after the consecration, so that the adorable body and blood of the Lord Jesus from that moment on are really before us under the sacramental species of bread and wine" (emphasis added by me).

Admittedly, few Catholics nowadays really *believe* in the official transubstantiation doctrine (or probably are even aware of it); most Catholics no doubt conceive of the wafer as *symbolizing* the body of Christ, so that in this respect they are *de facto* Protestants. Here the spontaneous rationality of the masses wins out over the most advanced theological erudition.

[7] I thank Marina Papa-Sokal for pointing out that, thanks to improved technology introduced in the early 1960s, it is now possible to transform wine into blood also in vernacular languages.

> life and all history there is a dedication and a purpose, set by the hand of a just and faithful *Zeus*." Imagine his speech to Congress (September 20, 2001) containing the sentence "Freedom and fear, justice and cruelty, have always been at war, and we know that *Apollo* is not neutral between them." Clearly, the commonplaces of language conceal the vacuity and strangeness of many of our beliefs. (pp. 46–47)

A related suggestion has been made recently by David Morris, who urges that the word "religion" — or its currently fashionable ecumenical-sounding euphemism, "faith" — be replaced by the epistemologically more illuminating term, "superstition".[8] For instance, President Bush could extol religion as follows:

> I believe in the power of superstition in people's lives. Our government should not fear programs that exist because a church or a synagogue or a mosque has decided to start one. We should not discriminate against programs based upon superstition in America. We should enable them to access federal money, because superstition-based programs can change people's lives, and America will be better off for it.

and then go on to stress that

> The superstition-based initiative is not about a single superstition. In this country we're great because we've got many superstitions, and we're great because you can choose whatever superstition you choose, or if you choose no superstition at all, you're still equally American.[9]

The clarity of our national discourse would be notably improved by this simple rephrasing.[10]

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[8] Morris (2005). The American Heritage Dictionary defines superstition as

> 1. An irrational belief that an object, action, or circumstance not logically related to a course of events influences its outcome. 2a. A belief, practice, or rite irrationally maintained by ignorance of the laws of nature or by faith in magic or chance. 2b. A fearful or abject state of mind resulting from such ignorance or irrationality.

[9] The first quotation was used by Morris (2005). The original texts can be found on the website of the White House Office for Faith-Based and Community Initiatives at `http://www.whitehouse.gov/government/fbci/guidance/charitable.html` and `http://www.whitehouse.gov/news/releases/2005/03/20050301-4.html`

[10] This clarification would also be salutary in Britain, where former Prime Minister Tony Blair assiduously promoted government subsidies for "superstition-based schools". After it was reported that a publicly funded Christian school in Gateshead had been teaching creationism, Blair was asked in Parliament whether he was "happy to allow the teaching of creationism alongside Darwin's theory of evolution in state schools". Blair (always the

Many people will no doubt be offended by Harris' (and my) characterization of Catholicism and other religions as "mad". Others — perhaps most readers of this essay — will concede the accuracy of the description but consider it needlessly aggressive. I beg to differ on both counts. Few people would, I presume, take umbrage were I to term Heaven's Gate a "pseudoscientific cult" or call the gods of Olympus a "myth"; these would simply be considered accurate descriptions of the epistemic status of the beliefs in question.[11] But adherents of Heaven's Gate are few and socially marginal, while believers in the Greek gods are long dead. Judaism, Christianity, Islam and Hinduism, by contrast, number millions of adherents around the world — hundreds of millions in the case of the latter three[12] — and wield significant (though by no means unchallenged) political, economic and social power in many countries. As a consequence, honest talk about the epistemic status of the dominant religions (e.g. Christianity in the West) is generally considered bad manners at best, blasphemous at worst. No such constraints are placed on discussions of astrology or tarot reading. Harris is rightly protesting against the double standard that mandates favored treatment for some crazy ideas over others.[13]

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consummate politician) avoided a direct answer, but defended the school in question and said that "In the end, a more diverse school system will deliver better results for our children." (House of Commons 2002) As Francis Wheen (2004, pp. 114–115) acerbically comments:

> Here was the leader of a supposedly secular, progressive government who, on being invited to assert that probable truth is preferable to palpable falsehood, pointedly refused to seize the opportunity — and indeed justified the teaching of bad science in the name of 'diversity.'... What if some schools informed their pupils that the moon was made of Swiss cheese, or that the stars were God's daisychain? Would that be officially welcomed as another healthy consequence of Blair's 'more diverse school system'?

[11] For those who may not remember: Heaven's Gate was a group, based in Southern California, who believed that a spaceship travelling behind (or alongside) the comet Hale–Bopp would transport their liberated souls to heaven; 39 members committed mass suicide in March 1997. For a history, see Daniels (1999, chapter 12); and for a fascinating "inside" ethnography, written before the mass suicide, see Balch (1995).

[12] The best estimates are that Christianity has at present approximately 2.1 billion adherents, Islam 1.3 billion, Hinduism 850 million, and Judaism 15 million. See Encyclopaedia Brittanica (2006).

[13] As social critic Wendy Kaminer (1999, p. 34) insightfully points out,

> It's easy to imagine a TV sitcom making fun of a character who visits psychics and astrologers and channels Sarah Bernhardt but virtually impossible to imagine it laughing at anyone who takes the Bible literally and believes that someone named Jonah once lived in a whale.

But of course, those who believe in Genesis or transubstantiation do not consider these ideas to be crazy; quite the contrary, they think that they have *good reasons* to hold their beliefs. Indeed, Harris argues convincingly that whenever any person P believes any proposition X — at least in the ordinary sense of the English word "believe" — this requires, first of all, that P must believe X to be *true*, i.e. to be a factually accurate representation of the world; and secondly, that P must think he has *good reasons* to believe X, in the sense that he envisions his belief as *caused*, at least in part, by the fact that X is true. As Harris puts it (p. 63), "there must be some causal connection, or an appearance thereof, between the fact in question and my acceptance of it."

So, what are the alleged good reasons that religious people will invoke when asked to explain why they believe what they do? That is to say, what is the implicit or explicit epistemology underlying the religious worldview?

Each religion makes scores of purportedly factual assertions about everything from the creation of the universe to the afterlife; and to believers, this knowledge

> can mean the difference between eternal torment and bliss everlasting.... [But] How can any person presume to know that this is the way the universe works? Because it says so in our holy books. How do we know that our holy books are free from error? Because the books *themselves* say so. (p. 35)

Theologians specialize in weaving elaborate webs of verbiage to avoid saying anything quite so bluntly, but this gem of circular reasoning really is the epistemological bottom line on which all "faith" is grounded. In the words of Pope John Paul II: "By the authority of his absolute transcendence, God who makes himself known is also the source of the credibility of what he reveals."[14] It goes without saying that this begs the question of whether the texts at issue really were authored (or inspired) by God, and on what grounds one knows this. "Faith" is not in fact a rejection of reason[15], but simply a

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[14] John Paul II (1998, paragraph 13). The Pontiff goes on to say: "By faith, men and women give their *assent* to this divine testimony. This means that they acknowledge fully and integrally the truth of what is revealed because it is God himself who is the guarantor of that truth."

[15] Indeed, Pope Pius XII, in his famous encyclical *Humani Generis* (1950), stressed that

> It is well known how highly the Church regards human reason, for it falls to reason to demonstrate with certainty the existence of God, personal and one; to prove beyond doubt from divine signs the very foundations of the Christian faith ...

But he did compassionately concede that

> the human intelligence sometimes experiences difficulties in forming a judgment about the credibility of the Catholic faith, notwithstanding the many wonderful

lazy acceptance of bad reasons — what Harris calls "motivated credulity" (p. 65).[16]

Of course, not all religions rely on bad reasons to an equal degree, for the simple reason that some religions make fewer dubious assertions than others. For instance, liberal Protestants nowadays accept evolution and the findings of scientific cosmology, having retreated from Biblical literalism a century ago[17]; and mainline Protestant seminaries teach the application of historical-critical methods to the Bible. But if one accepts the obvious conclusion from such historical studies — namely, that the New Testament is a melange of fact and fiction concerning a charismatic prophet who lived 2000 years ago in Palestine, and who was a human being like the rest of us[18] — what then is left of Christianity's factual doctrines? And if, despite all this, one continues to maintain that Jesus really is the Son of God, then one cannot evade the obvious question: On what evidence does one base this belief?

In order to shed light on the contrast between religion and other forms of knowledge, Harris proposes the following thought-experiment:

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external signs God has given, which are sufficient to prove with certitude by the natural light of reason alone the divine origin of the Christian religion.

[16] A paradigmatic example of theological obfuscation is provided by Anglican theologian Alister McGrath's definition of "faith", which he describes as "typical of any Christian writer":

> [Faith] affects the whole of man's nature. It commences with the conviction of the mind based on adequate evidence; it continues in the confidence of the heart or emotions based on conviction, and it is crowned in the consent of the will, by means of which the conviction and confidence are expressed in conduct. (McGrath 2005, p. 86, quoting Griffith-Thomas 1930, p. xviii)

As Shermer (2005, p. 206) accurately observes, nearly all of this definition "describes the psychology of belief. The only clause of relevance to a scientist [or, I would add, to an epistemologist] is 'adequate evidence,' which raises the follow-up question, 'Is there?'" Alas, McGrath does not bother to address this perfectly obvious question anywhere in his 200-page book.

Worse yet, McGrath wants to have his cake and eat it too: when it suits his argumentative purposes, he reverts to the everyday meaning of the word "faith", flatly contradicting his own definition:

> It is increasingly recognized that philosophical argument about the existence of God has ground to a halt. The matter lies beyond rational proof, and is ultimately a matter of faith, in the sense of judgments made in the absence of sufficient evidence. (McGrath 2004, p. 179)

[17] Catholics have also accepted evolution, albeit with many caveats, since the 1950 encyclical *Humani Generis* of Pope Pius XII (see its paragraphs 36 and 37).

[18] I leave aside, for the sake of argument, the question of whether it really is solidly established by historical evidence that there did exist a (and only one) prophet in Palestine 2000 years ago whose career conforms, at least in the rough outlines of its non-miraculous aspects, to the account given in the New Testament.

> Imagine that we could revive a well-educated Christian of the fourteenth century. This man would prove to be a total ignoramus, except on matters of faith. His beliefs about geography, astronomy, and medicine would embarrass even a child, but he would know more or less everything there is to know about God. Though he would be considered a fool to think that the earth is the center of the cosmos, or that trepanning [the practice of boring holes in the skull to allow the escape of evil spirits] constitutes a wise medical intervention, his religious ideas would still be beyond reproach. There are two explanations for this: either we perfected our religious understanding of the world a millennium ago — while our knowledge on all other fronts was still hopelessly inchoate — or religion, being the mere maintenance of dogma, is one area of discourse that does not admit progress. (pp. 21–22)

But, Harris continues,

> If religion addresses a genuine sphere of understanding and human necessity, then it should be susceptible to *progress* ... Whatever is true now should be *discoverable* now, and describable in terms that are not an outright affront to the rest of what we know about the world. By this measure, the entire project of religion seems perfectly backward. (p. 22)[19]

He concludes that

> It is time we admitted, from kings and presidents on down, that there is no evidence that any of our books was authored by the Creator of the universe. The Bible, it seems certain, was the work of sand-strewn men and women who thought the earth was flat and for whom a wheelbarrow would have been a breathtaking example of emerging technology. To rely on such a document as the basis for our worldview ... is to repudiate two thousand years of civilizing insights that the human mind has only just begun to inscribe upon itself through secular politics and scientific culture. (p. 45)

What about the ethical doctrines of Judaism, Christianity and Islam? Everyone knows the Old Testament passage in which we are urged to love our neighbor (though not our neighbor's wife); but some of Yahweh's rather

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[19] Of course, liberal Christians and Jews will argue that religion *has* made progress over the centuries, by discarding discredited ideas such as belief in the literal truth of Genesis and replacing them with more metaphorical interpretations of the Bible. But the key question is whether these religions' *currently* held factual doctrines (if indeed they still have any) are supported by evidence.

more precise commandments are less well known to modern Christians and Jews, who often "do not read the Bible in its entirety and consequently have no idea just how vigorously the God of Abraham wants heresy expunged. One look at the book of Deuteronomy reveals that he has something very specific in mind should your son or daughter return from yoga class advocating the worship of Krishna" (pp. 17–18):

> If your brother, the son of your father or of your mother, or your son or daughter, or the spouse whom you embrace, or your most intimate friend, tries secretly to seduce you, saying, "Let us go and serve other gods," unknown to you or your ancestors before you, gods of the peoples surrounding you, whether near you or far away, anywhere throughout the world, you must not consent, you must not listen to him; you must show him no pity, you must not spare him or conceal his guilt. No, you must kill him, your hand must strike the first blow in putting him to death and the hands of the rest of the people following. You must stone him to death, since he has tried to divert you from Yahweh your God. (Deuteronomy 13:7–11)[20]

In Islam the penalty for apostasy is likewise death (more on that later). Harris observes that

> While the stoning of children for heresy has fallen out of fashion in our country, you will not hear a moderate Christian or Jew arguing for a "symbolic" reading of passages of this sort. (In fact, one seems to be explicitly blocked by God himself in Deuteronomy 13:1 — "Whatever I am now commanding you, you must keep and observe, adding nothing to it, taking nothing away.") The above passage is as canonical as any in the Bible, and it is only by ignoring such barbarisms that the Good Book can be reconciled with life in the modern world. (p. 18)

Harris comments archly that

> No doubt an obscure truth of economics is at work here: societies appear to become considerably less productive whenever large numbers of people stop making widgets and begin killing their customers and creditors for heresy. (p. 17)

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[20] The death penalty for idolatry is repeated in Deuteronomy 17:2–13, where it is made conditional on the existence of at least two witnesses; on the other hand, anyone declining to participate in an execution ordered by a priest or judge is also sentenced to death. A closely related commandment is found in Leviticus 24:16:

> And anyone who blasphemes the name of Yahweh will be put to death; the whole community will stone him; be he alien or native-born, if he blasphemes the Name, he will be put to death.

The bottom line, Harris concludes, is that

> "moderation" in religion ... has nothing underwriting it other than the unacknowledged neglect of the letter of the divine law.... [It] is the product of *secular* knowledge and scriptural *ignorance* ... By failing to live by the letter of the texts, while tolerating the irrationality of those who do, religious moderates betray faith and reason equally. (pp. 18, 21)

To be sure, the holy books of most religions are not *uniformly* as barbaric as Deuteronomy. Rather, as befits multi-authored texts[21], they tend to be an incoherent mishmash of the sublime and the prosaic, the laudable and the abhorrent; furthermore, their ethical prescriptions are often couched in obscurely elliptical language (though not always, as we have just seen). Believers can therefore dredge up scriptural support for almost any proposition they fancy. Is it any surprise that among devout Christians one can find both passionate supporters and passionate opponents of the death penalty?

For this reason, discussions of the ethical consequences of religion that focus on counting the "good" and "bad" passages in scripture — a game played by opponents and defenders of religion alike — miss the point. A better approach is to consult the empirical evidence from history. But even then, efforts to establish a balance sheet for religion — weighing the good consequences against the bad — are likely to prove as futile as establishing a balance sheet for capitalism or communism. Harris provides a useful overview of the Inquisition and witch-hunting, and a brief summary of the religious origins of Christian anti-Semitism. But defenders of Christianity could retort by citing Bartolomé de las Casas, Martin Luther King and liberation theology. Harris also cites the long list of ongoing conflicts in which religion plays a major role and indeed "has been the *explicit* cause of literally millions of deaths in the last ten years" (p. 26). I personally tend to agree with Harris that the net effect of religion on humanity has been negative, but this is probably a fruitless debate.[22]

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[21] The Qur'an is an exception, as it was ostensibly authored in its entirety by a single person, Muhammad (though edited by many hands over the following century). However, even within this work there are glaring contradictions between verses composed before and after the flight from Mecca to Medina — a fact that led Qur'anic scholars to develop the doctrine that later verses "abrogate" earlier ones. See e.g. Coulson (1964, pp. 90–91), Hallaq (1997, pp. 68–74 and 189–190; 2005, pp. 66-67 and 136–138) and especially Burton (1990, 2006).

[22] Worse than a fruitless debate, it is also a *dangerous trap* for critics of religion. Defenders of religion are, in fact, more than happy to argue on the terrain of religion's ethical consequences in the world, as this relieves them — polemically, that is, not of course logically — of the unpleasant duty of defending the intrinsic merit of their doctrines. For egregious examples of this type of evasion, perpetrated by the Professor of Historical Theology at Oxford University, see McGrath (2004, 2005).

Harris does not, in fact, claim that *all* religions have a negative net effect on the world. At one point he comments semi-facetiously that "the uncontrollable spread of Jainism throughout the world would improve our situation immensely", even though "we would lose more of our crops to pests" because "observant Jains generally will not kill anything, including insects" (p. 148). Later in the book, he commends Buddhist views of consciousness and happiness, which he insists are "empirical" doctrines that are "susceptible of rational discussion" (p. 221). Harris reserves his (justified) venom for those religions that make radical claims in the absence of any credible evidence, and which indeed *disdain* subjecting their core doctrines to the test of evidence.[23]

Harris also concedes (albeit grudgingly) that secular doctrines can lead to great evil — the most obvious recent examples being Nazism, Communism and myriad virulent nationalisms and quasi-fascist ideologies. The thread that unites these diverse doctrines with religion is the allergy to doubt — and thus to inconvenient evidence — that is inculcated into every true believer. But secular ideologies also differ from religions in many ways, and Harris treats this question too cavalierly.

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[23] Well, not quite: Johann Hari (2005) has criticized Harris — rightly I think — for letting Buddhism and other Eastern religions off the hook. "Didn't the Buddha peddle notions [such as reincarnation] just as absurd as the Christianity Harris has mocked? ... Where is the critique of the layers of superstition and irrationality that coat Eastern religions just as surely as their Western cousins?" Indeed, in a subsequent article Harris concurred that "there are ideas within Buddhism that are so incredible as to render the dogma of the virgin birth plausible by comparison"; he praised "the wisdom of the Buddha" but decried "the religion of Buddhism" (Harris 2006, pp. 74, 73).

Harris' claims for "spirituality" and "mysticism" are likewise somewhat muddled (see Hari 2005, Flynn 2005 and especially Nanda 2005 for cogent critiques). For instance, Harris asserts that spiritual and mystical experiences "uncover genuine facts about the world" and "reveal a far deeper connection between ourselves and the rest of the universe than is suggested by the ordinary confines of our subjectivity" (p. 40). Taken literally, this sounds an awful lot like the Vedic/Yogic idea that "by knowing oneself one can know the world" (see Chapter 8) — a notion that rests, as Nanda (2005) points out, on the assumption that "what mystics see in their minds actually has an ontological referent in the world outside their minds". But where is the *evidence* for such an assumption?

Alas, it now appears that Harris meant to assert far less than this sentence seems to. In response to my queries, Harris now stresses (private communication, March 22, 2007) his belief that spiritual and mystical experiences uncover genuine facts about "the nature of our minds, not the nature of the cosmos". He adds that

> the experience of oneself as highly permeable to the world, and ultimately inseparable from it, is more accurate than experiencing oneself as a skin-encapsulated ego. But I am not saying that spiritual experiences of unity with nature (or anything else) allow us to make claims about physics, biology, etc.

One final issue that needs to be confronted is the relation between the factual and ethical aspects of religious doctrine. Some modern intellectuals, recognizing the absurdity of the factual claims of most religions but desiring nevertheless to keep a space for religion within our culture, argue that science and religion need not fall into conflict because they possess distinct domains of competence. For instance, Stephen Jay Gould (1999) has famously argued that science and religion should be understood as "nonoverlapping magisteria": science dealing with questions of fact, religion dealing with questions of ethics and meaning. But this position will not hold water, for two reasons. Firstly, it is anathema to the overwhelming majority of believers, who will not take kindly to Gould's diktat that they must abandon all their factual claims. (And why should they, given that they think their claims are *true*?) This poses a problem not only for fundamentalists, but for any serious religious person; after all, even the most watered-down version of Christianity has to have some bottom line — that God created the world, that Jesus is His son, that the Bible is His inspired word (even if it must sometimes be interpreted metaphorically) — otherwise what is the point of calling oneself a believing Christian? And secondly, if religion were to abandon all its factual claims, then on what grounds would its ethical judgments rest?[24]

> On the teachings contained in this or that revelation? But on what grounds should we choose one revelation rather than another, if not because it expresses the "true" word of God? And this latter claim sends us right back to ontological questions.... Moreover, religious moral systems run into a difficulty similar to that encountered by the non-literal interpretation of Scripture: nowadays no believer wants to follow literally all the ethical prescriptions contained in the Bible. But how should we figure out which ones to follow and which to ignore, if not by using moral ideas that are independent of revelation? And if revelation needs to be evaluated by means of criteria that are external to it, then what purpose can revelation serve? (Bricmont 1999, translation mine)

Thus far we have been focussing on the intrinsic merit of the factual, ethical and epistemological claims underlying Judaism and Christianity — for brevity I have restricted myself to these two examples — and we have seen that they rest on shaky logical and evidentiary ground, to put it mildly. But

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[24] Or more precisely: On what grounds would religion be able to vindicate any ethical statements *beyond* those that can be justified on purely secular grounds (e.g. as universal human moral intuitions)?

this sort of normative analysis sheds no light on a crucial descriptive question: *Why* do religious people hold the crazy beliefs that they do? That is to say, what are the psychological mechanisms underlying religious belief, and the social conditions that foster or inhibit it?

