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MAKING NATURAL KNOWLEDGE

Constructivism and the History of Science

In *Making Natural Knowledge: Constructivism and the History of Science*, Jan Golinski reviews recent writing on the history of science and shows how it has been dramatically reshaped by a new understanding of science itself. In the last few years, scientific knowledge has come to be seen as a product of human culture, an approach that has challenged the tradition of the history of science as a story of steady and autonomous progress. New topics have emerged in historical research, including: the identity of the scientist, the importance of the laboratory, the roles of language and instruments, and the connections with other realms of culture and society. Golinski has written a sympathetic but critical survey of this exciting field of research, at a level that can be appreciated by students or anyone else who wants an introduction to contemporary thinking about the development of the sciences.

Jan Golinski is Associate Professor of History and Humanities at the University of New Hampshire, where he teaches the history of European science since the Renaissance. He has also held visiting appointments at Churchill College, Cambridge University, and Princeton University. He is the author of *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760–1820* (Cambridge University Press, 1992) and of many articles on the history of science. His current work includes editing (with William Clark and Simon Schaffer) a collection of essays on *The Sciences in Enlightened Europe* and investigating the cultural history of weather in the eighteenth century.

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Preface

This is a book of uncertain genre, which seems to call for more than the usual amount of prefatory explanation. What follows is a kind of extended historiographical essay, a review of recent writing about the history of the sciences. It is not, however, a comprehensive survey; rather, it is selective and written from a clearly defined point of view. My aim is to explore the implications of what I have called a "constructivist" view of science for the question of how its history is to be written. By a "constructivist" outlook, I mean that which regards scientific knowledge primarily as a human product, made with locally situated cultural and material resources, rather than as simply the revelation of a pre-given order of nature. This view of science has attained widespread currency in recent years, although expressed in a variety of different idioms with varying degrees of explicitness. For historians, as for others, it brings in its train a series of questions: What does such an outlook imply for the history of the sciences? What issues does it open up for historical investigation? What new sources does it suggest historians might be able to use? What questions are posed to history by the constructivist perspective, and in what ways might historical research illuminate, extend, or challenge it?

In proposing answers to these questions, I shall give an avowedly partial survey of recent historical work, choosing to emphasize those studies that seem to draw strength from – or to develop implications of – "constructivism." I shall argue that identification of this theme provides a way to draw together much (though not by any means all) of what historians of science have been doing in the last few years. To make the general tendency explicit helps us to make sense of what has been done and point out directions in which we might go from here. My orientation toward this program is sympathetic, but not entirely uncritical. I shall point out ways in which some of its foundational claims have been questioned, and original approaches modified, as the work has unfolded. It should nonetheless be clear that I think constructivism is worthy of serious attention from those who are interested in the history of

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the sciences, and that historical study has contributed, and can contribute further, to its development.

Within the limits of my project, I have tried to be flexible in my choice of historical research that can be shown to be relevant to it. Some of the authors whose work I have mentioned may not share my view of their location in the current historiographical landscape. Other mappings of the field would certainly be possible. The value of the view I offer has to be judged by its utility. I have sketched a review of recent historical research that tries to bring into focus some of the most imaginative work of the last few years and to chart a path ahead. In thinking of those who might profit from reading the pages that follow, I have aimed to make them accessible, say, to senior undergraduates who have already studied a little history of science and want to undertake more advanced work. For graduate students in the subject, I offer a guide to some important recent research and a scheme for making sense of its overall direction. It is not, of course, a substitute for study of the monographs and journal articles themselves, but it will help students locate studies that pursue certain methodological themes, and make use of them. I believe the book can serve the same purpose for academic readers in other disciplines, such as general history, philosophy, sociology, anthropology, literary studies, and cultural studies. Readers with a limited amount of time to devote to the history of science will, I hope, be persuaded that they can learn something valuable in relation to their own concerns. Finally, for practitioners of the history of science itself, I offer an opportunity to pause for reflection, to lift our eyes from our immediate research preoccupations and think about where our subject is going. Not everyone will agree with my view about this – perhaps nobody will agree about everything – but we can benefit, I think, from some discussion of these general issues.

