The Golem: what you should know about science

The Golem

what you should know about science

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To the memory of

SIDNEY COLLINS

and

for JOAN PINCH

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Preface to second edition

The Golem has attracted many reviews and much comment. In particular, the chapter on the foundation of relativity has given rise to a long debate which included a three-day workshop in which scientists, historians and sociologists met to discuss the history of relativity and its significance for *The Golem*. What we learned from the criticisms and the discussions has been incorporated in this new edition.

There is no doubt that, from the scientists' point of view, the original text had its faults. We have corrected these and all such changes are detailed at the end of the new Afterword. The main text has probably changed less than our scientist critics would have liked and the larger part of the Afterword is taken up with explaining why: We examine each serious criticism, either accepting it and making a change or putting the sociologist/historian's point of view. We have found the discussions enormously to our benefit even where the scientists and ourselves were unable to reach agreement.

From our point of view, one of the greatest benefits of writing *The Golem* has been the discovery that scientists and social scientists can discuss the issues in a register more familiar to academics than to religious zealots. As a result each of us has been able to learn from the other though this does not mean we agree about everything.

The new Afterword is a little more technical than the main body of the book but we recommend it to those with a special interest in the debates that have taken place in recent years between scientists and social scientists or in the foundations of relativity.

For the work and comments which led to the existence of this new edition and new Afterword we thank the scientists Kurt Gottfried and David Mermin, and the social scientists and historians Clark Glymour, Arkady Plotnitsky, Simon Schaffer and Richard Staley. Klaus Hentschel and Skuli Sigurdsson were also involved at one remove. Neverthless, in so far as the new edition still contains mistakes and infelicities, responsibility cannot be assigned to the above named.

Finally, we have changed our sub-title. The original sub-title was 'What everyone should know about science', but much of the criticism seemed to be directed at a book which we did not write called 'Everything everyone should know about science'. We have said many times that we are concerned with the sub-set of controversial science because it fulfils a special role, and that is why we do not go on about what science has or has not contributed to the personal computer or the aeroplane at 30,000 feet. We do not think the book suffers unduly from this omission because there are already dozens of articles, speeches and books produced every year that set out the benefits of day-to-day science. We have also repeated that we see our book as mainly of benefit to the citizen and the novice, not the experienced scientist at the research front, but this is another message that has not been heard. Therefore we have changed the sub-title to the less general 'What you should know about science'; it means the same thing but it sounds less inclusive.

We might also mention that Cambridge University Press has just published a second volume of the series under the title *The Golem at Large: What You Should Know about Technology*. That volume discusses the science and technology that comes directly to public attention, from the Patriot missile in the Gulf War to cures for AIDS.

Cardiff University
Cornell University
Autumn 1997

Preface to first Canto edition

In the short time since *The Golem* was first published, it has received a number of reviews. This gives us the opportunity to clear up a source of misunderstanding. *The Golem* is not meant to be statistically representative of the ordinary science that is done every day in laboratories throughout the world. On the contrary, most science is uncontroversial. Thus, as an introduction to the day-to-day world of science *for scientists*, the book would be misleading; the average scientist would be lucky indeed (or unlucky!) to be personally involved in the kind of excitement represented here. In spite of this, as we suggest, citizens *as citizens* need understand only controversial science. One reviewer argues: 'it is quite easy to think of political decisions with a scientific side to them where the science is non-controversial' and offers as an example the effect on medical institutions of the development of a predictive test for Huntingdon's disease. But if the science is non-controversial, why do those running the medical institutions need to understand the deep nature of the science that gave rise to the results? If the test is uncontroversially valid they can make their decisions without understanding how agreement about the test was reached. Thus, while thanking our reviewers for the many generous comments about the importance, the informativeness, and they style of the book, we stand by our claim that 'For citizens who want to take part in the democratic processes of a technological society, all the science they need to know about is

controversial.' For this purpose, *The Golem* represents science properly.

Although the book is primarily aimed at the citizen, there are, as we explain in the text, perhaps, three lessons for scientists *as scientists* to take from *The Golem*. Firstly, the beginning researcher, such as the doctoral student, should be prepared for the untidiness of experiment revealed in these pages; that is a universal phenomenon. Secondly, those who may be put off a scientific career because of its cold, impersonal, automaton-like, precision, may take comfort in the discovery that it has a warm, everyday, exciting, argumentative aspect, just like the arts or social sciences. Thirdly, there is an unfortunate tendency these days for scientists writing for a popular audience to compare themselves and their subject with God. The final lesson is that science is less of a God more of a golem.