Curiously for someone with a background in neuroscience, Harris hardly addresses this issue at all. In particular, he fails to mention recent work by anthropologists and cognitive psychologists that is aimed at understanding the mental structures underlying the near-universal human tendency to invoke supernatural agents in explanation of natural phenomena.[25] In brief (actually *much too* brief), the main idea is the following: One key stage in the evolution of the brain of the higher primates was the development of a "theory of mind" module, in which individuals gain the ability to conceptualize other individuals' actions as governed by beliefs and intentions analogous to our own, and to form conjectures about those beliefs and intentions as explanations of observed behavior.[26] Once one conceives of other humans as having invisible thoughts that determine their actions, it is a short step to imagining invisible agents — ancestors, spirits, gods, saints — that likewise have thoughts and desires and are capable of taking action based on them. In short, religion piggybacks on the cognitive machinery that is already in place in the human mind.

It should be remembered that natural selection equipped the human brain with propensities toward accurate perception and reasoning in those areas of life that were relevant to our Pleistocene ancestors' survival and mating; but there was no selective pressure toward accuracy in cosmology, and there may even have been selective pressure against it (counterintuitive though this may at first seem). For instance, Geoffrey Miller, in his book *The Mating Mind*, has made the intriguing (though insufficiently fleshed-out) suggestion that the human proclivity for creative but not necessarily factually accurate ideologies — such as religion — may arise, at least in part, from sexual selection.[27] Whether or not this particular conjecture turns out to be correct, the fact remains that the human mind is only imperfectly designed for the rational evaluation of evidence; and the farther we move away from the tasks of everyday life, the more prominent those inadequacies become. To maintain a rational outlook requires a constant intellectual and emotional struggle against wishful, teleological and anthropomorphic

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[25] See, for instance, Boyer (2001) and Atran (2002).

[26] See, for instance, Mithen (1996) for an excellent introduction.

[27] See Miller (2000, pp. 262–265, 420–425). I thank Helena Cronin for very interesting discussions on this issue.

thinking, misjudgments of probability, correlation and causation, perception of nonexistent patterns, and the tendency to seek confirmation rather than refutation of our favorite theories.

But all this still does not explain how believers in the modern world manage to keep their minds partitioned. After all, as Harris points out,

> The faithful can be expected to behave just like their secular neighbors — which is to say, more or less rationally — in their worldly affairs. When making important decisions, they tend to be as attentive to evidence and to its authentication as any unbeliever.... Tell a devout Christian that his wife is cheating on him, or that frozen yogurt can make a man invisible, and he is likely to require as much evidence as anyone else, and to be persuaded only to the extent that you give it. Tell him that the book he keeps by his bed was written by an invisible deity who will punish him with fire for eternity if he fails to accept its every incredible claim about the universe, and he seems to require no evidence whatsoever. (pp. 68–69, 19)

Harris (pp. 64–67) offers a few insights into this paradox, but provides no convincing explanation. Neither, alas, can I.[28]

One crucial task for historians and sociologists, it seems to me, is to shed light on the social, political and economic conditions that foster the growth of superstition on the one hand, or of rational thinking on the other.[29] Unfortunately, Harris' conceptualization of the relation between religion and social forces is woefully inadequate. Harris of course acknowledges that, over the past few centuries, the majority of religious people in the West have become more "moderate" in their beliefs and practices, and hence less

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[28] One part of the explanation may be provided, ironically enough, by Pope John Paul II, who in his encyclical *Fides et Ratio* (1998, paragraph 27) asserts that

> people seek an absolute which might give to all their searching a meaning and an answer ... [T]hey seek a final explanation, a supreme value, which refers to nothing beyond itself and which puts an end to all questioning. Hypotheses may fascinate, but they do not satisfy. Whether we admit it or not, there comes for everyone the moment when personal existence must be anchored to a truth recognized as final, a truth which confers a certitude no longer open to doubt.

If this is indeed an accurate characterization of (one aspect of) human psychology, it might help to explain the human susceptibility to totalitarian dogmatisms of all kinds, secular as well as religious.

[29] Unfortunately, many sociologists and anthropologists adhere to a *methodological relativism* that rules such questions automatically out of bounds. For a critique of methodological relativism, see Bricmont and Sokal (2001, 2004).

irrational; but he does not investigate in detail the historical process that led to this evolution. Furthermore, he overlooks the fact that even on much shorter time scales — decades rather than centuries — the degree of people's religiosity can go up and down according to social, economic and political circumstances. Sometimes religion serves, at first, as a proxy for secular grievances — especially in places, like Poland under Communism or Iran under the Shah, where the church is one of the few institutions of civil society that is not totally repressed or state-controlled. In other places, where people have a choice of political affiliations, some may embrace religious parties initially for perfectly valid secular reasons, such as the altruism and honesty of their activists or the extensive social-welfare programs they sponsor. But then, over time, some people, as a consequence of their participation in religiously-infused collective struggles, may come to identify more strongly with their religion and become genuinely more devout. It is this process that needs careful investigation. Harris is of course correct that the resurgence of radical Islamism among Palestinians today would be impossible without pre-existing Islamic beliefs. But can he doubt that despair at the Israeli occupation, together with the inefficacy and corruption of secular nationalist groups such as the PLO, also played a major role?

Which brings us to the elephant in the closet: Islam. To a first approximation, Islam is neither better nor worse than any other religion. Its factual doctrines are no crazier than those of Judaism or Christianity — which in fact they closely resemble — and its ethical doctrines are a similar mishmash of the admirable and the barbaric.

To which Harris insists on adding: Yes, but the doctrines of Islam *are* a little bit worse than those of the other monotheistic religions. In support of this contention, Harris provides a tedious (by his own gleeful admission) five-page compilation of Qur'anic verses in which unbelievers are consigned to eternal damnation or worse (pp. 117–123); but the demonstration is inconclusive, because he does not attempt a quantitative comparison of the frequency of such messages in the Qur'an and in the Bible.[30]

More importantly, Harris notes that Islam, like Christianity (though unlike Judaism), is a religion of prosyletization, with pretensions to become the universal faith of humanity; but while Christ was only a prophet, Muhammad was a prophet *and* a statesman-soldier. Indeed, the early history of Islam was

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[30] Of course, even such a quantitative comparison would have limited significance, for the reasons discussed earlier.

strongly marked by its extraordinarily rapid expansion by conquest: in ten years (622–632 C.E.), Muhammad succeeded in unifying much of the Arabian peninsula under his rule; and within the next century, his successors built the largest empire humanity had heretofore seen, stretching from the Pyrenees to the Himalayas. This unprecedented success in warfare led believers to conclude (quite understandably) that Allah rewards those who follow the true faith.[31]

Harris insists that this is more than just ancient history:

> Islam is undeniably a religion of conquest.... While Muslims are quick to observe that there is an inner (or "greater") jihad, which involves waging war against one's own sinfulness, no amount of casuistry can disguise the fact that the outer (or "lesser") jihad — war against infidels and apostates — is a central feature of the faith. (pp. 110–111)

— which he backs up by quoting Islamic scripture (*hadiths*, or sayings and actions attributed to the Prophet):

> A single endeavor (of fighting) in Allah's cause in the forenoon or in the afternoon is better than the world and whatever is in it.
>
> A day and a night of fighting on the frontier is better than a month of fasting and prayer.[32]

To which he could have added:

> I have been commanded [by Allah] to fight people until they testify that there is no god but Allah and that Muhammad is the Messenger of Allah ...[33]

Harris concludes by citing Bernard Lewis: "The presumption is that the duty of jihad will continue, interrupted only by truces, until all the world either adopts the Muslim faith or submits to Muslim rule."[34]

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[31] For a sympathetic account, see Armstrong (2000, pp. 27–29). The same point is made by Lewis (2003, pp. 6–8, 10, 20, 26–27). It should be stressed that, within the Islamic empire, conversion to Islam was in most cases voluntary.

[32] Harris, pp. 27–28, citing Lewis (2003, p. 32) and an Internet database of *hadiths* hosted by the Muslim Student Association at the University of Southern California (`http://www.usc.edu/dept/MSA/reference/searchhadith.html`).

[33] Sahih Bukhari, Book 2, Number 24. This *hadith* is quoted, in a slightly different translation, by an-Na'im (1986, p. 215).

[34] Lewis (2003, pp. 31–32), cited by Harris, p. 111. A similar formulation, but with greater historical nuance, can be found in the work of Majid Khadduri (1955, pp. 51–137; 1966, pp. 10–22, 57–70; 1984, pp. 162–170), who traces the debates between those Islamic scholars who restricted *jihad* to defensive war and those who rejected any such limitation. See, however, Jackson (2002) for an opposing view.

But the notion that any religion has a single "true" and essential nature, unvarying throughout its history, is seriously misguided. Every religion is a complex amalgam of competing ideas and values; and the relative emphasis to be given to these precepts becomes inevitably a focus of theological and political struggle. The "nature" of any religion varies according to both time and place, and is affected as much by political and economic factors as by abstract theological considerations. Jesus' message may have been one of love and peace, but Christendom from at least the eleventh through the nineteenth centuries avidly pursued conquest hand-in-hand with evangelization. Jesus may have urged respect for one's neighbor, but that did not stop the Inquisition. And last but not least, Bernard Lewis' comment about the allegedly expansionist essence of Islam could apply at least as well to the policies and ideology of the American Empire as to those of Osama bin Laden.

In the Christian-dominated West, however, the place of religion in society evolved gradually but profoundly after the Middle Ages. Five hundred years of confrontation with secular politics and science slowly but surely forced the Church to relinquish its totalitarian pretensions to control over every soul — conceding the freedom of religion and, more generally, the freedom of thought[35] — and to retreat from many of its factual doctrines. The Church has by now lost nearly all of the political power, and a good deal of the cultural authority, that it once had. Even fundamentalists nowadays admit that the Earth goes around the Sun and hesitate to murder their neighbors for heresy. This is progress.

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[35] Of course, this evolution proceeded at different rates in different countries and for different religions. For instance, as late as 1864 the Roman Catholic church condemned as an "erroneous opinion" and indeed an "insanity" the idea that "liberty of conscience and worship is each man's personal right, which ought to be legally proclaimed and asserted in every rightly constituted society" (Pius IX 1864, paragraph 3). As late as 1888 the Pope said the following about freedom of speech and the press:

> Men have a right freely and prudently to propagate throughout the State what things soever are true and honorable, so that as many as possible may possess them; but lying opinions, than which no mental plague is greater, and vices which corrupt the heart and moral life should be diligently repressed by public authority, lest they insidiously work the ruin of the State. (Leo XIII 1888, paragraph 23)

His Holiness went on to discuss the "liberty of conscience" in terms worthy of Orwell's *1984*:

> If by this is meant that everyone may, as he chooses, worship God or not, it is sufficiently refuted by the arguments already adduced. But it may also be taken to mean that every man in the State may follow the will of God and, from a consciousness of duty and free from every obstacle, obey His commands. This, indeed, is true liberty ... (Leo XIII 1888, paragraph 30)

The trouble is that Islam has not yet undergone any such confrontation with an indigenous Enlightenment. The flowering of rationalist science and philosophy under Islam — a Golden Age that stretched from the ninth through the thirteenth centuries C.E. — was snuffed out by orthodox theologians just as the Renaissance, which was in fact heavily indebted to the contributions of Muslim scholars, began to gather steam in the West.[36] As a consequence, the line today dividing "moderate" Muslims from radical Islamists does not principally concern theological doctrine — all observant Muslims profess that the Qur'an is the literal and inerrant word of the One True God[37] — but concerns, rather, social and political philosophy and practice. To what extent must Islamic precepts govern politics, law and other aspects of human existence? More to the point, *which* Islamic precepts should take precedence over others? Which forms of governance, and which concrete social and economic policies, are most closely in accord with Islamic teaching and ideals? These questions are being debated today throughout the Muslim world.[38]

One contentious issue concerns the freedom of thought. Harris points out that in Islamic law (*shari'a*), as in Deuteronomy,

> the penalty for learning too much about the world — so as to call the tenets of the faith into question — is death. If a twenty-first-century Muslim loses his faith, ... the normative response, everywhere under Islam, is to kill him.... The justice of killing apostates is a matter of mainstream acceptance, if not practice. (pp. 115–116)[39]

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[36] See, for instance, Hoodbhoy (1991).

[37] For instance, the Sudanese liberal Muslim thinker Abdullahi an-Na'im has called for a thoroughgoing reform of Islamic law so as to protect the freedom of religion and other internationally recognized human rights, but he nevertheless adds that "I do not conceive of all aspects of *Shari'ah* as open to restatement and reinterpretation. Belief in the *Qur'ān* as the final and literal word of God and faith in the Prophet Mohammed as the final prophet remain the essential prerequisites of being a Muslim." (an-Na'im 1987, p. 17) See also Esposito (1999, pp. 5 and 24) and Lewis (2003, p. 131) for confirmation on this point by two authors who disagree on much else.

[38] See Esposito (1999) and Fuller (2003) for excellent overviews of the spectrum of Islamist political thought and practice.

[39] Harris also cites (p. 252n15) a chilling statement by the British folk singer Cat Stevens (now Yusuf Islam) defending Ayatollah Khomeini's death sentence against Salman Rushdie:

> Under Islamic Law, the ruling regarding blasphemy is quite clear; the person found guilty of it must be put to death. Only under certain circumstances can repentance be accepted.... The fact is that as far as the application of Islamic Law and the implementation of full Islamic way of life in Britain is concerned, Muslims realize

This much is fairly noncontroversial.[40] However, Harris exaggerates when he goes on to claim that

> there did not appear to be a single reasonable Muslim living on earth when the Ayatollah Khomeini put a bounty on the head of Salman Rushdie. Many Westerners wondered why millions of "moderate" Muslims did not publicly disavow this fatwa. (p. 116)

In fact, several Muslim jurists criticized the *fatwa*, on the (admittedly too limited) grounds that Islamic law requires a trial in which the accused is given an

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> that there is very little chance of that happening in the near future. But that shouldn't stop us from trying to improve the situation and presenting the Islamic viewpoint wherever and whenever possible. That is the duty of ever [*sic*] Muslim and that is what I did. (Islam 1989)

To be fair, Mr. Islam stresses that British Muslims must not take the law into their own hands, and should limit themselves to campaigning for "a ban on this blasphemous book". See also Islam (2003) for a recent summary.

[40] It should be stressed that *shari'a* is not a codified body of law, but comprises the consensus of traditional Islamic jurisprudence based on interpretation of the Qur'an and the *sunna* (traditions of the Prophet). There are four principal schools of Sunni Muslim law (Hanafi, Maliki, Shafi'i and Hanbali) as well as schools of Shi'i law; these legal traditions differ in many details. See Coulson (1964), Schacht (1964), Hallaq (1997) and Ruthven (2006, chapter 4) for general introductions to Islamic law.

Concerning apostasy,

> [the] traditional Islamic schools of jurisprudence are unanimous in holding that apostasy is punishable by death, although they differ on such questions as to whether to execute the sentence immediately or grant the apostate a reprieve of a few days in order to allow him time to reflect and reconsider his position ... There is also disagreement on whether a female apostate is to be killed or merely imprisoned until she returns to the faith. (an-Na'im 1986, p. 211)

For more details, see e.g. Hamidullah (1953, pp. 171–174), Khadduri (1955, pp. 149–152), Schacht (1964, p. 187), Saeed and Saeed (2004, pp. 51–56) and especially Peters and de Vries (1977). Of course, some modern Muslim scholars, including an-Na'im himself, disagree with this traditional interpretation of the Qur'an and *sunna*; they argue that Islam is compatible with, and indeed proclaims, the freedom of religion. See the references cited in note 42 below. Peters and de Vries (1977, p. 25) conclude their scholarly analysis of apostasy in classical and modern Islamic law by observing that

> As capital punishment for apostasy fell into desuetude by the introduction of Western inspired penal codes and by the spreading of the principle of freedom of religion, among the upper strata of Moslem society, Moslem thinkers were induced to reconsider the doctrine of apostasy. Some of them concluded that Islam does not require the execution of the apostate. However, a large majority of the Moslem still regard the apostate as a traitor, who should be killed, or, in the best case, be treated as a social outcast.

opportunity to defend himself.[41] Furthermore, some liberal Muslim thinkers have gone so far as to question the death penalty for apostasy, observing that it is mentioned unambiguously only in the *hadiths* (narrations of sayings and actions of the Prophet, some of dubious authenticity) and not in the Qur'an itself, and arguing that it contradicts the Qur'anic precept that "there shall be no compulsion in religion" (2:256).[42]

Despite these exaggerations, Harris is on firm ground in drawing attention to the repressive side of Islamic law. He once again stresses that

> Christianity and Judaism can be made to sound the same, intolerant note — but it has been a few centuries since either has done so. It is, however, a current reality under Islam that if you open the wrong door in your free inquiry of the world, the brethren deem that you should die for it. (p. 116)

Ironically, two key American allies in the War Against Terror — Pakistan and Saudi Arabia — have laws imposing the death penalty for apostasy and/or blasphemy.[43]

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[41] See e.g. Appignanesi and Maitland (1990, pp. 139–140 and 91–94) and Piscatori (1990, pp. 782–784). See also Abdallah *et al.* (1994) for a collection of 90 courageous essays in support of Rushdie from intellectuals around the Arab and Muslim world. Most of these intellectuals appear, however, to be basically secular in orientation.

[42] See, for instance, Rahman (1978), Khadduri (1984, p. 238), an-Na'im (1986; 1990, pp. 109 and 183–185), and Saeed and Saeed (2004). See also Dalacoura (1998, pp. 58–63) for an interesting discussion of several liberal Islamic thinkers, and Kurzman (1998) for an extensive sourcebook of writings by liberal Islamists. See Bielefeldt (1995) and especially Mayer (1999) for a lengthy discussion of liberal and conservative Muslim views concerning the freedom of expression and other basic human rights.

[43] Section 295-C of the Pakistan Penal Code, adopted in 1986, provides that "Whoever by words, either spoken or written, or by visible representation, or by any imputation, innuendo, or insinuation, directly or indirectly, defiles the sacred name of the Holy Prophet (peace be upon him) shall be punished with death, or imprisonment for life, and shall also be liable to fine". A 1990 decision by the Federal Shariat Court held that "the penalty for contempt of the Holy Prophet ... is death and nothing else", thereby abolishing the option of life imprisonment. See Amnesty International (1994; 1996, section 5; 2001a), Forte (1994) and Khan (2003). According to Amnesty International (2001b, 2004), "so far no one has been executed after a death sentence for blasphemy", but "many of those detained under the blasphemy laws have been assaulted or subjected to other forms of ill-treatment; some have been killed by fellow detainees or prison wardens". Amnesty further observes that "Pakistan's blasphemy laws are used for reasons which include religious oppression [notably against Ahmadis and Christians], professional jealousy, economic rivalry, political opposition or personal hostility."