I have chosen to trace the roots of the constructivist outlook to the philosophical arguments of the 1960s and 1970s, surrounding Thomas Kuhn's work and that of the succeeding "Strong Programme" and the "sociology of scientific knowledge." As I shall explain in the Introduction and in Chapter 1, I see the significance of this work as lying in its break with the project of epistemological validation of scientific knowledge – a break that brought in its train a series of novel techniques for the study of science as an aspect of human culture. I propose, in other words, that the uncoupling of historical and sociological inquiry from issues of truth, or realism, or objectivity opened the way to a remarkably productive period in the understanding of science as a human enterprise. Historians, and the others now involved in the interdisciplinary field of "science studies," continue to have reason to be grateful to those who took that step.

Notwithstanding my view of this, I should make it clear that what

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follows is not a *defense* of constructivism, in philosophical or sociological terms. I am more concerned to see how the constructivist approach can be put to work than to engage in a debate about it on an abstract level. There are, however, a number of very able defenses available, some of which can also serve as introductions to the constructivist outlook. (See, for example, the works of Barnes 1985a; Bloor 1976/1991; Collins and Pinch 1993; Knorr-Cetina and Mulkay 1983; Latour 1987; Mulkay 1979; Pickering 1992, 1995a; Rouse 1987, 1996; and Woolgar, 1988a.) Rather than reiterating philosophical arguments here, I argue implicitly that the best justification of an approach is to show that it can be used productively to generate new knowledge and to deepen understanding. It is nonetheless the case that, in choosing to give serious attention to constructivism, and in ascribing some importance to it in relation to historical understanding of the sciences, I am distancing myself from the recent conservative denunciations of its "fashionable relativism" (Gross and Levitt 1994; cf. Fuller 1995; Lewontin 1995), and even from the more measured discussions that have perpetuated what I believe is a misreading of it as the parent of a postmodernist challenge to the legitimacy of science (Appleby, Hunt, and Jacob 1994). I do not identify the constructivist outlook with a generalized relativism, if by that is meant a determination that all claims to knowledge *are to be judged equally valid*. As I explain in Chapter 1, I take constructivism to be based, rather, on a degree of methodological relativism, which stipulates that all forms of knowledge should be *understood in the same manner* – which is not the same thing.

Many of the sociological and philosophical books on constructivism make use of examples drawn from the research of historians (most recently, Barnes, Bloor, and Henry 1996). This is the first one to reverse the traffic and to explore the implications of the constructivist perspective for historical studies (though Dominique Pestre's recent article in the journal *Annales* [1995] follows a path very close to mine). Looking at it in this connection helps us to see how the program has been articulated and modified by engagement with the specific problems historians face in their work. Rather than portraying history as simply sociological theory put into practice, this account shows how historians have qualified theoretical schemes to accommodate empirical findings that are always more complex than theorists would wish. In the course of this dialectic, the abstract formulations with which constructivism began have been replaced by a more subtle awareness of the complexities of the sciences as creations of human culture. The reader will observe repeatedly, in the chapters that follow, a trajectory that leads from abstract formulations by sociologists and philosophers to the empirically richer and more nuanced accounts of historians. I offer this narrative thread as a reflection of my own experience of the last two decades' work in empirical study

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of the sciences. My argument is not an antitheoretical one, however. On the contrary, I insist that the course of recent research cannot be understood without acknowledging the critical and continuing importance of theoretical articulations of constructivism. If I had not been convinced of this, I would not have written the book in the way I have.

In tracing the progress of a dialogue between empirical research and theoretical interpretation, I have ended up writing an unusually long essay in historiography. I have however tried to avoid the tendency, sometimes found in that kind of writing, to lay down the law about what is good and what is bad history. I have also tried to avoid the tone of a manifesto or a call to arms. Neither negative criticism nor a programmatic clarion call seems to be necessary, given the wealth of good historical work of the last couple of decades which I have been able to draw upon for examples of concrete achievements. We can take pride, I believe, in what has been accomplished and look with optimism to the future.

Quite early in my thinking about this book, I decided that I could not write a survey, organized along chronological or geographical lines, of the historical picture that has emerged from constructivist studies. Instead, each chapter is organized around a theme that connects historical research with other varieties of science studies. The Introduction and Chapter 1 trace the origins and development of constructivism and outline some of the debates that have characterized its history. Chapter 2 develops the theme of the social dimension of scientific life, which has been brought under renewed scrutiny by constructivism. I describe work on the formation of the identity of the scientific practitioner in early-modern Europe, and on the creation of new disciplinary structures in the so-called second scientific revolution of the late eighteenth and early nineteenth centuries. In Chapter 3, I consider the issue of the locations in which scientific knowledge is produced. I describe work on laboratories, in which materials, instruments, and human skills are concentrated and put to use, and on the fieldwork sciences, which deploy their resources across much more extensive spaces. Chapter 4 looks at science as a linguistic activity, embodied in a variety of different kinds of discourse, from lectures and grant proposals to research papers and textbooks. I discuss how we can understand scientists' use of language as an activity that involves both persuasion and the making of meaning. In Chapter 5, we shall see that the study of science as a practical activity also involves taking seriously the way material resources are used to create knowledge. Two aspects of laboratory work emerge as crucial in this respect: the manipulation of apparatus and practices of visual representation. Chapter 6 moves beyond the laboratory to consider the means by which scientific knowledge acquires authority in general cul-