Bath University
Cornell University
January 1994

Preface and acknowledgements

This book is for the general reader who wants to know how science really works and to know how much authority to grant to experts; it is for the student studying science at school or university; and it is for those at the very beginning of a course in the history, philosophy or sociology of science. In sum, the book is for the citizen living in a technological society. The book adapts the work of professional historians and sociologists for a more general audience. The chapters are of different origins. Some are based on our own work and some on our readings of a selection of the few books and papers in the history and sociology of science that adopt a non-retrospective approach. In these later cases we have relied on the original authors for additional information, and have had occasional resource to archival material. In choosing chapters to represent science we have been limited by the materials to hand. But, given this constraint, we have covered the ground in two ways. We have selected from the life sciences and the physical sciences and we have selected episodes of famous science alongside relatively mundane science and what some would call bad science. We have done this because we want to show that, in terms of our concerns, the science is the same whether it is famous or infamous, big or small, foundational or ephemeral.

Chapter 5 on gravity waves and chapter 7 on solar neutrinos are based on our own original field studies in the sociology of scientific knowledge. The quotations included in these chapters, where not otherwise referenced, are taken from interviews conducted by us with

the principal scientists in the areas in question. The interviews concerning the search for gravitational radiation were conducted by Collins between 1972 and 1975. Pinch interviewed solar neutrino scientists in the second half of the 1970s. More complete accounts of this work have been published in other places, notably, Collins' book, *Changing Order: Replication and Induction in Scientific Practice*, and Pinch's book, *Confronting Nature: The Sociology of Solar-Neutrino Detection*.

Chapter 1, on memory transfer, is based on a PhD thesis entitled 'Memories and Molecules' by David Travis, completed with Collins at the University of Bath. Travis was able to read and comment in detail on earlier drafts of the chapter.

The remaining chapters rest on our use of less direct sources of evidence. Chapter 3 on cold fusion is based on Pinch's readings of two books: Frank Close, *Too Hot to Handle: The Race for Cold Fusion* and Eugene Mallove, *Fire From Ice: Searching for the Truth Behind The Cold Fusion Furore*. Pinch also used Thomas Gieryn's paper, 'The Ballad of Pons and Fleischmann: Experiment and Narrative in the (Un)Making of Cold Fusion' and Bruce Lewenstein's paper, 'Cold Fusion and Hot History', and the Cold Fusion Archives held at Cornell University.

For chapter 2 Collins used Loyd Swenson's book, *The Ethereal Aether: A History of the Michelson–Morley–Miller Aether-Drift Experiments, 1880–1930*, and a series of papers. These included Dayton Miller's 1933 publication 'The Ether Drift Experiment and the Determination of the Absolute Motion of the Earth', John Earman and Clark Glymour's 'Relativity and Eclipses: The British Eclipse Expeditions of 1919 and their Predecessors', and H. Von Kluber's 'The Determination of Einstein's Light-deflection in the Gravitational Field of the Sun'. Collins was also helped by personal correspondence with Klaus Hentschel. For chapter 4 Collins used *Louis Pasteur: Free Lance of Science*, by Rene Dubos, and the paper by John Farley and Gerald Geison entitled 'Science Politics and Spontaneous Generation in Nineteenth-Century France: the Pasteur–Pouchet Debate'. (Page references in the text of this chapter refer to the reprint of Farley and Geison's paper in *The Sociology of Scientific Knowledge: A Sourcebook*, edited by Collins.) Collins also referred

to the *Dictionary of Scientific Biography*, and consulted some original papers of Pasteur and Pouchet.

For chapter 6, on the sex life of lizards, Pinch relied on Greg Myers's, *Writing Biology: Texts in the Social Construction of Scientific Knowledge*.

The conclusion draws heavily on the last chapter of Collins' book *Changing Order*, on Paul Atkinson and Sarah Delamont's paper 'Mock-ups and Cock-ups: The Stage Management of Guided Discovery Instruction', and on the paper by Collins and Shapin entitled 'Experiment, Science Teaching and the New History and Sociology of Science'.

All the above-mentioned works are fully referenced in the bibliography.

For help and advice we thank David Travis, Lloyd Swenson, Clark Glymour, Klaus Hentschel, Bruce Lewenstein, Gerry Geison, Peter Dear, Pearce Williams, David Crews, Peter Taylor, Sheila Jasanoff, Greg Myers, Paul Atkinson, Frank Close, Eugene Mallove, Sarah Delamont and Steven Shapin. None of them are to blame for the mistakes we may have made in translating their professional work into our words, or in interpreting their findings in our way.