Saudi Arabia is governed by *shari'a* law as interpreted by judges with principal reference to the traditional jurisprudence of the Hanbali school. The death penalty is imposed not only for apostasy, but also for "witchcraft", "corruption on earth", adultery, sodomy, drug dealing,

The writings of contemporary radical Islamists are in many ways eerily reminiscent of medieval Christianity: in their unabashed pretension to possess the one true Word of God, in their hair-splitting exegesis of sacred Scripture, and in their totalitarian ambition to regulate all spheres of human existence according to God's immutable commandments.[44] Harris expresses this idea with his characteristic flair:

> While Christianity has few living inquisitors today, Islam has many.... [In Islam] we confront a civilization with an arrested history. It is as though a portal in time has opened, and fourteenth-century hordes are pouring into our world. Unfortunately, they are now armed with twenty-first-century weapons. (pp. 106–107)

One scholar of human rights under Islam puts the matter in more measured terms. Defining "liberalism" as "respect [for] the inherent worth of the individual and his or her inalienable rights", she argues that

> the religion of Islam is not inherently illiberal and ... it can be reconciled, at an abstract level of ideas, with the principles of human rights.... [I]f we want to understand why it is that illiberal interpretations of Islam frequently predominate in historical reality, we have to examine the social and political conditions of Muslim societies, not Islamic doctrine or tradition.[45]

But after detailed investigation she concludes that

> Islamic liberals ... are few and far between in the Middle East. To my knowledge, none of the major Islamist movements can be described as

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murder, rape and armed robbery (see Amnesty International 2000a, pp. 13–14, 19n1; 2001c, pp. 2–3, 9, 11). When the mandatory death penalty for "corruption on earth" was introduced in August 1988, an official source clarified the meaning of the offense:

> The source reaffirmed the Kingdom's keenness ... not to allow any person to propagate any belief, ideology or idea which runs counter to Islam and Shariah, including the fomentation of sedition and sowing seeds of discord among citizens. The rules of the decision shall be applied to any individual who breaches the teachings of Islam, undermines security or attempts to shake the foundations of the existing government in the country. (Cited in Amnesty International 2000b, p. 8)

[44] An extensive selection of the writings of prominent twentieth-century radical Islamists — including Hasan al-Banna, Sayyid Qutb, Syed Abul Ala Mawdudi and several others — can be found on the website of the Young Muslims Canada at `http://www.youngmuslims.ca/online%5Flibrary`. See also Mawdudi (1953) for an erudite modern defense of the death penalty for apostasy.

[45] Dalacoura (1998, pp. 39, 41). Another prominent scholar concurs, and contends that

> Islam is not the cause of the human rights problems endemic to the Middle East.... [R]ights abuses [are] every bit as prevalent and just as severe in countries

> liberal. There are wide variations in the ideologies of the Islamists ... but the 'moderates' are not liberals, as things stand at present.[46]

Harris' justified distaste for many aspects of present-day Islam leads him, lamentably, to make simplistic and one-sided pronouncements about the Israeli-Palestinian conflict. To his credit, Harris does observe that

> Judaism is as intrinsically divisive, as ridiculous in its literalism, and as at odds with the civilizing insights of modernity as any other religion. Jewish settlers, by exercising their "freedom of belief" on contested [*sic*] land, are now one of the principal obstacles to peace in the Middle East. (p. 94)

But he then goes on to repeat, without the slightest factual discussion, a series of sweeping assertions lifted from Alan Dershowitz's *The Case for Israel*:

> The truth is, as Dershowitz points out, that "no other nation in history faced with comparable challenges has ever adhered to a higher standard of human rights, been more sensitive to the safety of innocent civilians, tried harder to operate under the rule of law, or been willing to take more risks for peace." (p. 135, citing Dershowitz 2003, p. 2)

Harris seems here to think that quoting Dershowitz as to what "the truth is" suffices to settle the matter; he does not even acknowledge that reasonable people might have grounds for taking issue with some aspects of Dershowitz's panegyric to Israeli government policy. One might wonder, for instance, how the 39-year history of Israeli settlements in the West Bank, Gaza and the Golan Heights comports with "the rule of law" as enunciated unambiguously in the Fourth Geneva Convention (1949):

> The Occupying Power shall not deport or transfer parts of its own civilian population into the territory it occupies. (Article 49)[47]

Or how Israeli occupation tactics measure up:

> where Islamic law is in abeyance or consciously violated as in countries where it figures, at least officially, as the legal norm. (Mayer 1999, p. xvii)

She goes on to observe that "the United States [government] acquiesced in Islamization programs [in Pakistan and the Sudan] that grossly violated human rights — as long as the regimes served U.S. policies" (p. 6).

[46] Dalacoura (1998, p, 193).

[47] Apologists for Israel sometimes assert that the West Bank and Gaza are not "occupied" but are merely "disputed" or "contested". But this is a pure sophism. Irrespective of whether

> No protected person may be punished for an offence he or she has not personally committed. Collective penalties ... are prohibited. (Article 33)
>
> Any destruction by the Occupying Power of real or personal property belonging individually or collectively to private persons, or to the State, or to other public authorities, or to social or cooperative organizations, is prohibited, except where such destruction is rendered absolutely necessary by military operations. (Article 53)

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one maintains that the 1967 war was defensive on Israel's part, the fact remains that Article 2 of the Fourth Geneva Convention states clearly that

> the present Convention shall apply to all cases of declared war or of any other armed conflict which may arise between two or more of the High Contracting Parties, even if the state of war is not recognized by one of them.
>
> The Convention shall also apply to all cases of partial or total occupation of the territory of a High Contracting Party, even if the said occupation meets with no armed resistance.

Israel, Jordan, Egypt and Syria have been parties to the 1949 Geneva Conventions since 1952, 1951, 1953 and 1954, respectively.

In fact, a top-secret memorandum written on September 14, 1967 by the Israeli Foreign Ministry's legal counsel, Theodor Meron — a 37-year-old Polish-born Holocaust survivor, educated at Hebrew University, Harvard and Cambridge — came to the same unequivocal conclusion: "civilian settlement in the administered territories contravenes the explicit provisions of the Fourth Geneva Convention." Meron observed in his legal opinion that

> This clause ... is intended to prevent a practice adopted during the Second World War by certain Powers, which transferred portions of their own population to occupied territory for political and racial reasons or in order, as they claimed, to colonize those territories.... [This prohibition is] categorical and is not conditioned on the motives or purposes of the transfer, and is aimed at preventing colonization of conquered territory by citizens of the conquering state.

Meron also evaluated and explicitly rejected the argument that the West Bank was not really "occupied territory" because it had been annexed unilaterally by Jordan after the 1949 armistice. (Such an argument would in any case be irrelevant to the Golan Heights, which was undisputed Syrian territory.) This memo, which was uncovered by Israeli journalist Gershom Gorenberg in the Israeli state archives, was communicated first to Meron's immediate superior, Foreign Minister Abba Eban, and shortly thereafter to Prime Minister Levi Eshkol, Defense Minister Moshe Dayan, and Justice Minister Yaakov Shimshon Shapira. Alas, it does not seem to have swayed them. For more details, see Gorenberg (2006, pp. 99–102).

Meron, who is now an eminent international jurist and until 2005 was president of the International Criminal Tribunal for the Former Yugoslavia, commented recently that

> In terms of international law, it would have been entirely appropriate for Israeli military bases and a strong military presence in the territories to be maintained until there [was] a political resolution. So there was an alternative to the civilian settlements approach.... I reread that opinion recently and I believe that I would have given the same opinion today ... (Macintyre 2007, p. 18)

Even Harris might end up conceding, in retrospect, that this page was not the high point of his book.

When all is said and done, Islam is intrinsically neither better nor worse than the other monotheistic religions. Contemporary Islam — that is to say, Islam *as interpreted by contemporary Muslims* — might be more or less *dangerous* to humanity than contemporary Christianity or Judaism, depending on the criterion one uses to evaluate dangerousness: violation of the freedom of thought, violation of the rights of women, legitimation of violence against civilians, legitimation of economic injustice, legitimation of imperialism, ... To answer such a question would require a detailed factual analysis that goes far beyond the scope of this essay (and my own competence). Suffice it to say that Harris provides no such analysis either.

Even if we restrict attention to the fundamental human rights proclaimed by classical liberalism, the principal difference between the three monotheistic religions is not theological but historical. If present-day Christianity is compatible with basic human rights, it is only because Christianity has evolved, under the pressure of centuries of confrontation with secular Enlightenment ideas, to such an extent that nowadays even self-proclaimed fundamentalists in fact disregard large parts of their Scripture (such as Deuteronomy). Harris argues that, likewise,

> A future in which Islam and the West do not stand on the brink of mutual annihilation is a future in which most Muslims have learned to ignore most of their canon, just as most Christians have learned to do. (p. 110)

While the formulation ("mutual annihilation") is perhaps unduly extreme, the basic thought is sound. The key question, at least for non-Muslims, is: Which policies on our part are most likely to encourage such an evolution within Islam?

Regrettably, Harris does not really address this issue, except for a sensible proposal for alternative energy technologies to radically reduce the West's dependence on Middle Eastern oil. But his bellicose approach — "we are at war with Islam", he states flatly (p. 109) — is likely to be counterproductive. When societies are (or feel themselves to be) under attack, they tend to close ranks, marginalize dissenters and free-thinkers, and revert to the most conservative forms of the religious and/or nationalistic traditions that constitute their identity. This process has been evident in the United States since September 11, 2001, and it has been at work in large parts of the Muslim world over the past few decades.

Muslims (especially Arabs) have legitimate secular grievances against Western governments and particularly the United States:

- One-sided support for the Israeli state against the Palestinians.

- A hypocritical foreign policy that supports dictators who serve Western economic and strategic interests while opposing, often by force, anyone — whether dictator or democratic — who takes a more nationalist line. (U.S. policy toward Saddam Hussein exemplifies both aspects at different times.)[48]

Indeed, the rise of radical Islamism over the last few decades is in large part a response to the corruption of secular governments in the Muslim world (whether nationalist or pro-Western) and their failure to bring about durable economic development.[49] Redressing these legitimate grievances could go a long way toward reducing the attractiveness of radical Islamism, and more generally toward encouraging secular (and perhaps even liberal) political movements. But it may be too late to solve the problem completely in this way, because secular conflicts become less tractable, and less amenable to compromise, once they have acquired a theological tinge.

The bottom line is that *all* religions, not just Islam, are potentially dangerous — and they are dangerous precisely to the extent that their adherents take their sacred scriptures seriously, for the simple reason that reliance on revelation rather than evidence[50] undermines the possibility of rational discussion.[51] "God gave Palestine to us." "No, to *us*!"

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[48] It should be stressed, however, that legitimate grievances of this sort are by no means unique to Muslims or Arabs — as Latin Americans well know.

[49] One exception to this failure is (or rather was) Iraq under Saddam Hussein, who for all his brutality did manage to invest oil revenues in the economic development of the country, before it was destroyed by war with Iran in the 1980s — a war begun by Saddam's unprovoked invasion (with Western and Arab support) of revolutionary Iran and then prolonged by all parties' intransigence — and Western-imposed sanctions in the 1990s.

[50] Or more precisely, treating sacred scriptures *as if* they were incontrovertible evidence. For instance, Mel Gibson has responded to criticisms that his film *The Passion of the Christ* (2004) portrays the Jews as responsible for Jesus' crucifixion by insisting — falsely, it turns out, but that is beside the point — that his film is rigorously faithful to the Gospels (see ABC News 2004 and Boyer 2003). The unspoken assumption is, of course, that the Gospels provide an accurate and factual account of the life of Jesus. But what is the *evidence* for this assumption? Why should a collectively-authored (and internally inconsistent) work of religious propaganda, written many decades after the events it purports to describe — as scholars long ago established — be taken as (pardon the pun) the gospel truth?

[51] More precisely, the trouble arises when religious people take their sacred scriptures seriously *as sacred scriptures*. There is nothing wrong in principle with considering Jesus or Muhammad (or the Buddha, or Marx or Freud, or Shakespeare, or George W. Bush) to be a fount of timeless wisdom, *provided that* one recognizes that the illustrious pedigree of an idea is irrelevant to its evaluation, so that one takes care to justify the ideas in question by independent rational arguments.

Most seriously in the long run, Harris observes that "the beliefs of Muslims" — and, I would add, those of evangelical Christians obsessed with Rapture —

> pose a special problem for nuclear deterrence. There is little possibility of our having a *cold* war with an Islamist regime armed with long-range nuclear weapons. A cold war requires that the parties be mutually deterred by the threat of death. Notions of martyrdom and jihad run roughshod over the logic that allowed the United States and the Soviet Union to pass half a century perched, more or less stably, on the brink of Armageddon. (pp. 128–129)

Harris goes on to pose a politically incorrect — but overwhelmingly important — question:

> What will we do if an Islamist regime, which grows dewy-eyed at the mere mention of paradise, ever acquires long-range nuclear weaponry? If history is any guide, we will not be sure about where the offending warheads are or what their state of readiness is, and so we will be unable to rely on targeted, conventional weapons to destroy them. In such a situation, the only thing likely to ensure our survival may be a nuclear first strike of our own. Needless to say, this would be an unthinkable crime — as it would kill tens of millions of innocent civilians in a single day — but it may be the only course of action available to us, given what Islamists believe. (p. 129)

He immediately adds that

> All of this is perfectly insane, of course: I have just described a plausible scenario in which much of the world's population could be annihilated on account of religious ideas that belong on the same shelf with Batman, the philosopher's stone, and unicorns. That it would be a horrible absurdity for so many of us to die for the sake of myth does not mean, however, that it could not happen. (p. 129)

Harris' discussion of this issue is, unfortunately, much too brief. For instance, the main danger may not in fact come from Islamist *regimes* — after all, even the Iranian mullahs have territory to defend and temporal power to lose[52] — but from *non-state groups*, Islamist or otherwise, that

[52] Indeed, Iran's barely concealed quest for nuclear weapons is almost certainly defensive in nature — at least in the short term — and is motivated by the quite rational fear of being the next target on the U.S. (or Israeli) hit list. On the other hand, it hardly needs be added that in the longer term the possession of a nuclear arsenal can serve *both* defensive *and* intimidatory

manage to acquire weapons-grade nuclear material either from ideological sympathizers within a nuclear state or via clandestine purchase.

Furthermore, Harris' use of the word "we" in this passage is ambiguous. Does he mean "we atheists"? Or "we non-Muslims" (fundamentalist Christians and Jews included)? Or perhaps "we citizens of the United States"? But none of these three groups possess nuclear weapons capable of a first strike. By "we", Harris must evidently mean "the government of the United States", *identified implicitly with all of its citizens*. But this failure to distinguish conceptually between different groups within a country — groups that may have different ideas and different material interests — undermines his ability to think clearly about politics.[53]

Nor are all Islamists hell-bent on martyrdom and the mass murder of infidels. In fact, Islamism encompasses a wide spectrum of political and social attitudes and programs; probably only a small minority of Islamists subscribe to Osama bin Laden's notions of *jihad*.[54] Furthermore, we should remember that a staple of war propaganda from time immemorial has been to exaggerate the aggressive intentions of the official enemy, thereby enabling the home government to portray itself and its allies as righteous victims and to present its own aggressions as preemptive defense.[55] The Bush administration's propaganda against Saddam Hussein in 2001–03 was too crude to convince more than a handful of leftists (though it did, alas, convince many self-described liberals); but we should not delude ourselves into thinking that we are immune to more sophisticated manipulations, any more than the European socialist movement was immune in 1914.[56] This is not a reason to ignore or minimize the threat posed by radical Islamism — which is all too real — but it does suggest caution, as well as a great vigilance in verifying purported "facts".

Still, even paranoids can have real enemies, and our enemy's enemy is not necessarily our friend. Moreover, even a small group of well-organized and well-armed extremists can cause a catastrophe; and for this reason alone, Harris has done a public service by raising so starkly the question of nuclear

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functions: this would be as true for Iran, were it to acquire nuclear weapons, as it currently is for the United States, Israel and the other nuclear states.

[53] Harris' ambiguous use of the word "we" has been pointed out also by Hari (2005).

[54] See Esposito (1999) and Fuller (2003) for good overviews of the spectrum of Islamist movements.

[55] See e.g. Chomsky (1989, 2003), Herman and Chomsky (2002), and Solomon (2005).

[56] See, for instance, Bricmont (2007) for a detailed analysis of the selective use of human rights as a pretext for old-fashioned imperialism.

annihilation, despite the inadequacies of his own answers. And the fact that American military strategists are actively worrying about such doomsday scenarios should not lull progressives into thinking that we can be complacent. For if we do, we risk falling into a leftist version of the mid-1980s joke in which God, fed up with human folly, decides to destroy the world and start over from scratch. He summons the three main world leaders — Ronald Reagan, Mikhail Gorbachev and Menachem Begin — and asks them to inform their peoples.

> REAGAN: My fellow Americans, I have good news and bad news. The good news is that there really is a God. The bad news is that He is going to destroy the world.
>
> GORBACHEV: Comrades, I have bad news and worse news. The bad news is that there really is a God. The worse news is that He is going to destroy the world.
>
> BEGIN: Brothers and sisters, I have good news and I have great news. The good news is that there really is a God. The great news is that there will *not* be a Palestinian state in the land of Israel.[57]

Michael Lerner's message is in most respects diametrically opposed — both philosophically and politically — to Harris'. Lerner advocates an Emancipatory Spirituality (the capitals are his) that stands in opposition both to the reactionary spirituality of religious traditionalists and to the uncompromising secularism of many liberals and leftists. He calls for a "politics of meaning" that could address people's non-material — or in his terminology, "spiritual" — as well as material needs.[58]

There is much wisdom in this latter proposal, or so it seems to me. The trouble is that the wisdom comes encased in a dense conceptual muddle, from which it must be painstakingly extracted. To put the matter briefly, Lerner uses the term "spirituality" to encompass both cosmological and psychological notions, which he jumbles together without even recognizing it. I shall argue that Lerner's cosmology is exceedingly dubious — to put it

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[57] This joke suffers from a minor chronological defect: Begin resigned as Prime Minister in September 1983, while Gorbachev did not become General Secretary until March 1985. Oh, well.

[58] Lerner's political vision is further elaborated in his recent book *The Left Hand of God* (2006a). This book is better-written (or better-edited) than *Spirit Matters*, and its first half sets forth an astute analysis of the success of the Right and the failure of the Left in American politics over the past three decades. But the book is vague in its use of the word "spiritual"; for clarification of what Lerner means by "spirituality", one must return to *Spirit Matters*.

politely — while his psychology contains crucial insights that the Left can ill afford to ignore. By throwing out a few gallons of murky and unhygienic bathwater, we can extricate a lively and intelligent baby.

Early in the book, Lerner defines spirituality as

> a lived experience, a set of practices and a consciousness that aligns us with a sense of the sanctity of All Being. It usually involves:
>
> a. an experience of love and connection to the world and to others
> b. a recognition of the ultimate Unity of All Being, and through that, of the preciousness of the Earth and the sanctity of every human being on the planet
> c. a conviction that the universe is not negative or neutral but tilts towards goodness and love
> d. awe, wonder, and radical amazement in response to the universe and a consequent unwillingness to view the world merely in instrumental terms
> e. a joyous and compassionate attitude toward oneself and others
> f. a deep trust that there is enough for all and that every human being deserves to share equally in the planet's abundance and is equally responsible for shaping our future
> g. a sense that the world is filled with a conscious spiritual energy that transcends the categories and concepts that govern material reality and inclines the world toward freedom, creativity, goodness, connectedness, love, and generosity
> h. a deep inner knowing that our lives have meaning through our innermost being as manifestations of the ultimate goodness of the universe (or, in theistic terms, through our connection to, and service of God) (p. 5)

Please note that items a,d,e,f are psychological or ethical in nature, and can be interpreted in purely secular terms (though Lerner would probably not want to do so). Items b,c,g,h, by contrast, are cosmological claims, even if their precise content is somewhat vague (what exactly is meant, for instance, by the Unity of All Being?). The two classes of claim will thus have to be evaluated separately. I would also like to draw attention to the epistemologically revealing words "recognition", "conviction", "sense" and "knowing" that Lerner uses in his cosmological claims; we shall need to inquire (as Lerner does not) whether his conviction is true, his sense is accurate, and his claims to recognize and know are well-founded.