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ture, and the implications this has for our understanding of what "culture" is. In this connection, constructivist studies have emphasized the material means by which verbal and visual representations are transported across time and space. The final Coda tackles the question of the responsibilities of constructivism as a form of historical narrative. I consider what forms of writing constructivist history of science might produce, and what the prospects might be for relations with its potential audiences.

Having organized the book thematically, I have drawn for historical examples upon studies that are concentrated in my own areas of competence. The biases and limitations revealed by my choices will be readily apparent to knowledgeable readers. My own scholarly research has been on the sciences of the "long eighteenth century," particularly in Britain. My knowledge of more modern physical and biological sciences is much less comprehensive. And I am quite unable to address the question of how constructivist perspectives could affect our understanding of natural knowledge in the premodern or non-Western worlds. In other respects, my choices of historical research to discuss have been even more arbitrary. I am well aware that there is much relevant work that I have not been able to incorporate, either because of my ignorance or because I did not see how to do justice to it within the small compass and limited number of themes I had chosen. I apologize to authors who may feel slighted in this respect, and (even more) to those who think their work has been misrepresented by my treatment of it.

My most substantial debt of gratitude is to the many colleagues, in the various fields of science studies, from whose work I have learned. For most, a reference in the Bibliography is a scarcely adequate acknowledgment of my indebtedness. I would just add that I feel privileged to have been a witness of the intellectual excitement that has characterized this field in the last two decades.

This book originated in a happy coincidence of my own ideas and those of John Kim, when he was working at Cambridge University Press. After John's departure, Frank Smith and Alex Holzman at the Press continued the encouragement. Owen Hannaway and George Basalla have been most supportive series editors.

The work was begun during my period as a visiting assistant professor at Princeton University, in the spring of 1992. I owe a particular debt to Norton Wise and the other faculty and students in the History of Science Program for their friendly advice.

Just when I was wondering if I would ever have time to write the book, the Dibner Institute for the History of Science and Technology at MIT came forward with a very welcome offer of a resident fellowship in the spring of 1994. I am most grateful to Jed Buchwald, Evelyn Simha,

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the institute staff, and the other resident fellows, for making my time at the Dibner so profitable.

At my home institution, the University of New Hampshire, colleagues in many departments have fostered and sustained my interdisciplinary interests. Those in the History Department have helped me anchor them firmly in a commitment to historical scholarship, while also giving me the sense of intellectual freedom to undertake a project like this.

Peter Dear, Simon Schaffer, Jim Secord, Steven Shapin, and Roger Smith deserve special thanks for their careful readings of the manuscript and their very helpful comments.

Many colleagues have aided me by sharing their work, by commenting on mine, or just by illuminating conversation. In addition to those mentioned above, I can recall particularly helpful discussions with Mario Biagioli, Jed Buchwald, Harry Collins, Steve Fuller, Dominique Pestre, Larry Prelli, Anne Secord, Miriam Solomon, Maria Trumpler, and Andrew Warwick. No doubt there were others. Anne Harrington, Everett Mendelsohn, and Sam Schweber invited me to participate in seminars at Harvard that were good-humored and very productive. Earlier versions of parts of the book were also presented to audiences at the Boston Colloquium for Philosophy of Science, and at the Dibner Institute. I thank those who commented or asked questions on either occasion, especially Evelyn Fox Keller. I am also grateful to the following for sharing their work with me in advance of publication: Pnina Abir-Am, Jon Agar, Mario Biagioli, Harry Collins, Michael Dennis, Sophie Forgan, Steve Fuller, Graeme Gooday, Dominique Pestre, John Pickstone, Hans-Jörg Rheinberger, Simon Schaffer, Steven Shapin, and Mary Terrall. None of these people should be held responsible for what I have made of their work or their advice.

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