Lerner defines Spirit as "the aspect of reality that cannot be quantified or subjected to repeated observations" (p. 7) and then goes on to mix cosmological and psychological claims in the following startling juxtaposition:

> God or Spirit or Highest Reality is the Force in the universe that makes it possible for us to break the cycle of necessity, to act in ways that are not governed by scientific law. Spirit or God or Highest Reality is the phenomenon that allows us to transcend the human tendency to act out on others the pain that has been acted upon us and thus to break the "repetition compulsion." (p. 7)

The latter sentence contains a psychological insight, however misleadingly expressed; the former, by contrast, is a conceptual mess that Lerner does not even seem to notice. Does Lerner really mean that the laws of physics can sometimes be suspended when human beings are concerned? If so, which laws can be suspended, and which not? Under what conditions? Lerner does not bother to say; and any attempt to make his claims more precise is likely to make them even less plausible than they already are.[59]

Later in the chapter, Lerner stresses that "what makes talk about Spirit so difficult is that language is so limiting" and that "every attempt to define it in itself rather than in its manifestations ends up seeming silly, empty, or vague" (p. 32). "The best I can do", he continues, "is point to a few aspects of what I mean by Spirit" — some of which are more dubious than others:

> About fifteen billion years ago a cosmic bang released all the energy and mass of the universe from a small point into billions of particles that eventually self-organized into atoms that eventually self-organized into clouds that formed into galaxies that formed into stars that grew, died,

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[59] One might charitably interpret Lerner as referring here to the unpredictability of human actions — and also, though he does not mention it, of the behavior of many inanimate physical systems — as a consequence of the extreme complexity of those systems and/or their sensitive dependence on initial conditions. Indeed, this interpretation is suggested by the only *argument* that Lerner gives in support of his proposition:

> [I]f you knew all the laws of science that could ever be discovered, plus all of the initial conditions that needed to be factored into the relevant scientific formulas, you would still never be able to determine what any living creature will do in the next moment. (p. 7)

But he immediately goes on to claim that

> The reason for this is not some quantum indeterminacy or randomness, but the fact that there is an aspect of the universe that is fundamentally free and self-determining. In its widest form, we call that reality God. (p. 7)

Lerner does not say on what grounds he knows this to be a "fact".

> and reorganized into new stars and planets. About four billion years ago, one of the planets gave birth to tiny life forms that began to develop in manifold forms, reproducing, experimenting, learning to share with each other, and cooperating to form unions of more and more complex multicellular organisms with capacities far beyond those of individual cells.... The energizing Force behind this process of continuing experimentation, creativity, consciousness, and cooperation is what we call Spirit. (pp. 32–33)

Lerner's astrophysics and biology are fairly accurate[60], but his last sentence is a *non sequitur*. By "energizing Force", does he mean something that goes beyond the ordinary laws of physics? Something that even causes violations of the ordinary laws of physics? If so, he needs to give some evidence that such a Force actually exists.

> Recent controlled studies ... have demonstrated that prayer can have a statistically significant impact on a group of people being prayed for from thousands of miles away (even in double blind studies, where the people praying don't know the people being prayed for and the people prayed for don't know that they are the recipients of those prayers). This and other psychic phenomena suggest a form of spiritual communication and causation in the universe that far surpasses any of our current categories. (p. 33)

Here we go from bad to worse. If the studies mentioned by Lerner were to be confirmed, they would constitute a scientific revolution far surpassing Copernicus, Galileo, Newton, Dalton, Darwin, Mendel, Maxwell, Einstein, Heisenberg and Schrödinger combined. Such radical claims need stronger evidential support than a handful of contested studies purporting to show a statistically significant effect at the 95% confidence level. Lerner does not seem even to realize this.[61,62]

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[60] His biology is, however, rendered hopelessly tendentious by a romantic emphasis on cooperation to the exclusion of competition. In fact, biological evolution is driven by the differential reproductive success of certain aggregates of cooperating genes, cells and organisms *in competition with other such aggregates.*

[61] In fairness, it should be added that also Sam Harris makes the bizarre claim that there is credible evidence "attesting to the reality of psychic phenomena" and even of reincarnation (pp. 41, 232n18).

[62] Lerner does not bother to give specific citations to medical studies claiming effects of distant prayer; but for the record, the main ones are Byrd (1988), Sicher *et al.* (1998) and Harris *et al.* (1999). For a critique, see Sloan (2006, chapter 9); and for details of the statistical manipulation employed in the Sicher *et al.* study and revealed only after its publication, see

But Lerner's allusion to medical studies on intercessory prayer is a rare excursion into fairly precise, empirically testable (albeit highly implausible) propositions. He seems more comfortable when holding forth in a poetic vein:

> Spirit is the undergirding of all that there is, the ultimate substance of the universe, in which all else is grounded.... [It is] the ultimate consciousness of the universe, a consciousness that pervades, sustains, and includes All Being and yet cannot be reduced to any part of it.... [O]ur consciousness is part of the universal consciousness, a local manifestation of the Unity of All Being, and a stage in the development of the self-consciousness of the universe.... The consciousness of the universe is not separate from other aspects of Being but is that through which All Being exists and becomes manifest to us and to itself.... Spirit is the playful, joyful, loving energy that pulsates through All Being, imminent [*sic*] in all, and yet fully transcendent of any given state of being and any given manifestation.... The Unity of All Being is an unfolding evolutionary process, mirrored through the development of the consciousness of human beings. The Force of Healing and Transformation and the Creative Energy of the Universe are One. (pp. 33–36)

Lerner insists, in a section title, that "the realm of Spirit is not flaky New Age mush" (p. 10); but his own explanation does little to persuade me. Even a charitable reader might want a bit of clarification before assenting to the foregoing propositions.

Though Lerner professes a belief in God (p. 8), he rejects the notion of an "All-powerful, All-knowing Unmoved Mover who sits in heaven and sends down blessings or curses according to His mood". Rather, he defines "the God who does exist" as "the Unity of All Being, in whom everything exists, but who is more than all that exists, yet manifests through all that

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Bronson (2002). A long-awaited (and much more rigorous) large-scale trial of the effects of intercessory prayer on cardiac bypass patients, funded by the John Templeton Foundation, came up, alas, with negative results (Benson *et al.* 2006), as did another large-scale trial of patients undergoing angioplasty or cardiac catheterization (Krucoff *et al.* 2005).

Lerner now informs me (private communication, May 27, 2007) that "subsequent studies have cast doubt on the results I cite, and so I no longer make that claim [about the effects of distant prayer]". He adds (August 26, 2007) that

> I don't think of God as a cosmic bellhop waiting to do our wishes if we say prayers correctly. On the other hand, I'm not sure whether or not S/He created and evolved the universe in such a way that prayers and other forms of speech do or do not have an impact on the health and well-being of others; but if it does, it will be a mechanism that should show up not only on the spiritual level, but also on the measurable physical level.

exists.... God is the totality of all Being and all existence that ever was, is or will be, and more than that."[63] Is that clear? If not, Lerner elaborates as follows:

> One problem you might have with the story I've told here is that it seems to suggest that God is just the physical universe. But that concern is based on a faulty assumption: that there is a physical universe in any conventional sense of what we mean by physical.
>
> The truth is that as we begin to evolve into higher levels of consciousness we begin to see that objects themselves are actually energy fields in which "energy events" seem to happen, and in which particles emerge and disappear back into energy. Everything that once seemed dead or quiescent or dormant is in fact alive....
>
> The universe is pulsating with spiritual energy, and every ounce of Being is permeated with and an extension of that spiritual energy. (Lerner, n.d.)

This, alas, is nothing more than a run-of-the-mill New Age rip-off of overheated popularizations of quantum field theory. In case some narrow-minded scientist (such as myself) were to ask Lerner how he can be so sure that "spiritual energy" really exists, he answers preemptively as follows:

> Just as our sensory apparatus is inadequate for capturing the energy forces that are play [*sic*] in the nuclei of all the cells that constitute the visually observable objects of the world, so too our conceptual apparatus provides us with inadequate tools or means to apprehend the rich web of spiritual reality in which we and all of Being are embedded. (Lerner, n.d.)[64]

But all of us are stuck with the conceptual apparatus that we have. If this conceptual apparatus is so inadequate to apprehend "God" and "spiritual reality", what good reason do we have to believe that our intuitions of God are not mere fantasies?

Which brings us to the issue of Lerner's epistemology. Regrettably, Lerner is clearer on what his epistemology is not than on what it is. He criticizes the "narrow empiricism" that

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[63] These quotations come from Lerner (n.d.).

[64] I pass over without comment the bizarre confusion of biology with physics that is contained in the phrase "the nuclei of all the cells that constitute the visually observable objects of the world".

> claims that things are only "real" if they can be objectively verified by our senses and confirmed by others who experience something similar under similar circumstances. Anything that does not conform to this picture is understood as literally *non-sense*. If a statement cannot be either verified or falsified by some conceivable set of observations, it is dismissed as meaningless. (pp. 57–58)

But no philosopher of science nowadays — at least none that I know of — subscribes to this curious mishmash of logical positivism and Popperianism.[65] I will happily concede that spiritual assertions, like all other claims of alleged fact, are *meaningful* (at least when formulated with sufficient precision). But we still need to ask: What types of *evidence* can validly be used to support the belief that those claims are *true*?[66]

A few pages later, Lerner provides the following purported *reductio ad absurdum* of the scientific worldview:

> The deep dark secret of the ideology of scientism is that it is all based on a very flimsy foundation: the assertion that statements about reality must be intersubjectively validatable through sense experience.
>
> When you look at that worldview, you might ask the same question that it asks of every other assertion: what data *could* validate or verify its truth. It quickly becomes apparent that there is no such data, nor could there be. The criterion of truth being asserted by contemporary descendants of the empiricists turns out to be without foundation according to its own criterion of truth. (p. 64)

But this argument rests on a ludicrously obvious confusion between empirical statements and philosophical assertions. Not even the most rabid empiricist would demand that *philosophical* propositions be demonstrated empirically through sense experience. No matter: Lerner is happy with his conclusive proof that "scientism itself is another faith, its own foundation just as tenuous or just as solid as any other spiritual or religious tradition" (p. 64).[67]

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[65] See e.g. Brown (2001) for an excellent introduction to contemporary debates in the philosophy of science.

[66] In his latest book, Lerner introduces yet another red herring, defining "scientism" as

> the belief that nothing is real in the world except that which can be observed *and measured*. (Lerner 2006a, p. 131, emphasis mine; see also Lerner 2006b)

But this is a ridiculous view to which no scientist subscribes. Quite simply, some empirical observations are amenable to quantification and measurement, others not; but that does not make the latter any less real.

[67] In a similar way, Lerner rides roughshod over the crucial distinction between assertions about *factual* matters and assertions about *ethical* or *aesthetic* matters. Indeed, his argument

But what is the positive epistemology lurking behind Lerner's attacks on "narrow empiricism" and "scientism"? He's not terribly explicit about it, but the bottom line seems to be a desire to validate "the verification in personal experience that is often used in spiritual circles" (p. 12). He says that "a postmodern science would recognize the validity of subjectively derived knowledge" (p. 67).[68] But, though he decisively rejects relativism (pp. 60–61, 174), he never addresses the crucial question: What should we do when people's "subjectively derived knowledge" conflicts? What methods should we use to to evaluate all the *mutually incompatible* claims to "personal experience" of God?

Lerner is likewise at pains to distinguish "serious thinking" about spiritual matters from the sloppiness proferred by "charlatans, opportunists, and flakes" (p. 11). But on what criteria does he propose to distinguish between the two? Once again, he doesn't say. He merely observes that

> I've also witnessed incredible silliness and stupidity parading as academic philosophy or empirical psychology.... It's pure hypocrisy to focus on distortions justified in the name of spirituality without recognizing the same tendency within the supposedly more respectable intellectual arenas. (p. 11)

Alas, *tu quoque* does not a valid argument make.

The nub of the conflict between the scientific worldview and religion/spirituality concerns the methods by which humans can obtain reasonably reliable knowledge of factual matters.[69] Science relies on intersubjectively validatable sense experience combined with rational reflection on those empirical observations. Religious/spiritual people acknowledge the validity of that method, but insist that reliable knowledge can *also* be obtained by "hear[ing] God's voice", as Lerner puts it (p. xii). The insuperable difficulty with the latter method is charmingly explained by biologist Richard Dawkins in a letter to his then-ten-year-old daughter Juliet:

> Suppose I told you that your dog was dead. You'd be very upset, and you'd probably say, 'Are you sure? How do you know? How did it

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against "scientism" rests almost entirely on this conflation. See pp. 59–67 as well as Lerner (2006a, pp. 130–132 and 147–152).

For a more sophisticated but equally misguided version of the argument that "both religion and science are founded on faith", see Davies (2007); and for cogent critiques, see Coyne *et al.* (2007).

[68] The validity of "intuitive knowledge" obtained by "passionate immersion in the life-world" is explicitly claimed by Lerner's close collaborator Peter Gabel (1987).

[69] See Bricmont (1999, 2005) for further discussion of this point.

> happen?' Now suppose I answered: 'I don't actually know that Pepe is dead. I have no evidence. I just have this funny feeling deep inside me that he is dead.' You'd be pretty cross with me for scaring you, because you'd know that an inside 'feeling' on its own is not a good reason for believing that a whippet is dead. You need evidence. We all have inside feelings from time to time, and sometimes they turn out to be right and sometimes they don't. Anyway, different people have opposite feelings, so how are we to decide whose feeling is right? (Dawkins 2003, pp. 245–246)[70]

Perhaps Lerner has some argument in response to this, but I have been unable to find one anywhere in his book or in his other writings.

Epistemology is not Lerner's strong point, but psychology is. Drawing on his experience as a psychotherapist at the Institute for Labor and Mental Health (ILMH), Lerner offers a plethora of insights into people's everyday experiences under contemporary capitalism and the varied conceptualizations that they construct from them. "Many people", Lerner observes,

> have sensed that there is something deeply missing in their lives and have found that the rewards of the marketplace don't satisfy their hunger for some framework of meaning and purpose to their lives.... [S]omething very important is missing from the world we live in ... something deeper than just social justice (though we need that too).... The hunger for meaning and purpose is as strong and central to human life as the hunger for food or for sex. (pp. 3, 10)

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[70] For instance, in Neale Donald Walsch's mega-best-selling *Conversations with God* — which Lerner praises effusively (p. xii) — God declares at one point that

> I do not love "good" more than I love "bad." *Hitler went to heaven.* When you understand this, you will understand God. (Walsch 1996, p. 61, italics in the original)

Some believers may, I suspect, have had contrary colloquies with their Creator.

For the record, I cannot resist quoting Wendy Kaminer's (1999, pp. 124–125) mordant commentary on Walsch's lucrative dialogue with the deity:

> In *Conversations with God*, the Almighty Himself compares author Neale Donald Walsch to John the Baptist.... [But] If I were inclined to believe in God, I'd expect him to write well and with some originality. Walsch didn't have to converse with God to write this book; he could simply have read an assortment of recovery and pop spirituality books.... But God is no elitist: He wants His words to be accessible to the least discriminating among us, which is apparently why he chose Walsch.

Alas, Walsch's book was on the New York Times bestseller list for over two-and-a-half years and has recently been made into a movie (rated PG), "with bearded Henry Czerny looking suspiciously Christ-like" in the starring role of writer Walsch (Scheib 2006).

A central role in Lerner's psycho-social analysis is played by the concept of "pathogenic beliefs": interpretations of the world that, when held by many people, tend to recreate the same phenomena that they lament.

> People who have spent all day at work thinking in terms of the bottom line come home shaped by this experience ... More and more they find themselves surrounded by others who, in the words of a common complaint, "only care about themselves and can't really be trusted at all." (p. 72)

As a result, people become cynical about the possibility of social change or even of finding socially meaningful work. Because we "live in a society in which most people have come to believe that everyone else is going to rip them off unless they do the ripping-off first", people become reluctant to make altruistic personal or political choices, lest they end up as "the only jerks who pursued a selfless agenda" (p. 146).

But our needs for meaning and purpose do not disappear; rather, they reappear in repressed form. On the one hand, "we tend to protect ourselves" — in the first instance from predatory others, but more importantly, from our own feelings of inadequacy and meaninglessness — "by accumulating material goods, money, power, sexual conquests" (p. 146). On the other hand, we desperately seek identification with some larger community, be it as fans of a sports team or pop idol, as members of a religious congregation, or as practitioners of a hobby (p. 74).

Between 1977 and 1986, Lerner and his colleagues carried out in-depth interviews with "thousands of working people from a wide variety of workplaces".[71]

> We had not expected what we heard: that work was frustrating not just because workers felt powerless to control the agenda, but at some more basic level because work did not serve any higher social good. People wanted more than "making it" in "the rat race." Spiritual meaning, not money or power, was the thing they were missing — and they made no bones about how painful it felt to be "wasting our lives" for no purpose except "the almighty paycheck." (p. 81)

Lerner argues that

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[71] Lerner's book *Surplus Powerlessness* (1986) provides a more detailed account both of his group's research methodology and of his psycho-social theories. Indeed, in my view *Surplus Powerlessness* is vastly superior to *Spirit Matters*, not only because of its greater detail, but also because of its more explicitly political focus and its lesser contamination by (what I consider to be) irrelevancies about "spirituality".

> If working people fought for more money in the world of work, it was often because they had become cynical about securing workplaces in which they might find meaning and spiritual nourishment — not because they had no such need.
>
> ...
>
> So they went to church, even though there was no money to be gotten there, and did not go to union meetings (because there was no meaning to be found there except during negotiations when they could fight for more money). People used their unions to fight for more money not because money was all they wanted from life, but because it was the only winnable compensation they could get for a life they felt was being wasted all day in meaningless work. (p. 77)

In Lerner's view, it is not surprising that

> many of these people responded to the Right. However irrational the Right's solutions might appear to be, it at least seemed to notice the problem of the decline in America's ethical and spiritual sensitivities.... It never occurred to the liberals or progressives that people were responding to the Right at least in part because it was speaking to some real and legitimate human need that was excluded from the liberal and progressive agenda. (p. 77)[72]

One obstacle to social change is people's tendency toward self-blaming. Most participants in the ILMH's occupational stress groups

> had bought into the meritocratic fantasy that in this society you could make it if you really tried. Hence, if they hadn't made it, hadn't found work that was fully satisfying, they had nobody to blame but themselves. (p. 85)

This is by no means a novel insight — the analysis of self-blaming (albeit of a different type) played a central role already in 1970's feminist consciousness-raising — but it is nonetheless an important observation that is often forgotten.

Another of Lerner's psychotherapy clients was a middle-management executive who described himself as "a Republican and a conservative" but

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[72] Lerner adds that his interviewees

> were happy the unions were there for them as insurance companies that put some constraints on arbitrary power from management at the workplace. But though most unionized workers were glad they had their unions, just as they were glad that they had auto insurance companies, they felt no closer to their union leadership than to their insurance brokers, and they were equally unlikely to reveal to either the deep concerns in their lives. (p. 77)

nevertheless felt nostalgia for the idealism of the 1960s. Despite outward success at work, he exhibited symptoms of depression; he felt trapped between his bosses' demands for increased productivity and a sense of loyalty to his hard-working subordinates; his innovative ideas for socially valuable products were repeatedly rejected by higher-ups concerned only with the bottom line. Lerner poses the question:

> "Why doesn't Samuel rebel, become part of a progressive political movement?" you might ask.
>
> The answer is that *there is no movement that even begins to address his concerns or that wouldn't make him feel like a bad person*, except the most conservative movements, to which he might well be attracted. (p. 126)

Lerner argues that in a society where the conventional wisdom consists in Looking Out for Number One,

> urging people to reduce their level of consumption in order to protect people in other parts of the world is whistling in the wind. People will be unwilling to make those choices if they believe they will be the only jerks who pursued a selfless agenda. (p. 146)

Furthermore,

> when asked to support programs that constrain corporate selfishness, many people are reluctant to impose on others an ethos that they don't believe they can follow in their own lives.... Fearful that they must give up their VCRs and compact discs, their Web surfing and their networking, many sensitive people see themselves as "just as bad as the corporations," and thus feel very conflicted about constraining corporate power.
>
> Ecologists often play into this dynamic, blaming ordinary people as the source of the problem. Instead of wagging accusatory fingers, those who wish to transform America need to preach an ethos of compassion — helping people understand that their underlying fears are rational, yet can be overcome. (p. 147)

Of course, Lerner's psychological and sociological ideas are not above criticism. Like much work emanating from the psychoanalytic tradition, Lerner's discussion is heavy on theorization and light on empirical evidence. Furthermore, Lerner has a disturbing tendency to assert ideas rather than argue them.[73] Still, my own hunch — and it is only a hunch — is that Lerner is on to something important, even if many of the details turn out to be

[73] For instance, in criticizing "some of the most honored psychological theorists of our time [who] claim to have discovered an innate tendency toward hurtful and destructive behavior"

wrong.[74] Lerner's ideas are perhaps best thought of as intriguing hypotheses meriting more rigorous investigation.

But my main gripe, in all of this, concerns the bait-and-switch scam that Lerner plays with the word "spiritual" (presumably without recognizing it himself). Over and over again, Lerner gives examples of his interviewees' dissatisfaction with work that is boring, alienating and serves no social purpose — complaints straight out of the old-time socialist gospel — after which he proceeds to label the malaise not just "emotional and ethical", but "spiritual". For instance:

> Whether they came from the high-pressure workplaces of Silicon Valley, from San Francisco's financial district, or from factories building automobiles or creating cutting-edge fashion, everyone told of corporate structures in which decisions were made primarily on the basis of what might generate corporate profit. Ideas about how their capacities and skills might be used to solve societal problems were systematically discounted.... Over and over again members of our occupational stress groups identified meaningless work as a central aspect of the stress in their lives.
>
> Many acknowledged that they themselves hadn't known how upset they felt about the absence of *spiritual* purpose in their lives... (p. 83, emphasis added by me)

> [When Joan] spoke to her coworkers privately, she learned that they were not cynical about the desire to have some *spiritual purpose* at work, but about the possibility of ever achieving that purpose in the world as they knew it. When Joan talked about the *common good*, her coworkers felt she was wasting their time, or even mocking their deepest but hidden selves — precisely because they felt so bad about living a life in which their work would never be about anything more than serving the interests of the powerful. (pp. 85–86, emphases added)

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among children, Lerner blithely asserts — without presenting an iota of evidence — that

> In fact, what they've discovered is that the pain of misrecognition and disconnection can be transmitted from the instant of birth and perhaps even prenatally in the way that a parent relates to a fetus or newborn child — and this produces angry, aggressive, or destructive behavior in children. (pp. 108–109)

Let me stress that my purpose here is not to take sides in the substantive controversy of psychological interpretation, but simply to draw attention to Lerner's unfortunate habit of employing dogmatic assertion ("In fact ...") as a substitute for evidence and argument.

[74] However, to the extent that Lerner's ideas about human psychology are correct, they should be able to explain human behavior cross-culturally: for instance, in largely secular Europe as well as in the comparatively religious U.S. It is not clear whether Lerner's theories are robust enough to do this. (I thank Jean Bricmont for raising this issue. See also note 78 below.)

> The more Samuel told me of his work situation and his daily life, the more it sounded like a *spiritual* crisis rooted in pathogenic beliefs about the impossibility of love, solidarity, and caring and about the inevitability of a system that gave profit priority over human needs. (p. 123, emphasis again added)

Only once or twice does Lerner address any aspect of "spiritual" yearnings that goes beyond the purely secular.[75]

At another point, Lerner suggests the following "spiritual exercise":

> Take anything in your life — a musical instrument, a computer, a car, a piece of fruit that sits in your home but was grown far away ... Now try to imagine all the steps that needed to happen between the moment that human beings began to evolve and the moment you were able to have this thing in your life. If you ask what knowledge those who brought this object into your life had to have, what those who developed that knowledge had to learn from previous people who developed their knowledge, you will quickly be overwhelmed by the amount of cooperation through thousands of years that made all the things that populate your daily life possible. (p. 45)

It's an instructive proposal, which can lead to profound reflections on human history; but I don't see why Lerner calls it "spiritual".

Let me stress that my complaint is not about Lerner's use of the word "spiritual" *per se*. Anyone is free to use this (or any) word however he wishes, provided that he is up-front with his readers about his intended usage. The trouble is, rather, that Lerner has *already* defined the word "spiritual" to encompass both psychological/ethical and cosmological notions (p. 5). It is a gross error of logic to try to sell the latter by using arguments that concern only the former.

As Tom Frank shows brilliantly in his book *What's the Matter with Kansas?: How Conservatives Won the Heart of America* (2004), contemporary right-wing populism is in large measure a working-class backlash against perceived upper-middle-class liberal snobbery and condescension.[76] This class resentment is of course relentlessly stoked by the right-wing

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[75] On p. 85 he discusses how some of his interviewees "looked forward to trips to the country ... because in these country settings, or standing at the edge of the ocean, they could reconnect with their highest sense of the universe and their place within it".

[76] See, however, Bartels (2005) for an interesting critique of Frank's theses, drawing on polling data from the National Election Study (NES) surveys; and see Frank (2005b) for a reply.

media — which moreover greatly exaggerate its factual basis — but it is not constructed out of whole cloth. Liberals and leftists, rightly horrified by the reactionary agenda of the religious right, *are* often wont to view fundamentalists — and working-class social conservatives more generally — as either ignorant fools or evil, bigoted people.[77] Lerner's attitude toward the rank-and-file of the religious right, like Frank's, is not only more compassionate than these patronizingly elitist postures, but quite likely more empirically accurate as well:

> Hungry for some community in which their need for meaning can be explored, some are attracted to a reactionary spirituality that is used to justify right-wing political agendas. It is frequently not the right-wing politics, but rather the safety to explore spiritual issues, that attracts them to these communities — which, for many people, are the only places they've encountered a community of people that cares about others and doesn't evaluate others by how wealthy, physically attractive, smart-talking, or powerful they are. (pp. 10–11)

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[77] For an analysis of similar prejudices among liberals and leftists in contemporary Italy, see Ricolfi (2005). A particularly nauseating specimen was provided by Italy's most famous intellectual, Umberto Eco, on the eve of the May 2001 elections that brought Silvio Berlusconi's right-wing Pole of Freedom coalition to power. According to Eco, the Berlusconi electorate can be divided into two categories: "Motivated Voters" and "Beguiled Voters". The former consist of

> fanatics of the Northern League who would like to load non-EU citizens, and perhaps our own southerners, into sealed wagons.... League moderates who want to defend the interests of their region, imagining they can live and prosper separately from the rest of the world.... businessmen who reckon (correctly) that the tax changes promised by the Pole would benefit the well-off.... people who, having had trouble with the judiciary, reckon the Pole can rein in independent public prosecutors.... people who do not want their taxes spent on depressed areas.

The second group consists of people who

> have learned their own set of values through creeping education by television for decades ... [who] read few newspapers and fewer books ... There's no point warning these people that Berlusconi would change the constitution, because these people have never read the constitution.... Why talk to them of "offshore", when this denotes only exotic beaches to visit on holiday? What sense does it make to talk to these voters about *The Economist*, when they don't know the names of many Italian papers? They buy a left- or right-wing magazine indifferently, depending on whether there's a pretty derriere on the cover. (Eco 2001)

In short, all those who decline to vote as Eco would like are either selfish (if not downright evil) or stupid. It goes without saying that Eco does not deign to provide any statistical evidence to back up his purportedly factual claims about the Berlusconi electorate.

Indeed,

> The people who feel most attracted to reactionary spiritual or fundamentalist communities are often those who have come to believe that they will not "make it" in the capitalist market. In the religious world they are considered valuable not according to what they can do or accumulate, but because they *are*. Their very being is seen as intrinsically worthwhile. (p. 177)

(Lerner does not cite any sociological studies in support of the eminently empirical proposition contained in his first sentence, but it does seem plausible.[78])

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[78] In a very interesting study, Norris and Inglehart (2004, chapters 2–4) analyze cross-cultural data from the World Values Surveys (1981–2001), covering 59 nations including predominantly agrarian, industrial and postindustrial societies and including nearly a quarter-million respondents. Comparing religious participation (worship, prayer) and religious values *between* countries, they find that poorer societies are more religious (no surprise there), as are societies with a greater inequality in the distribution of income (this interesting finding may explain, at least in part, the greater religiosity of the United States as compared to Western Europe). Comparing religiosity *within* countries, they find that the poor are significantly more religious than the rich. Norris and Inglehart interpret these findings by conjecturing that differences in religiosity are explained largely by the experience of "existential insecurity" at both the individual and societal level:

> [W]e hypothesize that, all things being equal, *the experiences of growing up in less secure societies will heighten the importance of religious values*, while conversely *experience of more secure conditions will lessen it*.... [A]s societies transition from agrarian to industrial economies, and then develop into postindustrial societies, the conditions of growing security that usually accompany this process tends [*sic*] to reduce the importance of religious values. The main reason, we believe, is that the need for religious reassurance becomes less pressing under conditions of greater security. These effects operate at both the societal level (socio-tropic) and the personal level (ego-tropic), although we suspect that the former is more important. Greater protection and control, longevity, and health found in postindustrial nations mean that fewer people in these societies regard traditional spiritual values, beliefs, and practices as vital to their lives, or to the lives of their community. This does not imply that all forms of religion necessarily disappear as societies develop; residual and symbolic elements often remain, such as formal adherence to religious identities, even when their substantive meaning has faded away. But we expect that people living in advanced industrial societies will often grow increasingly indifferent to traditional religious leaders and institutions, and become less willing to engage in spiritual activities. (pp. 18–19, emphasis in the original)

Concerning the comparison between the United States and Western Europe, they conclude from a correlation analysis of postindustrial nations that

> [T]he level of economic inequality measured by the GINI coefficient proves strongly and significantly related to both forms of religious behavior, but especially to the propensity to engage in individual religiosity through prayer.... [T]he United States

Lerner's analysis of the Right's political success overlaps in many ways with Frank's, but he adds an interesting psychological twist. Frank starts from the paradox of

> a rebellion against "the establishment" that has wound up abolishing the tax on inherited estates.... a movement whose reponse to the power structure is to make the rich even richer; whose answer to the inexorable degradation of working-class life is to lash out angrily at labor unions and liberal workplace-safety programs; whose solution to the rise of ignorance in America is to pull the rug out from under public education.[79]

Frank attributes working-class support of right-wing causes to a variety of factors: Democrats' abandonment of pro-working-class economic policies; liberals' real or perceived condescension towards working-class people; right-wingers' astute hammering on "values" issues to the exclusion of economics.[80,81] Lerner tells a similar story:

> When I was a psychotherapist studying the psychodynamics of American society and why middle income Americans were moving to the Right, even when doing so conflicted with their economic interests, I found that the people we were studying, people who had previously supported liberal candidates, were experiencing the impact of the ethos of selfishness

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> is exceptionally high in religiosity in large part, we believe, because it is also one of the most unequal postindustrial societies under comparison. Relatively high levels of economic insecurity are experienced by many sectors of U.S. society, despite American affluence, due to the cultural emphasis on the values of personal responsibility, individual achievement, and mistrust of big government, limiting the role of public services and the welfare state for basic matters such as healthcare covering all the working population. Many American families, even in the professional middle classes, face risks of unemployment, the dangers of sudden ill heath [*sic*] without adequate private medical insurance, vulnerability to becoming a victim of crime, and the problems of paying for long-term care of the elderly. Americans have greater anxieties than citizens in other advanced industrialized countries about whether they will be covered by medical insurance, whether they will be fired arbitrarily, or whether they will be forced to choose between losing their job and devoting themselves to their newborn child. (pp. 107–108)

[79] Frank (2004, p. 7).

[80] See also Frank (2005a) for an illuminatingly acerbic post-mortem on the 2004 American presidential election.

[81] See, however, Willis (2006) for a thoughtful critique of Frank's privileging of economics over "cultural" issues. While I am ultimately not persuaded by most of Willis' arguments against Frank, she raises important questions that merit careful attention. With Willis' recent death at the young age of 64, America has lost an incisive and fiercely iconoclastic cultural critic.

> in their lives and wanted a spiritual discourse that could address that. (Lerner 2004b)

Lerner's liberal colleagues rejected that explanation, and attributed the upsurge of the Right to manipulation by the media.

> Yet the people I was encountering were not manipulated at all — they knew that they didn't agree with parts of what the Right stood for, but still preferred the Right to the arrogant tones of the Left. In particular, they were offended by the covert and sometimes overt message of the liberals that anyone who voted for Reagan must be either stupid or racist or homophobic or sexist. They felt misunderstood and felt the liberals were so far out of touch with their life experience that it confirmed them in thinking that they had more of a home on the Right! (*ibid.*)

This feeling of "home" led them gradually, as Frank documents, to accept additional aspects of the right-wing worldview, including its economic doctrines.

Lerner raises another example of what he calls "liberal contempt" toward the American electorate. Though 68% of Democratic primary voters in 2004 thought that the war in Iraq was fundamentally wrong — according to numerous polls — they selected as a presidential candidate a senator who voted for the war, continued to support the war, and criticized Bush only for managing it incompetently. Why?

> The reason they selected Kerry, they quite openly proclaimed, is that they imagined that "the other," those Americans who were not smart enough or good enough to share our moral opposition to the war in Iraq, would vote for Kerry because he could be presented as a tough military man ...
>
> Privately, they told themselves and each other [that] ... once he is elected ... the real John Kerry, the one who testified against the war in Vietnam once he came home from that war, will re-emerge and save us from this war.
>
> In short, what liberals were saying was: "This guy is an opportunist, and that's why we are for him. Once elected, he will flip-flop away from his stated positions. He won't be a militarist, as he tries to present himself now ... He's just saying all this stuff to fool the American majority, but once in office, he'll (we pray and fervently hope) flip-flop and do the opposite of what he is saying now ... " (*ibid.*)

Lerner asks the reader to

> Please understand the contempt for the American public conveyed in this. Liberals were saying: we can trick these others into voting for someone who we ourselves don't believe stands for what he says he stands for. And the response of the Republicans was very effective: "This guy is a flip-flopper and you don't ever know where he really stands, and our proof is that his own supporters actually think there is a good chance he will flip-flop once in office. Our side has the integrity of really meaning what it is saying, but the liberals don't have that integrity." (*ibid.*)

According to Lerner, liberals follow this self-defeating path because they

> deeply believe that if they were to ever present their own highest vision of a good world and a good society, the American public would reject it and then they'd be out of power. So they have to lie to the American public, based on the assumption that they are too stupid or too evil (racist, sexist, homophobic, militarist, or authoritarian) to ever respond to a really visionary progressive perspective.
>
> And in the short run, they might be right that they wouldn't win with a more visionary perspective, because for so long the American public has heard only mush from them that it will take some time to convince them of a different vision. The Right was in this situation in the 1960s, and yet it chose a different path. ... [They] said: "we will stick with our ideological position, make it clearer and more easy to understand, but in some ways make it more intellectually coherent and more clearly based on some key principles, and we will be prepared to lose elections but will use those to educate the public to our perspective." And within 16 years it worked. But the liberals have never had the backbone to do that, to articulate and stick with their own most visionary perspective — and that lack of backbone is precisely why so many Americans don't respect liberals. (*ibid.*)

Thus far, Lerner's spiel is not so different from the standard leftist critique of contemporary liberals' timidity and spinelessness.[82] But Lerner drives home the barely concealed psychological message:

> [Y]ou Americans are too stupid or evil to ever respond to our vision of The Good, so in order to win you over we have to hide from you (and even from ourselves) our own highest vision of what a good society would be like, and instead offer you only those ideas we think will appeal to you even though those ideas don't appeal to us.

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[82] Leftists add, of course, the observation that the Democratic Party is dependent on corporate interests for its financing. Lerner also mentions this in passing (2006a, p. 105).

> And that is what I mean when I say that liberals and progressives reflect contempt for the American people. The liberal and progressive camp is so sure that Americans will never respond to our vision that we never give them a chance to do so — instead we feed them what we think that they want to hear, and imagine that we can get away with that. *But they see that that is what we are doing, and that quite reasonably makes them feel that we have little respect for them.* (*ibid.*, emphasis added by me)

In the 2004 American presidential election, according to the national exit poll, an astonishing 22% of voters cited "moral values" as the most important issue, above the economy/jobs (20%), terrorism (19%), Iraq (15%), health care (8%), taxes (5%) and education (4%). And of those who cited moral values as their main concern, 80% voted for Bush.[83] If we could win even a small fraction of those voters to our side, we could end the right-wing dominance of politics in our country, and perhaps even start rebuilding a constituency for progressive reforms.

It seems to me that much further study — for instance, interviews that probe more deeply than a conventional poll — is needed in order to understand all the nuances of what those voters meant by "moral values". *To some extent*, "moral values" is undoubtedly a code word for opposition to abortion and gay marriage. But I suspect that that is far from the whole story. For instance, a Zogby International poll conducted a few days after the election found that, when voters were asked "*Which* of the following moral issues most influenced your vote in this election?" (emphasis mine), 42% answered the Iraq war, compared to only 13% for abortion and 9% for same-sex marriage. Even more strikingly, when voters were asked "Which of the following is the most urgent moral problem in American culture?", 33% answered greed and materialism and 31% answered poverty and economic justice, compared to only 16% for abortion and 12% for same-sex marriage. One strategically important finding is that concern over greed and materialism was particularly high among self-described moderates; all told, 96% of liberals, 78% of moderates and fully 30% of conservatives rated greed,

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[83] The national exit poll, which was conducted by Edison Media Research and Mitofsky International on behalf of a consortium of media organizations, is available on-line at `http://www.cnn.com/ELECTION/2004/pages/results/states/US/P/00/epolls.0.html` See, however, Langer (2004) for a critique of the methodology behind this question, which placed the vague notion of "moral values" together with six concrete policy issues.

Table 9.1. Results from a Zogby International poll of 10,550 voters in the 2004 American presidential election, conducted November 3–9, 2004.

	All voters	Liberals	Moderates	Conservatives
Which of the following moral issues most influenced your vote in this election?				
Iraq war	42.3%	54.6%	47.2%	32.8%
Abortion	12.8%	3.3%	6.4%	21.4%
Same-sex marriage	9.3%	2.8%	4.7%	18.7%
Poverty	7.4%	16.6%	7.8%	0.9%
Health care	5.6%	9.1%	9.0%	1.3%
Preventing stem cell research	2.1%	1.5%	3.1%	2.0%
None	7.0%	2.4%	9.7%	9.0%
Other	13.3%	9.7%	12.0%	14.0%
Which of the following is the most urgent moral problem in American culture?				
Greed/materialism	32.6%	34.9%	40.8%	24.3%
Poverty/economic justice	30.6%	61.4%	37.6%	6.0%
Abortion	15.7%	0.3%	5.8%	30.0%
Same-sex marriage	12.3%	1.5%	6.7%	26.5%
None/no response	8.9%	1.9%	9.1%	13.3%

Source: Eisenberg (2004).

poverty and economic justice as the most important moral problems facing America today (see Table 9.1).

These data tend to support Lerner's view that "Tens of millions of Americans feel betrayed by a society that seems to place materialism and selfishness above moral values.... Sure, they will admit that they have material needs, and that they worry about adequate health care, stability in employment, and enough money to give their kids a college education. But even more deeply they want their lives to have meaning — and they respond to candidates who seem to care about values and some sense of transcendent purpose."[84] If the Left cannot address this longing for values, the Right will. And it has — quite successfully.

So Lerner's call for a Left that couches its proposals in moral as well as economic terms — that appeals to voters' values as well as to their self-interest — makes a lot of sense.[85]

[84] Lerner (2004a).

[85] See, however, Aronson (1998) for a thoughtful Left critique of Lerner's "politics of meaning". Tom Frank (2004) offers a diagnosis of the reasons for the Right's success among working-class Americans that is somewhat different from Lerner's, and also a different cure. In Frank's

But Lerner goes further: he wants to organize a Left movement that is explicitly "spiritual/religious", with the aim of drawing on most Americans' profound religious beliefs and harnessing them towards progressive ends.

> Imagine if John Kerry had been able to counter George Bush by insisting that a serious religious person would never turn his back on the suffering of the poor, that the bible's injunction to love one's neighbor required us to provide health care for all, and that the New Testament's command to "turn the other cheek" should give us a predisposition against responding to violence with violence. (Lerner 2004a)

Columnist Van Jones has likewise observed that "The last time U.S. progressives captured the national debate and transformed politics" — namely, during the civil rights movement of the 1950s and 1960s — "people of faith were at the *center* of the movement, not stuck in its closet." Lauding the efforts today of Michael Lerner, Jim Wallis[86], Frances Hall Kieschnick and others to rebuild a spiritual/religious Left, Jones sees in them

> the seeds of a wisdom-based, Earth-honoring, pro-democracy movement — one that affirms and applauds religious and spiritual impulses, while opposing fundamentalism, chauvinism and theocracy. Over time, this kind of progressive movement has the potential to win — and win big — in the United States. To be honest: it is probably the *only* type of progressive movement that stands a chance in a country as religious as ours.[87]

Much as it may pain my secular conscience to admit it, it seems to me that Jones is very likely right.

This poses a big problem for some of us. As the reader has undoubtedly by now surmised, I am an atheist. This is not for me a matter of taste, of

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view, the Democrats' abandonment of pro-working-class economic policies — effectively removing economic issues from the political debate — played a fundamental role in the rise of the Right, by allowing the formation of a cross-class reactionary coalition held together by a concern for "traditional values". As a remedy, Frank recommends old-time economic populism. In my view, Frank's and Lerner's strategic suggestions are complementary rather than contradictory; a revived Left needs both. Lerner agrees (2006a, pp. 124–125).

[86] See Wallis (2005), which was on the New York Times best-seller list for 15 weeks in January–May 2005. Unfortunately, no detailed critical review of this book from a rationalist point of view seems yet to have been published.

[87] Quotes from Jones (2005), italics in the original. Jones calls for a "progressive approach to 'faith in politics' " that acknowledges "the awful *crimes* of religiously-inspired people" and at the same time "honor[s] and embrace[s] the *positive* contributions of religiously inspired people". He does not address the factual aspects of religious doctrine.

"faith", or of mere "belief"; it is simply a recognition that, in my best rational judgment, there is no credible evidence that an entity possessing the properties that most believers attribute to "God" — e.g. a supernatural being who takes interest in our moral and immoral actions, to whom one may pray in the expectation of receiving a response, etc. — actually exists. I am an atheist toward the Jewish, Christian, Islamic and Hindu gods in exactly the same way, and for exactly the same reasons, that the readers of this essay are (I presume) atheists toward Zeus and Thor.[88]

So, if a revived left is to be "religious", then I and like-minded folk will have to remain — will have to *choose* to remain — outside the fold.

Now, that fact, by itself, would not be a fatal flaw: out-of-the-closet atheists are so rare in the United States (except perhaps on the Upper West Side) that a progressive political movement could conceivably do without us.[89] The difficulty is more fundamental: Why on earth would we want to base

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[88] To forestall any misunderstanding about the term "atheist", let me stress that I do not, of course, claim to have *proof* of the nonexistence of the Jewish, Christian, Islamic and Hindu gods, any more than I claim to have proof of the nonexistence of Zeus and Thor, or proof of the nonexistence of a porcelain teapot in orbit around the Sun (an example used by Bertrand Russell). I simply observe that there is no good reason to believe that these entities do in fact exist.

Some readers might prefer to call this position "agnostic" — a term that is generally considered more polite than "atheist". But its politeness arises precisely from hiding behind a dangerous ambiguity, as Bricmont (1999) and Dawkins (2003, pp. 149–150) have noted. On the one hand, many self-declared agnostics simply point out, as I do, that there is no good reason to believe in any of the various proposed deities, any more than there is to believe in the orbiting teapot; and agnostics of this type might as well be called atheists. After all, the Pope would never call himself "agnostic" vis-à-vis the gods of Olympus; he, like the rest of us, recognizes that there is no credible evidence that these gods actually exist, and he is therefore an atheist towards them (and indeed towards 99% of the gods in which humans have ever believed). Some of us, as Dawkins quips, just go one god further. By contrast, some other people who call themselves agnostics do so because they give some credence to the logical and/or empirical arguments that can be made in favor of one or another deity, even if they do not find those arguments totally convincing; and these people are true agnostics, in precisely the same sense as I am agnostic (at present) as to whether string theory is the correct theory of quantum gravity.

[89] Indeed, given the current level of prejudice against atheists, a progressive political movement would almost certainly do *better* without us. For instance, an August 2006 Gallup poll asked respondents how they "feel about people of different religious or spiritual groups in the United States. Please say whether your overall view of each group is very positive, somewhat positive, neutral, somewhat negative or very negative." For atheists, the results were 30% very negative and 14% somewhat negative, compared to 11% very negative and 22% somewhat negative for fundamentalist Christians, 11%–19% for Muslims, 9%–20% for Mormons, 4%–8% for Catholics, 2%–8% for Baptists, 1%–4% for Methodists, and 1%–3% for Jews. (Of course, some

our politics on what is, at bottom, a massive delusion? If 45% of our fellow citizens believed in a flat earth, it would certainly behoove us — if only for practical political reasons — to understand as accurately and compassionately as possible the causes of their misguided belief; but surely we would not want to adopt that belief ourselves.

The same problem can be posed in more practical terms. Do we really want to get into a debate with the Right about which is the more "authentic" Biblical commandment: to condemn homosexuality or to provide universal health insurance? Michael Lerner's many talents notwithstanding, exegesis of divine revelation is unlikely to be a winning terrain for the Left.

Nor, as I have argued, is anything much gained by referring, as Lerner does, to "spirituality" instead of "religion". Whereas the traditional religions assert doctrines that are clearly ridiculous — transubstantiation, for instance — Lerner's spiritual credo appears less ridiculous principally because it is less clear. I do not consider this to be a great improvement.[90]

Instead of "spirituality/religion", why don't we just talk straightforwardly about people's legitimate psychological needs (for community, caring, love, meaningful work, etc.) and moral needs (feeling that one is doing good for others, that society is organized in a fair way, etc.)? That is really the upshot of what Lerner is getting at, despite his "spiritual" language; and his comments are very much on target.

Lerner is at least partly right, I think, in contending that the secular Left — non-Marxist as well as Marxist — has sometimes felt uneasy talking

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respondents may be lying about their purportedly positive or neutral feelings towards Muslims and Jews.) Only Scientologists were viewed more negatively (26%–27%) than atheists.

Similarly, a December 2006 Fox News/Opinion Dynamics poll read respondents a list of religious affiliations and asked whether "you think that affiliation would make you more or less likely to vote for" a presidential candidate belonging to that group (a third option was "doesn't matter"). The result was 50% less likely if the candidate is an atheist, compared to 45% if the candidate is a Muslim, 32% if a Mormon, 24% if a member of the Christian Coalition, 10% if Roman Catholic or Jewish, and 6% if Protestant. Once again, only Scientologists were viewed more negatively (53%) than atheists.

In fact, the available data suggest that prejudice against atheists is at present stronger in the U.S. than prejudice against gays or Muslims. For a detailed scholarly analysis, see Edgell *et al.* (2006). The polls cited here are available on-line at `http://web.lexis-nexis.com/universe/form/academic/s_roper.html`

[90] Rather, I concur with George Orwell that the main advantage of speaking and writing clearly is that "when you make a stupid remark its stupidity will be obvious, even to yourself". (Orwell 1953 [1946], p. 171)

about ethics and morality.[91] Perhaps we have unconsciously accepted conservatives' definition of morality as *sexual* morality — and a repressive sexual morality at that. But there is no more reason to accept conservatives' narrow understanding of "morality" than there is to accept capitalism's self-description as "free enterprise" or the former communist countries' self-description as "people's democracies".[92]

Misleading the American people about the reasons for war is *immoral.* Killing thousands of civilians who have done us no harm is *immoral.* Giving inflated no-bid contracts to one's friends is *immoral.* Rationing health care on the basis of wealth is *immoral.* Sure, let's point out that formulating policy in secret, behind the backs of the people, tends to lead to blunders; that invading Muslim countries and killing civilians help to bring thousands of new recruits to Osama bin Laden's cause; that no-bid contracts waste the taxpayers' hard-earned money; and that our private health-care system is horribly inefficient. But let's *also* point out that these policies are in conflict with most Americans' deeply held moral values.

Research in cognitive science is beginning to confirm what we all know intuitively: humans are endowed with strong intuitions about fairness, and they will react vehemently to any perceived unfairness, even when it is directed at someone other than themselves or their families.[93] But people do not spontaneously understand all the unfair things happening in the world around them, any more than they spontaneously understand their own economic interests. Rather, unfairness has to be pointed out publicly, over and over again, and made the subject of open debate.

Some religious people think that atheists and "secular humanists" cannot be moral.[94] Of course this is nonsense; but what is interesting is that it

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[91] One prominent exception is Noam Chomsky. See e.g. Chomsky and Herman (1979) and Chomsky (2003, especially chapter 8), among many other writings.

[92] I confess, for instance, to a sneaking admiration for those teenagers who brave peer ridicule (or at least peer bemusement) to take virginity pledges (see e.g. Cobb 2001 for a sensitive account). At the same time, one cannot help be saddened by the bizarre sense of moral priorities — on the part of both the teenagers and their adult sponsors — that focusses such energy on spurning consensual sexual pleasure but remains silent about greed, consumerism, poverty, and the manipulation of patriotism into wars of aggression.

[93] See, for instance, Fehr and Fischbacher (2004). I thank Oliver Curry for drawing my attention to this article.

[94] Fortunately, this view is less widely held than one might fear, even in the highly religious U.S. An August 2006 Newsweek poll asked respondents: "Do you think someone can be a moral person and be an atheist, or not?" The results were 68% yes, 26% no, 6% don't

may in fact get things precisely backward. For there is some evidence that human intuitions about morality are to a large extent universal; religion may be, in large part, an after-the-fact rationalization for moral concepts that all humans share.[95] Consequently, there is a large shared ground of morality between atheists and evangelicals, progressives and Bush enthusiasts — if only we could find it. We will probably continue to disagree vehemently — and indeed to clash politically — on some issues such as abortion, gay rights, and the teaching of evolution. But there is no reason why we cannot engage in dialogue with the Bush rank-and-file about the immorality of right-wing economic and foreign policies.[96]

Some progressive activists and political candidates might feel comfortable couching such a dialogue in Biblical terms, as Lerner suggests; and that approach would certainly resonate with a large fraction of the American populace, *provided that* the religious feeling is genuine and not feigned. Others, like myself, would prefer to articulate the same ethical ideas in purely secular terms. There is no contradiction between the two approaches; we need a

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know. This poll is available on-line at `http://web.lexis-nexis.com/universe/form/academic/s_roper.html`

On the other hand, a Pew Global Attitudes Project survey from April–May 2007 got radically different results (which illustrates how polling data can be extraordinarily sensitive to the precise wording of questions). Respondents were asked: "Which one of these comes closest to your opinion? Number 1 – It is not necessary to believe in God in order to be moral and have good values OR Number 2 – It is necessary to believe in God in order to be moral and have good values." The results in the U.S. were 57% necessary to believe in God, 41% not necessary, 2% don't know. It is not clear to me why the Newsweek and Pew results were so different.

The Pew survey also provided informative international comparisons. Among the rich countries, Americans were by far the strongest in their belief that religion is necessary for morality: agreement with this proposition was lowest in Sweden (10%), the Czech Republic (14%) and France (17%), intermediate in Britain (22%), Italy (24%) and Russia (26%), and a bit higher in Canada (30%), Japan (33%), Germany (39%) and Israel (43%); only South Korea (56%) came close to American attitudes. Among the poorer countries, by contrast, the *only* low rate was found in China (17%); the remaining results ranged from the Ukraine (42%) and Mexico (53%) through Lebanon and India (each 66%) to South Africa (74%), Nigeria (82%), Brazil (83%), Turkey and the Palestinian territories (each 84%), Pakistan (88%), Senegal (91%), Indonesia (98%) and Egypt (99%). See Pew Global Attitudes Project (2007, p. 116). I thank Meera Nanda for drawing my attention to the Pew survey.

[95] See, for instance, Boyer (2001, especially chapter 5) and Hauser (2006).

[96] A similar approach was taken by Rosa Luxemburg in her 1905 essay "Socialism and the churches", in which she stressed the communist ideology and practice of the early Christians (see Luxemburg 1970). I thank Catherine Samary for drawing my attention to this reference.

movement pluralistic enough to accommodate both. The key thing is to talk with our fellow Americans, rather than looking down at them.

> At Cambridge University I was taught a laudable method of argument: you never personalise, but you have absolutely no respect for people's opinions. You are never rude to the person, but you can be savagely rude about what the person thinks. That seems to me a crucial distinction: people must be protected from discrimination by virtue of their race, but you cannot ring-fence their ideas. The moment you say that any idea system is sacred, whether it's a religious belief system or a secular ideology, the moment you declare a set of ideas to be immune from criticism, satire, derision, or contempt, freedom of thought becomes impossible.
>
> — *Salman Rushdie (2005)*

> We must respect the other fellow's religion, but only in the sense and to the extent that we respect his theory that his wife is beautiful and his children smart.
>
> — *H.L. Mencken*

Postscript. Readers of this essay might well be moved to ask me: How do you reconcile your description of religion as "a massive delusion" with your call for respectful dialogue with right-leaning evangelicals? Isn't there a huge contradiction here?

Well, there is not in fact any contradiction, but there is a serious tension. Like many of us, I am struggling with the problem of how to deal with religion and religious people in a way that is both intellectually honest and politically effective. I don't claim to have any final answers, but here is my way of looking at the problem:

First of all, it is crucial to distinguish between ideas and the people who hold them. People who hold false ideas are not necessarily stupid.

Secondly, as I have repeatedly stressed, religious doctrines usually have two interrelated but distinct parts: a corpus of assertions about matters of alleged fact (the existence and properties of God, the age of the universe, the virgin birth, etc.), and a corpus of moral teachings. Atheists like myself may totally reject the first part and yet agree with many (though not all) aspects of the second part.

I have called the factual assertions contained in Judaism, Christianity, Islam and Hinduism "delusions" simply because that is, in my best rational judgment based on the available evidence, what they are. That is where intellectual honesty leads me. And I don't think that progressives — or indeed

sincere democrats of any stripe — can be politically effective while being intellectually *dis*honest.[97] (Of course, as an academic I have the luxury of saying what I think. A politician might find that silence is a better strategy.)

But people who hold false beliefs are not necessarily stupid or even irrational. For most of human history, most people have believed that the earth is (approximately) flat; and indeed, they had *good reasons* to think so. It took many centuries of work by some extremely talented people to piece together the evidence for the (approximate) sphericity of the earth. Those of us who live today are not smarter than our ancestors, but are simply standing on the shoulders of giants.

Of course, this explanation does not excuse an American in the year 2008 who still believes that the universe and humanity were created in one week about 6000 years ago. But even so, we ought not be too harsh on hard-core believers. Religion is a delusion, but one that is extraordinarily well-adapted to the human mind (in exactly the same way that the cold virus is well-adapted to the human nose); that is presumably why religion of some kind is near-universal in human societies. In particular, *young* minds are designed to absorb information in vast quantities from their caretakers; and even if some of that "information" is false, it can become very difficult to dislodge later (especially in matters, such as cosmology, that are not open to everyday observation and falsification).[98] So those of us who were not exposed,

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[97] Dishonesty of all kinds can, alas, be politically successful, at least in the short run. But dishonesty is not an ethically acceptable option for anyone who genuinely values democratic participation in governance: for it denies to our fellow citizens a right that we justly demand for ourselves, namely, the opportunity to evaluate the competing policy options on the basis of the best available evidence, weighed in the light of our own ethical values.

[98] Let me stress that I am *not* asserting a generalized "gullibility" on the part of children — that would be empirically false. Clearly, children (like adults, for that matter) are *both* trusting (hence potentially gullible) *and* critical; the exact mix of these two attitudes (and others) depends on the interpersonal circumstances and on the subject matter (who is saying what to whom, and in what context). Research in developmental psychology is beginning to elucidate the details of these processes.

It is an empirical fact that in societies where people have a choice of religion (including no religion at all), adults' religious beliefs and affiliations are extremely strongly correlated with those of their parents (see e.g. Flor and Knapp 2001 and the many earlier studies cited therein). But the precise causal pathways underlying this correlation – in particular, the respective roles played by childhood and adolescence — are not yet understood.

I am grateful to Helena Cronin for drawing my attention to the subtleties of this issue, and to her as well as Susan Carey, Robin Cornwell and Steven Pinker for information concerning it. It goes without saying that these people should not be held responsible for my misunderstandings of what they told me.

in youth, to this particular intellectual virus should not be too smug towards those who were.[99]

There is another reason not to be smug, and it has to do with that forbidden category of American political discourse: class. Philosopher Philip Kitcher puts it well:

> Academics and scientists, as well as other professionals, can more easily sustain a sense of their lives as amounting to something, even in the absence of faithful service to God. Their lives are centered on work that is frequently significant and challenging, exciting and rewarding.... [But] For people who are buffeted by the vicissitudes of the economy, or who are victimized by injustice, or who are scorned and vilified by the successful members of their societies, or for whom work is tedious and unrewarding ... [and] who can unburden themselves most readily in religious settings and who find in their church a supportive community, above all for people who hope that their lives mean something, that their lives matter, the secular onslaught threatens to demolish almost everything.[100]

Or as a well-known nineteenth-century thinker put it, somewhat more poetically but no less empathetically,

> Religious suffering is at one and the same time the expression of real suffering and a protest against real suffering. Religion is the sigh of the

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[99] I have plagiarized this fruitful metaphor, as well as many of the ideas in this paragraph, from Richard Dawkins' illuminating essay "Viruses of the Mind" (2003, pp. 128–145).

[100] Kitcher (2007, pp. 159–160). Commenting on the efforts of atheist scientists such as Richard Dawkins and Steven Weinberg to promote humanity's quest to understand the universe as a substitute for religious delusions, Kitcher observes insightfully that

> those most excited by the secular vision — those who celebrate the honesty of spurning false comfort — are people who can feel themselves part of the process of discovery and disclosure that has shown the reality behind old illusions. Celebrations of the human accomplishment in fathoming nature's secrets are less likely to thrill those who have only a partial understanding of what has been accomplished, and who recognize that they will not contribute, even in the humblest way, to the continued progress of knowledge. (pp. 155–156)

All this is not to belittle the valiant and fruitful efforts of Dawkins, Weinberg and others to explain scientific ideas and methods to lay readers, but only to recognize that in the present state of (mis)education, such efforts are unlikely to penetrate much beyond a narrow scientifically-inclined segment of the well-educated upper-middle class.

> oppressed creature, the heart of a heartless world and the soul of soulless conditions. It is the opium of the people.[101]

Empirical work by contemporary political scientists suggests, in fact, that even modest progress in reducing economic and social insecurity — far short of the abolition of capitalism — could help weaken the appeal of reactionary religion.[102]

When all is said and done, cosmology is not a subject of prime political importance. When I run into fundamentalists, I don't spend my time lecturing them on the Big Bang and evolution. I just nod, and politely switch the subject. (To tell the truth, here in lower Manhattan I don't run into all that many fundamentalists. But I do run into believers in homeopathy, which is no less a delusion; and unless severely provoked, I still refrain from lecturing them on atomic theory.) If fundamentalists insist on revising the school science curricula, well, then yes, we'll have a fight. And if, in conversation, they ask me what I honestly think about God and the universe, I will tell them. But for the most part, cosmology can remain a private matter.

It is the ethical side of religion that plays a more direct political role.[103] And here, once again, we will have some fights: I support gay rights and they don't. But these "hot-button" social issues are not the *central* political questions of our time, though the spin doctors of the right wing would dearly like to make them so. Progressives should keep our eye on the main issues affecting the fate of humanity today. And on these issues, atheists and fundamentalists (and everyone in-between) have much common ground in shared moral beliefs: a potential starting point for dialogue in which we

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[101] Marx (2002 [1844], p. 171). Of course, religion is not *only* an anesthetic against worldly pain (and fear of death); religious ideologies can also, under some circumstances, motivate people to struggle against oppression, as the experience of liberation theology in the United States and Latin America eloquently shows.

[102] Norris and Inglehart (2004): see note 78 above.

[103] Secular people usually argue that religion is inoffensive in private but should be kept out of the public sphere. But this position will not hold water. Each person will inevitably base her or his political decisions on her ethical beliefs as well as on her beliefs about the relevant factual matters. And for a religious person, those ethical beliefs, as well as some of the relevant factual beliefs, come from religion. It is as silly to tell a devout Christian to keep her religious beliefs out of the public sphere as it is to tell me to keep my secular-humanist-leftist beliefs out of the public sphere. The only cogent objection that one can make vis-à-vis a devout Christian is that the Bible is not a *valid* source of knowledge on ethical or factual matters. (I do not mean that the Bible is always wrong, but merely that the fact that the Bible says X does not constitute evidence for or against X.) When ethical or factual beliefs conflict, there is no substitute for debate on the *evidence* supporting those beliefs.

attempt to convince our fellow citizens of the desirability of our policy proposals.[104]

> I once asked a distinguished astronomer, a fellow of my college, to explain the Big Bang to me. He did so to the best of his (and my) ability, and I then asked what it was about the fundamental laws of physics that made the spontaneous origin of space and time possible. 'Ah,' he smiled, 'Now we move beyond the realm of science. This is where I have to hand over to our good friend the Chaplain.' But why the Chaplain? Why not the gardener or the chef? Of course chaplains, unlike chefs and gardeners, *claim* to have some insight into ultimate questions. But what reason have we ever been given for taking their claim seriously?
>
> — *Richard Dawkins (2003, p. 149)*

Postscript 2. Some readers might object — as one reviewer of this essay did — that Harris and I are making a category mistake in seeking to subject religious claims to the test of evidence:

> The author's natural-scientific training and predispositions lead him to believe that religious belief can be subjected to evidentiary criteria; that religion is making truth claims in the same way and the same sense as scientific practice does.... [But] belief in God is not "false"; it is simply not amenable to scientific truth criteria, and therefore neither "true" nor "false."

Since this viewpoint is likely to be widespread, and packs a goodly number of confusions into its two sentences — confusions concerning both the nature

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[104] Or as Lerner puts it, with laudable humility:

> *Reach out to people who disagree with our ideas, listen to their concerns, and engage in respectful dialogue.* We have much to learn from others, so the point of these sessions should be less to convince them than to share ideas and perspectives.... You'll be amazed to find that many people who identify with the Right actually support many of our goals, particularly in regard to ecological sanity and ending poverty. Many of them don't want to be part of a nation that tortures people. Many simply do not know the story of how the global economy works to generate poverty in the third world, do not know about the realities of torture that the United States supports both directly and indirectly, do not know about the role of this country in overthrowing democratic governments over the past fifty years, or do not know the pain the United States has inflicted upon the people of Vietnam and Iraq. Sharing information can be a very powerful way to begin a conversation. (Lerner 2006a, pp. 374–375, italics in the original)

of religious claims and the methods that should be used to evaluate them — it is perhaps worth taking a bit of time to disentangle those confusions.[105]

Let us begin with the nature of religious claims. Consider the following propositions:

1. The car you sold me has defective brakes.
2. Water at atmospheric pressure boils at 100° C.
3. Approximately 11–12 million Africans were enslaved by Europeans in the period 1450–1900.
4. Christopher Columbus had a severe attack of diarrhea on the night before sailing for America.
5. The universe and humanity were created during one week approximately 6000 years ago.
6. Mary, the mother of Jesus, became pregnant without engaging in sexual intercourse.

All of these propositions make claims about the world — claims whose meaning is reasonably unambiguous, at least once we clarify which one of the three cars you sold me we are talking about (#1), how "atmospheric pressure" and the Celsius temperature scale are defined (#2), and so forth. Once these preliminary clarifications have been made, each of these claims is true or false insofar as it corresponds or not to the way the world really is (or was).[106] The religious claims (#5 and #6) are no different, in this respect, from the claims concerning history (#3 and #4), science (#2) and everyday life (#1). Indeed, these particular religious claims *are* claims concerning history. Those people who really believe (and claim) #5 or #6 to be true believe (and claim) them to be true *in exactly the same sense* that I believe (and claim) #2 and #3 to be true — namely, that they are accurate representations of the way the world is.[107,108,109] The same analysis applies to each one of the

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[105] See also Bricmont (1999) for further discussion of these issues.

[106] See Chapter 7 for further discussion of this issue.

[107] Documentation supporting #3 can be found in Thomas (1997, pp. 805–806 and 862–863) and Lovejoy (2000, pp. 47, 146) and in the references cited by them.

[108] Of course, some liberal Christians will say that they believe #5 or #6 to be "true" in some metaphorical sense — which is just a polite way of saying that they do *not* believe #5 or #6 to be true in the usual sense of the word but are embarrassed to declare this so bluntly.

[109] In fact, the most philosophically problematic of these six claims is #2. Unlike the others, which assert fairly discrete facts about the world (or, in the case of #3, the aggregation of a large but finite number of fairly discrete facts about the world), #2 asserts a *general law*: namely, that *anywhere* and *anytime* in the universe where water at atmospheric pressure is to be found, it

claims belonging to the factual part of any religion's doctrine — provided, of course, that the claim is formulated clearly enough to have any precise meaning at all.[110]

Now, what methods should we use to evaluate these six claims (and others like them)? For the first four propositions, at least, the appropriate method is clear: study, as carefully and objectively as one can, the available *evidence* bearing on the truth or falsity of the assertion in question; weigh that evidence rationally to the best of one's ability; and debate the results with other people who are using the same method (especially people who have relevant expertise).[111] This approach is not *guaranteed*, of course, to yield the correct result, since the available evidence may be incomplete or misleading[112], our reasoning may be faulty, etc. But it is the best that imperfect human beings can do. And it works amazingly well — in some areas of life, at least — as the epistemic successes of the natural sciences spectacularly demonstrate.[113]

Please note, however, that this method is not unique to the natural sciences; quite the contrary, it is part of the rational attitude toward all aspects of life. In history and anthropology no less than in physics and biology,

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will boil at 100° C. The evaluation of such lawlike claims is clearly much more subtle than the evaluation of discrete claims of fact (see Chapters 6 and 7 for further discussion).

[110] Liberal religions frequently evade this requirement by formulating their factual claims so vaguely that it is unclear what, if anything, is actually being asserted. In this way they can avert falsification, but at the price of not asserting anything clear at all.

[111] This is admittedly an oversimplified and idealized summary of the rational approach to evaluating evidence: it applies, perhaps, to simple situations such as jury duty, but needs considerable modification in order to deal with scientific knowledge. After all, most of us have neither the time nor the expertise to weigh rationally the evidence concerning Maxwell's theory of electromagnetism or the double-helix model of DNA (or, for that matter, the claim that Thomas Jefferson wrote the Declaration of Independence); in practice, we often have to rely on the consensus of the best of current science. (This is true not only for non-scientists, but also for scientists concerning subjects outside of our own narrow field.) But this reliance is not — or at least *ought not be* — a matter of blind trust, like fundamentalists' trust in the literal truth of Genesis. Rather, it is an *informed* reliance, founded on at least a rough understanding of how "experts" in a given field become accredited and what methods they employ within their area of "expertise"; only if we consider those methods to be epistemically reliable do we give (suitably cautious) endorsement to the results. In a certain sense, then, we are indeed applying the idealized approach set forth in the main text, but many elements of that approach are socially delegated rather than carried out by any single individual.

[112] Indeed, in some cases (such as #4 and #6) it may be the case that *no* credible *direct* evidence is currently available to us, and we may have to proceed on the basis of what lawyers would call "circumstantial evidence".

[113] See again Chapters 6 and 7.

factual claims need to be supported by evidence, and the quality of that evidence will be assessed critically by scholars. If I sue you in court, making a series of assertions of alleged fact (such as #1 above), the judge and jury will take me seriously only to the extent that I provide convincing evidence for my assertions. All human beings, in nearly all domains of their lives, have an interest in adjusting their beliefs to reality, and for this reason they are inevitably concerned with the relationship between assertion and evidence. (Harris expresses this idea more colorfully, in the passage cited on p. 386 above.) As philosopher Susan Haack observes:

> Our standards of what constitutes good, honest, thorough inquiry and what constitutes good, strong, supportive evidence are not internal to science. In judging where science has succeeded and where it has failed, in what areas and at what times it has done better and in what worse, we are appealing to the standards by which we judge the solidity of empirical beliefs, or the rigor and thoroughness of empirical inquiry, generally.[114]

The glaring — indeed, perhaps the *only* — exception to this general rule is religion. Not only do religions relax the standards of evidence that human beings employ in all other areas of life[115]; they even make a virtue of this laxity, by exalting the merits of "faith" in the absence of sufficient evidence (or even, in some cases, in the face of strong contrary evidence).

But what is the justification for such laxity? Granted, the problems addressed by religion — the fundamental nature of the universe, the existence or nonexistence of the afterlife, the foundations of morality — are among the most important, and the most difficult, that anyone can pose. But important and difficult problems call for using the *best* (i.e. most reliable) methods at our disposal, not the worst.

Religious/spiritual people sometimes claim to be in the possession of additional methods for evaluating assertions of alleged fact — methods that go beyond the mere assessment of empirical evidence — such as intuition, revelation, or the reliance on sacred texts. But what good reason do we have to believe that such methods *work*, in the sense of steering us systematically (even if not invariably) towards true beliefs rather than towards false ones?[116] At least in the domains where we have been able to test these

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[114] Haack (1998, p. 94).

[115] More precisely, they relax the standards of evidence when evaluating the assertions forming part of *their own* doctrine — but not, of course, when evaluating the doctrinal claims of competing religions.

[116] Of course, the same question can and should be posed about scientific methods, but in this case there is a strong answer: the fact that we are able to make accurate predictions of

methods — astronomy, geology and history, for instance — they have not proven terribly reliable. Why should we expect them to work any better when we apply them to problems that are even more difficult, such as the fundamental nature of the universe?

Last but not least, these methods suffer from an insuperable logical problem, already noted in the discussion of Lerner's epistemology (p. 407 above): What should we do when different people's intuitions conflict? How can we know *which* of the many purportedly sacred texts — whose assertions frequently contradict one another — are *in fact* sacred?

Postscript 3. Biblical scholar Jacques Berlinerblau points out, in an interesting recent book, *The Secular Bible: Why Nonbelievers Must Take Religion Seriously* (2005), that most contemporary atheists and agnostics — myself included, I must confess — are astoundingly ignorant of the details of the Hebrew Bible, the New Testament and the Qur'an (not to mention the Bhagavad Gita and the Tripitaka, one could add). Berlinerblau's rebuke is justified, but one still might ask: Is our religious philistinism really so horrible?

Intellectually, it seems to me that this biblical illiteracy is hardly more reprehensible than most contemporary physicists' ignorance of the details of astrology or nearly everyone's ignorance nowadays of Old Norse mythology. No one, after all, has the time or energy to become expert on all the implausible theories that might lay a claim on one's attention. And the mere fact that a theory is popular — as divinely revealed theism indubitably is[117] — does not provide, in and of itself, the slightest reason to believe it is true. When all is said and done, I see no reason to amend my judgment that the existence of the Jewish, Christian, Islamic or Hindu gods is about as plausible, given the currently available evidence, as the existence of Zeus or Thor.

Nevertheless, it is a serious liability *politically and socially* to be ignorant of those particular implausible theories that happen to be widely held in one's own society (or in the world). For how can one argue effectively

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the results of experiments that have *never yet been performed* — sometimes to extraordinary accuracy (see Chapter 7) — strongly suggests that our scientific theories must be correctly capturing *at least something* about the world. If "direct experience" of "spiritual reality" has some equally compelling argument in favor of its reliability, I would very much like to hear it.

[117] More than 4 billion people — about two-thirds of the world's population — identify themselves as Christians, Muslims or Hindus. By contrast, only about 900 million, or roughly 14% of the world's population, identify themselves as "nonreligious" or "atheists". See note 12 above.

against a system of ideas that one only superficially understands? For this reason alone, Berlinerblau's attempt to revitalize the secular public's biblical knowledge can only be applauded. One can furthermore hope that other scholars will step forward to give us *The Secular New Testament*, *The Secular Talmud*, *The Secular Qur'an* and *The Secular Hadith*, as Berlinerblau suggests.[118]

This tension between intellectual and socio-political criteria of evaluation recurs in many aspects of the analysis of religion. What, for instance, should be our attitude towards religious moderates and liberals? *Intellectually*, as Harris rightly points out, religious moderates put forward an epistemologically incoherent congeries of ideas, derived partly from evidence and partly from revelation, held together only by a sentimentality towards the faith of the forefathers that prevents those in its thrall from following the evidence to its atheist or at least agnostic conclusion.[119] Not a pretty sight, intellectually speaking — or so at least it seems to me — and certainly not a belief system that a fair-minded outsider could take seriously. And yet, *politically and socially*, religious moderates may be nothing less than the key to the survival of the human race in the twenty-first century. As Berlinerblau observes,

> That a scholar beholden to religious convictions could openly criticize the reigning interpretation of his or her own corpus of sacred Scripture and live to tell about it is, historically speaking, not an unremarkable feat. The ensuing routinization and institutionalization of this activity in the guise of twentieth-century biblical scholarship *is* a remarkable feat and it must be reckoned as one of the truly distinct (and I hasten to add, laudable) features of the modern Occident. For it has developed an eminently *functional* mechanism which effectively prevents particular social groups from channeling the word-and-thought-defying energy of this text into their arsenals of power. Unwittingly perhaps, modern biblical scholars — devout men and women from a variety of religious traditions who

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[118] Berlinerblau (2005, p. 12). Berlinerblau also seeks to revitalize secular biblical scholarship; he draws attention to the immense intellectual conflict of interest created by the fact that nearly all contemporary biblical scholars are (or at least once were) committed Christians or Jews (see Berlinerblau 2002 and 2005, pp. 138–139 for an incisive discussion; see also Wiebe 1999). Indeed, I would go farther than Berlinerblau and call this state of affairs an intellectual *scandal*: What would one think of a Classics department in which 95% of the professors believed in the Greek gods (even if they conceded that not all of the *Iliad* should be taken as the literal truth)?

[119] Or as Berlinerblau (2005, p. 132) puts it, with greater sympathy than I am able to muster, religious moderates "are true moderns, epistemologically fractured souls, grandchildren of the 'believing critics' " of the late nineteenth century.

> devote their lives to the study of a text that is the fount of their religious devotion — comprise an effective bulwark against facile and allegedly "literal" readings of a complex text which is nevertheless susceptible to such readings.[120]

The future of humanity may rest in part on whether this type of moderate religion, which took centuries to mature within Christianity and which even now is not guaranteed to remain forever dominant, can be constructed in the space of a few decades within Islam.[121,122]

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[120] Berlinerblau (2002, p. 299), italics in the original.

[121] Hari (2007) makes the intriguing suggestion that the dominant force for constructing this type of moderate Islam will come from Muslim *women* — particularly Muslim women in Europe — "rebelling ... against the literalist, quasi-fascist interpretation of the Koran popularized by the mullahs. Tired of being its first victims, they are creating their own liberal lived Islams as an alternative." (p. 127)

[122] The future of humanity will even more importantly depend, as Bricmont (2007) points out, on whether the West, and particularly the United States, can reduce its greed and its habit of interfering in the affairs of other nations — actions that fuel hatred and a desire for revenge, sometimes expressed through religion.

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10

Epilogue: Epistemology and ethics

> [You people] in what we call the reality-based community ... believe that solutions emerge from your judicious study of discernible reality. That's not the way the world really works anymore. We're an empire now, and when we act, we create our own reality.
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> — *A senior adviser to President Bush, summer 2002, quoted in Suskind (2004, p. 51)*

In this book I have been at pains to distinguish clearly between *factual* matters and *ethical* or *aesthetic* matters, because the epistemological issues they raise are so different. And I have restricted my discussion almost entirely to the former, simply because of the limitations of my own competence.

But if I am preoccupied by the relation between belief and evidence, it is not solely for intellectual reasons — not solely because I, like my friend Norm Levitt, am a "grumpy old fart who aspire[s] to the sullen joy of having it known that [I] don't suffer fools gladly".[1] Rather, my concern that belief (and public debate) be grounded in the best available evidence is, above all else, *ethical*.

The connection I have in mind between epistemology and ethics was brilliantly enunciated over a century ago by the English mathematician-philosopher William Clifford (1845–1879), in an essay entitled "The Ethics of Belief". Clifford asks the reader, in his inimitable Victorian prose, to imagine the following scenario:

> A shipowner was about to send to sea an emigrant-ship. He knew that she was old, and not over-well built at the first; that she had seen many seas and climes, and often had needed repairs. Doubts had been suggested

[1] Levitt (1996).

> to him that possibly she was not seaworthy. These doubts preyed upon his mind, and made him unhappy; he thought that perhaps he ought to have her thoroughly overhauled and refitted, even though this should put him to great expense. Before the ship sailed, however, he succeeded in overcoming these melancholy reflections. He said to himself that she had gone safely through so many voyages and weathered so many storms that it was idle to suppose she would not come safely home from this trip also. He would put his trust in Providence, which could hardly fail to protect all these unhappy families that were leaving their fatherland to seek for better times elsewhere. He would dismiss from his mind all ungenerous suspicions about the honesty of builders and contractors. In such ways he acquired a sincere and comfortable conviction that his vessel was thoroughly safe and seaworthy; he watched her departure with a light heart, and benevolent wishes for the success of the exiles in their strange new home that was to be; and he got his insurance-money when she went down in mid-ocean and told no tales.[2]

Clifford asks what we should think of this shipowner, and he answers in no uncertain terms:

> Surely this, that he was verily guilty of the death of those men. It is admitted that he did sincerely believe in the soundness of his ship; but the sincerity of his conviction can in no wise help him, because *he had no right to believe on such evidence as was before him.* He had acquired his belief not by honestly earning it in patient investigation, but by stifling his doubts. And although in the end he may have felt so sure about it that he could not think otherwise, yet inasmuch as he had knowingly and willingly worked himself into that frame of mind, he must be held responsible for it.[3]

Indeed, Clifford argues, even if the ship had been seaworthy after all, and had "made her voyage safely, and many others after it", the shipowner's guilt would be diminished "not one jot", for

> When an action is once done, it is right or wrong for ever; no accidental failure of its good or evil fruits can possibly alter that. The man would not

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[2] Clifford (1879, pp. 177–178). See also Kitcher (2005) for an interesting discussion.

[3] Clifford (1879, p. 178), italics in the original. Of course, "those men" should have been written as "those men *and women and children*", as Clifford was talking about emigrant *families*. It goes without saying that this sexist blindness on Clifford's part is irrelevant to the validity or invalidity of his philosophical argument.

> have been innocent, he would only have been not found out. The question of right or wrong has to do with the origin of his belief, not the matter of it; not what it was, but how he got it; not whether it turned out to be true or false, but whether he had a right to believe on such evidence as was before him.[4]

In this particular example, the unjustified belief gave rise to a dangerous action; perhaps, one might argue, it is only the subsequent action that should be criticized, not the underlying belief. Clifford disagrees (evidently overstating his case a bit):

> If a belief is not realized immediately in open deeds, it is stored up for the guidance of the future. It goes to make a part of that aggregate of beliefs which is the link between sensation and action at every moment of all our lives, and which is so organized and compacted together that no part of it can be isolated from the rest, but every new addition modifies the structure of the whole. No real belief, however trifling and fragmentary it may seem, is ever truly insignificant; it prepares us to receive more of its like, confirms those which resembled it before, and weakens others; and so gradually it lays a stealthy train in our inmost thoughts, which may some day explode into overt action, and leave its stamp upon our character for ever.[5]

Moreover, Clifford reminds us that beliefs are not merely private: they are shaped by and incorporated in the web of thoughts and ideas that a society inherits from previous generations and passes on, together with its own

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[4] Clifford (1879, p. 178).

[5] Clifford (1879, pp. 181–182). Clark (1990, p. 99) objects that "Surely the belief that my lawn has an even number of blades of grass has little impact on any of my actions". But Clark has overlooked Clifford's limitation to *real* beliefs, not contrived ones. If Clark *really and sincerely* believes that his lawn has an even number of blades of grass, given the evidence available to him (he admits not having counted all the blades), then we would rightly judge him *epistemically* deficient even if — to this extent he is right — not necessarily *morally* deficient. (Any sensible person would assign a subjective probability of approximately 50% to the proposition of blade-evenness of any sizable lawn, provided that he has not counted all or nearly all of the blades.) Indeed, it is hard to imagine that any person, other than a mentally ill one, would care enough to have a firm belief one way or the other about a lawn's blade-evenness. By contrast, if person X *really and sincerely* believes proposition P, then P becomes a part (albeit perhaps a minor part) of X's conceptual system and may potentially have an effect, direct or indirect, on X's subsequent actions. The moral danger posed by holding unjustified beliefs is, I think, a matter of degree, which needs to be judged on a case-by-case basis. Clifford is right in principle but has exaggerated the point for rhetorical purposes.

innovations, to its successors. "Into this, for good or ill," Clifford argues, "is woven every belief of every man who has speech of his fellows. An awful privilege, and an awful responsibility, that we should help to create the world in which posterity will live."[6] With democratic (by nineteenth-century standards) eloquence, Clifford insists that

> It is not only the leader of men, statesman, philosopher, or poet, that owes this bounden duty to mankind. Every rustic who delivers in the village alehouse his slow, infrequent sentences, may help to kill or keep alive the fatal superstitions which clog his race. Every hard-worked wife of an artisan may transmit to her children beliefs which shall knit society together, or rend it in pieces. No simplicity of mind, no obscurity of station, can escape the universal duty of questioning all that we believe.[7]

Nor is the harm caused by unjustified beliefs limited to their direct consequences in action. Indeed, the greatest social damage arises not from specific misguided beliefs, but from the proliferation of general habits of intellectual laziness, which "weaken our powers of self-control, of doubting, of judicially and fairly weighing evidence".[8] What is more,

> The harm which is done by credulity in a man is not confined to the fostering of a credulous character in others, and consequent support of false beliefs. Habitual want of care about what I believe leads to habitual want of care in others about the truth of what is told to me.... The credulous man is father to the liar and the cheat ...[9]

Clifford's essay has been widely perceived as a scathing critique of religion — though in fact he mentions religion only in passing, and then only (astutely for his Victorian audience) to explain why we ought not trust Muhammad's claim to have been visited by the angel Gabriel or the Buddha's ideas on cosmology. But it is not hard to understand why religious thinkers have felt themselves to be a target of Clifford's argument. Clifford's bottom line is that "it is wrong, always, everywhere, and for any one, to believe

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[6] Clifford (1879, p. 182).

[7] Clifford (1879, p. 183). In the final sentence, Clifford would have done better to write "being *prepared* to question anything that we believe, if legitimate doubts are raised about the solidity of the supporting evidence". Obviously it is a practical impossibility to simultaneously question *all* of our beliefs. I thank Helena Cronin for this observation.

[8] Clifford (1879, p. 185).

[9] Clifford (1879, p. 186).

anything upon insufficient evidence."[10,11] And what more obvious transgressor of this dictum than religion?[12,13]

The harm caused by belief based on insufficient evidence is by no means limited to contrived situations such as the one proposed by Clifford. Here, for instance, is a simple but overwhelmingly important real-life example of how epistemology impacts on ethics. The holy books of Judaism, Christianity and Islam all declare that women must obey their husbands (but not vice versa).[14] For those who take their sacred texts seriously, this is a divine

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[10] Clifford (1879, p. 186). Please note that Clifford does *not* insist that one must always have *personal* knowledge of the evidence bearing on one's beliefs — such a demand would be absurdly stringent, and would paralyze nearly all of our human activities. Indeed, Clifford devotes a lengthy discussion (pp. 188–205) to analyzing the conditions under which one may legitimately rely on another person's belief, concluding that "We may believe the statement of another person, when there is reasonable ground for supposing that he knows the matter of which he speaks, and that he is speaking the truth so far as he knows it." (pp. 210–211)

[11] Clifford's formulation has the defect of implying that there is an asymmetry between belief and non-belief, along with some sort of presumption that misguided belief in false propositions is a greater epistemic sin than misguided non-belief in true propositions. This is a tenable view, but it is debatable, and also a red herring. A better formulation, which acknowledges *degrees* of rational belief, is that of David Hume (2000 [1748], p. 84): "A wise man ... proportions his belief to the evidence."

[Note for experts: Bayesians might wish to formulate Hume's maxim more precisely as "A wise man assigns to each proposition the subjective probability that is warranted by the complete set of evidence available to him." But many philosophers have questioned whether "degree of rational warrant given the available evidence" has the formal properties associated with the probability calculus. For instance, I may have very little evidence one way or the other concerning proposition P; or alternatively I may have a large quantity of evidence which, however, is equivocal, confusing and partly contradictory. Epistemically these are quite different situations, even though in both cases, if forced to bet, I might assign a subjective probability of around 50% to P.]

[12] Officially, of course, theologians insist that their faith is a "conviction of the mind based on adequate evidence" (McGrath 2005, p. 86). But in their hearts they must know this is prattle: for if there really were adequate evidence, why would faith be needed at all? See also footnote 16 in Chapter 9 above.

[13] Clifford was in fact well known to his contemporaries as a freethinker and unbeliever. One historian offers the following delicious anecdote:

> It is memorable that in 1878, when Clifford was going abroad to die [of tuberculosis at age 33], there appeared a newspaper report that he, like Mr. W. H. Mallock, had been converted to Roman Catholicism. He at once replied that his doctor "had certified he was ill, but it was not mental derangement, and he gave flat contradiction". (Robertson 1929, p. 412)

[14] "[Y]our husband ... will rule over you." (Genesis 3:16)

"[W]ives, be submissive to your own husbands ..." (1 Peter 3:1)

"Wives, be subject to your husbands, as is fitting in the Lord." (Colossians 3:18)

"Wives, be subject to your own husbands, as to the Lord. For the husband is the head of the wife, as Christ also is the head of the church, He Himself being the Savior of the body. But as

commandment, which cannot be countermanded or evaded on the basis of mere human reasoning. But what if the religion's factual claims are erroneous? What if the purportedly divinely-authored text is in fact a human artifact?[15] Then half the human race is being oppressed for no good reason at all.[16,17]

It goes without saying that good ethics can coexist, most of the time, with bad epistemology.[18] Working in Nicaragua in the mid-1980s[19], I had the privilege of knowing many devout Christians — both Nicaraguan and North

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the church is subject to Christ, so also the wives ought to be to their husbands in everything." (Ephesians 5:22–24)

"Men are the protectors and maintainers of women, because Allah has given the one more (strength) than the other, and because they support them from their means. Therefore the righteous women are devoutly obedient, and guard in (the husband's) absence what Allah would have them guard. As to those women on whose part ye fear disloyalty and ill-conduct, admonish them (first), (next), refuse to share their beds, (and last) beat them (lightly); but if they return to obedience, seek not against them means (of annoyance) . . ." (Qur'an 4:34) Please note that the parenthetical words do not appear in all translations.

[15] Indeed, this is exactly what Jews claim about the Christian and Islamic holy books, and what Christians claim about the Islamic one, despite their agreement on the divine right of husbands.

[16] Of course, I am not so naive as to think that the male oppression of women arises *solely* from these (or other) sacred texts; obviously it has deeper sources. But sacred texts clearly do play *some role* in maintaining and legitimating the oppression of women in those societies where religion is taken seriously.

[17] Here is another, more fanciful, example of the harm caused by inadequate epistemology. Suppose that the leader of a militarily powerful country believes, sincerely but erroneously, on the basis of flawed "intelligence", that a smaller country possesses threatening weapons of mass destruction; and suppose further that he launches a preemptive war on that basis, killing tens of thousands of innocent civilians as "collateral damage". Aren't he and his supporters *ethically* culpable for their epistemic sloppiness? (I stress that this example is fanciful. All the available evidence suggests that the Bush administration *first* decided to overthrow Saddam Hussein, and *then* sought a publicly presentable pretext, using dubious or even forged "intelligence" to "justify" that pretext. See e.g. Prados (2004), Miller (2006, chapter I) or Rich (2006) for documentation.)

[18] And it also goes without saying that good epistemology can coexist with bad ethics, as generations of military scientists and technologists have demonstrated.

[19] For those who may not remember: In 1979 a popular insurrection led by the Sandinista National Liberation Front (FSLN) — a leftist movement inspired by an amalgam of Marxism and liberation-theology Christianity — overthrew the 43-year Somoza family dictatorship. The FSLN-led government redistributed land to peasants (both individual families and cooperatives) and initiated ambitious literacy and health-care programs. In 1984 the first free multiparty elections in Nicaragua's history were held, which the FSLN won with 67% of the vote; international observers judged the elections to have been free and generally (albeit imperfectly) fair. Starting in 1981, the U.S. government under President Reagan began to finance

American, mostly Catholic but also evangelical Protestant — whose active solidarity with the poor and downtrodden was inspired by their interpretation of Jesus' teachings. In the face of such exemplary dedication and selfless labor, it would have been churlish of me to draw attention to the irrationality of my friends' supernatural beliefs. Moreover, I had great admiration for those brave Nicaraguans who were ready to risk their lives to protect their fellow citizens from U.S.-organized terrorists; and I realized that in many (but not all) cases, that bravery was bolstered in part by a Christian belief in the afterlife. Of course I thought that belief a delusion, but this in no way lessened my admiration, for I knew that I personally would be much less brave.

Times have changed, and I am no longer as willing to tolerate the irrationality of religion as I was 20 years ago. Religious people continue, of course, to do innumerable good deeds, but the intolerant face of religion — Christian, Jewish, Muslim and Hindu — is manifestly on the ascendancy

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and train a counterrevolutionary army (*contras*) whose principal mission was to sow terror in isolated rural areas, murdering teachers, health-care workers and members of peasant cooperatives and committing economic sabotage. In 1986 the International Court of Justice ruled (by votes of 12–3 and 14–1) that the U.S. government had violated both international law and its Treaty of Friendship with Nicaragua by organizing the *contra* army, attacking Nicaraguan territory, and mining Nicaraguan harbors; the U.S. was ordered to cease the illegal activities and pay reparations for the damage caused. (This ruling was simply ignored by the U.S. government, which continued to support the *contras*; but no international sanctions were ever adopted against this "rogue state", nor was a "coalition of the willing" assembled to force "regime change" in Washington.) Between 1981 and 1990, approximately 30,000 Nicaraguan civilians and combatants died in the violence and more than 600,000 were uprooted (Armony 1997, p. 207) — about 1% and 17%, respectively, of the total Nicaraguan population of 3.5 million, or the equivalent of 2.5 million killed and 50 million made homeless in the present-day U.S. population. In the 1990 presidential election, Nicaraguans — exhausted by a decade of war and rampant inflation, exacerbated by the Sandinistas' economic missteps — voted by 54%–41% to remove the FSLN from power. Right-wing parties governed Nicaragua until a much-tamed FSLN won the 2006 presidential election. For a balanced account of these developments — generally sympathetic to the Sandinistas' goals but critical of some of their policies — see Vanden and Prevost (1993). For a fascinating analysis of poll data from the 1990, 1996 and 2001 elections — aiming to understand why a majority of impoverished Nicaraguans voted for right-wing parties against the FSLN — see Anderson and Dodd (2005).

In the summers of 1986, 1987 and 1988 I taught mathematics, for about six weeks each year, as a volunteer professor at the National University of Nicaragua (UNAN) in Managua. It goes without saying that my minor contribution pales in comparison to that of the brave foreign volunteers who worked in the rural areas — people like engineer Benjamin Linder (1959–1987), whose effort to bring electricity and running water to the village of San José de Bocay was cut short by a bullet paid for by his and our tax dollars — not to mention that of the Nicaraguans themselves.

worldwide. The factual doctrines of Christianity and Islam are not a whit more (or less) irrational today than those same doctrines were two decades ago[20], but it has today become vastly more urgent that we think and speak clearly, without deference or euphemism. As Richard Dawkins eloquently observes,

> To label people as death-deserving enemies because of disagreements about real world politics is bad enough. To do the same for disagreements about a delusional world inhabited by archangels, demons and imaginary friends is ludicrously tragic.[21]

All of us are understandably reluctant to give offense to our fellows, especially concerning their most cherished beliefs; and in personal interactions this self-restraint is generally a sound instinct. But public debate is

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[20] Of course, the degree of rationality (or irrationality) of any belief is always relative to some specified body of evidence; and the available evidence can and does change (usually, grow) over time. Some beliefs that were plausible 200 years ago — for instance, that matter is continuous rather than atomic, that the earth is less than a million years old, or that homeopathy is an effective system of medicine — have today become irrational, thanks to the growth of our scientific knowledge. Conversely, some beliefs that seemed implausible then — e.g. that clocks slow down when they move at speeds close to the speed of light — are now empirically established beyond any reasonable doubt. Suffice it to say that there has been no significant change, over the past 20 years, in the evidence bearing on the irrationality of Christianity, Islam and other religions.

[21] Dawkins (2003, p. 188). Dawkins also responds to the predictable objection that he is naive about the political origins of inter-religious conflicts:

> How can I say that religion is to blame? Do I really imagine that when a terrorist kills, he is motivated by a theological disagreement with his victim? Do I really think the Northern Ireland pub bomber says to himself, 'Take that, Tridentine Transubstantiationist bastards!' Of course I don't think anything of the kind. Theology is the last thing on the minds of such people. They are not killing because of religion, but because of political grievances, often justified. They are killing because the other lot killed their fathers. Or because the other lot drove their great grandfathers off their land. Or because the other lot oppressed our lot economically for centuries.
>
> My point is not that religion itself is the motivation for wars, murders and terrorist attacks, but that religion is the principal *label*, and the most dangerous one, by which a 'they' as opposed to a 'we' can be identified at all. I am not even claiming that religion is the *only* label by which we identify the victims of our prejudice. There's also skin colour, language and social class. But often, as in Northern Ireland, these don't apply and religion is the only divisive label around. Even when it is not alone, religion is nearly always an incendiary ingredient in the mix as well. (pp. 186–187, italics in the original)

impoverished and distorted by our culture's deferent attitude toward "faith". After all, conservatives are not ordinarily offended by the obligation to debate their ideas with liberals (though in recent years this seems, alas, to be changing[22]); and most capitalists can even tolerate the occasional encounter with a socialist. Nor would we consider it acceptable for them, in such debates, to offer the argument "because Adam Smith said so": we would demand to know the details of *why* they contend, for instance, that private health insurance is more efficient than the state-sponsored alternative; the fact that their preferred policy was endorsed by an illustrious predecessor would be understood to be utterly irrelevant. Why, then, should it be acceptable to cite the Bible or the Qur'an as support when debating homosexuality, abortion, capital punishment, or the international borders in Palestine? (Or, for that matter, peace and justice.) There can be one and only one legitimate reason: namely, if the Bible or the Qur'an *really is* a book of sacred precepts dictated by the Creator of the Universe.[23] But if that is the argument, then we need to hear the *evidence* that the speaker's favorite book is in fact the Word of God, while the other fellow's purportedly holy text is a mere imposter.

The free ride given to "faith" is so deeply imbued in our culture — so taken for granted — that even critical voices often end up committing the very errors they decry.[24] For instance, the American scholar of religion Mark C. Taylor, in the course of a thoughtful critique of "religious correctness", nevertheless felt obliged to reassure his readers that

> The aim of critical analysis [of religion] is not to pass judgment on religious beliefs and practices — though some secular dogmatists wrongly cross that line — but to examine the conditions necessary for their formation and to consider the many functions they serve.[25]

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[22] See Coulter (2004), Hannity (2005) and Savage (2005), among many other recent books in the same genre.

[23] Here I have been a bit too fast: There is nothing wrong with citing the Bible or the Qur'an to remind one's listeners of universal moral values that can also be defended on secular grounds, *provided that* it is remembered that such allusions to religious texts have *no probative value whatsoever* (any more than a citation of Adam Smith or Karl Marx would). Unfortunately, this caveat is frequently forgotten by people on the Left as well as the Right, who want to take advantage of their listeners' belief in "holy" texts when it suits them politically.

[24] Indeed, as Helena Cronin has pointed out to me, I myself have committed precisely such an error in the first sentence of the preceding paragraph, by praising "self-restraint" but failing to note that it is in practice decidedly unidirectional. "I haven't noticed much self-restraint from religious people in peddling their views in front of non-religious people, even when those views are blatantly offensive", Helena rightly notes.

[25] Taylor (2006).

But why should anyone accept such an arbitrary limitation on the aims of "critical analysis"? Substitute "scientific", "philosophical", "economic" or "political" for "religious" in that sentence, and the double standard becomes patent. In every other sphere of life, beliefs and practices are subjected not only to descriptive analysis but also to evaluative judgment — and rightly so. When analyzing a scientific or philosophical theory, we do not merely ask how it arose historically or what functions it serves; we also assess the cogency of the logical and empirical arguments offered for and against it. Likewise with economic or political systems: we analyze how they arise and how they function, but we *also* judge them according to criteria of efficiency, stability and fairness. Why, of all things, should the class of ideas *least* supported by evidence be granted some special immunity? On the contrary, it seems to me that *all* ideas, without exception, must be subjected to rigorous critique, with special privileges for none. If that insistence makes me a "secular dogmatist", then I proudly plead guilty. (But it goes without saying that this attitude is, in reality, the exact opposite of dogmatism.)[26]

Religion is not, of course, the only social force elevating dogma over the rational analysis of evidence, though it is the most blatant and shameless in so doing. Economic, environmental and foreign-policy doctrines can all become so fossilized in conventional wisdom that their evidentiary basis, shaky or solid, is forgotten. Nationalism, often though not always conjoined to religion — as in the United States, where Americans frequently see their country as entrusted with a God-given mission to spread righteousness throughout the world — further undermines people's ability to think clearly and dispassionately. Knowing the limitations of my own expertise, I prefer not to burden the reader with my half-baked opinions on the details of these

[26] It is curious that, while epithets like "secular dogmatist" (or "Enlightenment fundamentalist") are frequently used to stigmatize people like Dawkins, Weinberg and myself who reject our culture's double standard for religion, rarely does the author using this epithet give any precise definition of this purported error, much less any evidence that the people in question have committed it. *Rhetorically*, the category of "secular dogmatist" manifestly functions as a mirror image of "religious dogmatist", thereby allowing the writer to present himself as a moderate who avoids "both extremes". But *intellectually* this maneuver is empty, absent a more precise analysis.

and related issues; suffice it to say that such details, and the evidence behind them, are the heart of the matter.

The epigraph to this book, from Chilean folk singer Violeta Parra (1917–1967),

> I sing of the difference between what is true and what is false. Otherwise I do not sing.

is, alas, ambiguous.[27] On one reading it could be endorsed by true believers of all stripes — Christian or Muslim, Marxist or Chicago School — who think they know the truth and (naturally enough) want to proclaim it far and wide. But on another reading — the one I advocate — this motto simply underlines the importance of making a clear *distinction* between truth and falsity, without yet purporting to label particular statements as true or false. It is thus a defense of intellectual honesty, conceived as an *ethical* value: namely, the value of sincere truth-seeking, as embodied in patient and careful inquiry, attentiveness to evidence (especially evidence that challenges our preconceptions), and openness to reasoned criticism. It is a rejection of the types of pseudo-inquiry that philosopher Susan Haack terms "sham reasoning" (making a case for some proposition to which one is already unbudgingly committed) and "fake reasoning" (making a case for some proposition concerning whose truth one is indifferent, but which might be useful e.g. for self-advancement).[28,29] And it is, above all, an implicit critique of propagandists, spin doctors, and postmodernists — all of whom, in their different ways, really do not care about the difference between what is true and what is false.

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[27] This line comes from the first verse of Violeta Parra's *Yo canto la diferencia* (1960): a song that acerbically juxtaposes generals, politicians and vicars celebrating the Day of National Independence with their elegies to freedom, to a homeless woman giving birth under the moonlight "without a candle or a diaper". The full Spanish text can be found (in several variants) in Parra and Alcalde (1975, pp. 123–124) or Torres Alvarado (2004, anexo 1) or at various places on the web. A wonderful recording of Violeta Parra singing *Yo canto la diferencia* can be found at `http://setiweb.ssl.berkeley.edu/~davea/nueva_cancion.php`

[28] Haack (1998, pp. 8–9). The phrase "sham reasoning" goes back to C.S. Peirce (1965 [c. 1896], pp. 25–26, paragraphs 57–58).

[29] The Bush administration's case in 2001–03 for invading Iraq provides an interesting composite situation: the proximal proposition ("Saddam Hussein possesses weapons of mass destruction") is supported by fake (when not simply fraudulent) reasoning, while the ultimate proposition ("the United States should invade Iraq") is supported in part by sham reasoning and in part by genuine reasoning based on publicly undeclared (and undeclarable) goals. See footnote 17 above.

Of course, honest inquirers can also have beliefs — albeit tentative and revisable ones — as a result of the inquiries already carried out. I believe that matter is made of atoms, that biological species have evolved, and that much American foreign policy is immoral. Furthermore, I think I have good reasons to hold these beliefs, and I would be happy to explain those reasons to anyone who will listen — and, it goes without saying, to listen to reasoned counterarguments.[30]

This plea for sincere inquiry and honest debate may, I must acknowledge, be whistling in the wind. Powerful economic and political forces are acting strongly to *prevent* a forthright public debate over our species' current predicaments and the true range of policy options for addressing them.[31] And the craving for comforting superstition may be too deeply entrenched in the human psyche to be dislodgeable by mere evidence.[32] Still, it would be wrong to be too pessimistic about the social efficacy of human reason. We no longer (most of us, anyway) believe in burning witches, torturing heretics, or enslaving other human beings; and this, from the long view of human history, constitutes genuine epistemic and ethical progress in an extraordinarily short lapse of time (a mere few centuries). Will the human race grow up fast enough to save itself from catastrophic climatic change and technologically-facilitated mass murder? And can this be done while deepening democratic participation and human rights rather than sliding slowly into "fascism lite"? The answer, which is at present unknown, will depend on the decisions to be taken by all of us.

I am grateful to Helena Cronin for many helpful comments on a draft of this chapter. I also wish to thank Michael Albert, Jonathan Fox, Russell Jacoby and Mark Crispin Miller for bibliographic suggestions.

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[30] Of course, I recognize that the arguments for the third proposition are far less conclusive than those for the first two.

[31] For lack of space and competence, I refrain from discussing or demonstrating this crucial point in detail. For illustration of the dumbing-down of political discourse in recent decades — and analysis of the vested interests that are served, consciously or not, by this infantilization of public life — see (from a variety of points of view, and with varying levels of scholarly rigor) McChesney (1999), Frank (2000), Bagdikian (2004), Rich (2006) and Gore (2007).

[32] It would, however, be wrong to conclude prematurely that this *is* the case. Quite simply, the scientific study of religion and the psychology of religious belief is in its infancy; we do not yet know what the human mind is and is not capable of. Indeed, recent research in the anthropology and psychology of religion does *not* support the idea that "comfort" is the principal driving element behind religious belief. For an overview of the current state of understanding about the psychology of religion, see Boyer (2001) and Atran (2002).

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