have different rates of cable penetration (p.44,48). Each of his reasons are persuasive and I wonder why the European case has ended up with this controversial result in contrast to the situation in the Asian region, typified by the success of Star TV, a Pan-Asian satellite TV program, where the identical differences exist across countries. The author should have some explanation. The satellite broadcasting market has expanded opportunities for both hardware manufacturers and software producers and has provided advertising opportunities to numerous growing companies. This and increased program choice has upgraded the quality of life for viewers worldwide. This book provides an opportunity to reconsider whether such a general brief is still viable in other regional markets including Asia-Oceania .

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The Uses of Life: A History of Biotechnology *by Robert Bud* (Cambridge University Press, Cambridge, 1993), pp. xvii + 299, A$99.00, ISBN 0-521-38240-8

Biotechnology is a contested term. Authors of biotechnology policy documents often remark on the difficulties of arriving at a workable definition of the field; one that enables policy statements to be translated into action. Yet there is rarely the space in such documents to devote much reflective attention to the process involved in arriving at definitions of biotechnology. Nor is much attention paid to the more subtle consequences of adopting any particular definition, consequences that go beyond what does or does not get funded.

Robert Bud's history of biotechnology might appear, at first glance, to be in a similar vein, merely a chronological account of the various definitions that biotechnology has embraced over the past hundred years. This would be a misconception. The thorough scholarship and meticulous detail of the work might initially give the impression that the book is only of interest to specialist historians. This would be a mistake.

What Bud has produced amounts to much more than a straightforward evolutionary narrative of the 'rise of biotechnology'. Far from telling us how one development led to another culminating in our modern conception of the word, *The Uses of Life* constitutes a genealogy of many biotechnologies. It documents the various meanings of biotechnology which have been employed, forgotten and sometimes completely re-invented. The result is a rich account of why some of these meanings prevailed over others in the various struggles to define the term itself; at stake was the very meaning of biotechnology.

Bud starts by unearthing an almost forgotten term, zymotechnology. In the nineteenth century this encompassed the study of all types of industrial fermentation. From chemistry applied to brewing, over the course of the century zymotechnics came to denote a confluence of microbiology, chemistry and engineering applied to a range of problems. Then, through other transient terms such as chemurgy, Bud takes us to the 1920s and 1930s with the first suggestions of a biological science applied to society, encapsulated in terms such as biotechnics, social biology and, of course, biotechnology. The middle parts of the book then provide a post-WWII account of biotechnology; first as a sub-set of chemical engineering, intimately bound up with Cold War concerns over biological warfare, then as a proposed ecological panacea in the 1970s.

It is only towards the close of the account that the more familiar uses of the term, the 'new biotechnology', come to the fore. Although biotechnology at present is virtually synonymous with recombinant DNA techniques and molecular biology, this was a fairly sudden colonization. Bud recounts the well-known events surrounding Cohen and Boyer's discoveries, Asilomar and the marriage of traditional fermentation with the new genetics. In addition, he argues forcefully that the positioning of the human-nonhuman focus within debates about the new technologies was vital to their popularization and adoption amongst policymakers. Arguments about genetic engineering of humans which were rehearsed in the sixties were shuffled off-stage a decade later as scientists, in the face of growing public consternation, took genetic engineering to apply largely to microbes and plants. The emphasis on humans returned in the 1980s as the newly emerging biotechnology firms in the U.S. saw the pharmaceutical market as their shortest route to successful innovation.

I have already mentioned that one of the strengths of this history is its genealogical stress on what was taken to constitute biotechnology at any one moment. Bud shows how these were not simply debates over labels. Instead, they reflected different strategies adopted by different groups to maintain particular visions of the future. This is akin to what Lyotard referred to in the *Postmodern Condition* as 'narrative knowledge', the various legitimating stories which are necessarily employed to justify support of any area of science.

So accordingly, Bud charts the vicissitudes of a biotechnology caught between science and technology, chemistry and biology, human and nonhuman, basic and applied science. At each stage these tensions shape the characteristics of biotechnology and are intimately bound up with narratives about the future. We see, for example, the early chemical vision of a society dependent on fermentation products. This is associated with practitioners attempting to overcome the marginal status of zymotechnology within the broader landscape of the chemical industry. During the Great Depression, the chemical vision is appropriated by biology and its potential application to socio-technical problems . Yet, whereas in Europe this vision was linked to strategies attempting to place biological sciences at the centre of social planning, in the U.S. the shift was used to enhance the credibility of engineering as an academic discipline. The practical up-shot of these different visions was an emphasis on biotechnology as concerned with the human-machine interface in the U.S., whilst in Europe the human-environment interface became the prevailing focus of attention.

Bud's account should remind policy analysts that carving up an area of research is far more than a neutral administrative procedure. It is most certainly about more than passively managing research, as opposed to actively creating and shaping some of the features of the research enterprise.

There is another important point of relevance to science policy studies which emerges from the details of this history. Readers who are looking for revolutionary techno-economic paradigm shifts will be disappointed. So will those who would like their history of science and technology to be all about incremental change. The rich empirical details of Bud's account to not match up to either simplification. Whilst some things change, others stand still; there are discontinuities and continuities. The rapid and dramatic importation of the new genetics into traditional biotechnology, for instance, may have been revolutionary from a technological perspective. But as a science it was one more incremental step, albeit an important one, in the development of molecular biology from Watson and Crick's work in 1953, or even the rediscovery of Mendel's laws in 1900. So, although Bud closes his book by stressing the intellectual and institutional links between biotechnology at the close of this and the last century, he is equally keen to point out the ideas which now appear as "fossils of a remote age" (p.219). This in turn suggests that we should be less quick to label emerging technologies as revolutionary or not and then treat them accordingly. Instead we should be asking how and why the historical breaks and links that we

will always observe actually occur.

Science policy, of course, is a future-orientated field of study. The relevance of the past is often underplayed, perhaps because we expect simply to read off lessons from the history of science and apply them wholesale to current dilemmas. As Bud points out, "arguments of the past cannot, and should not, determine how disputes should be resolved, or biotechnology regulated" (p.220). Instead, *The Uses of Life* illuminates the dynamics of the policy process and highlights the complexities in the emergence of new areas of research. Above all, it draws our attention to what is at stake when we define the boundaries and contents of our policy categories.

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The Golem: What Everyone Should Know About *Science* by *Harry Collins and Trevor Pinch* (Cambridge University Press, Cambridge, 1994), pp. xvii + 164, A$15.95, ISBN 0-521-47736-0 (pbk).

Three years ago I was in a quandary. I had spent the best part of twelve months chasing down a novel property of nerve cells which, if true, would suggest new areas of memory research and enhance my scientific reputation. Then one day the effect I was studying disappeared; experiments that had worked for a year abruptly stopped working. For two weeks I laboured over my apparatus, varying every parameter that seemed relevant – and some that did not – while the dread word "artifact" loomed in my mind. Just as suddenly, and just as inexplicably, the effect returned; experiments were hurriedly concluded; and the paper was published with scant mention of the problem I had encountered. This problem I came to regard as an epiphenomenon, the consequence of some unknown flaw in those particular experiments, that did not detract from the force of my conclusions. That fortnight of unsuccessful experimentation I dismissed as an anomaly. By behaving in this way, it seems that I was doing my bit to animate the Golem.

Harry Collins and Trevor Pinch have written an entertaining, provocative book with a sting in its tail. It is, in their own words, a "straightforward" book for the citizen, displaying science as it really is, stripped of the historical revisionism that so frequently imparts an heroic gloss. The book contains seven short chapters, each describing a case study in controversial science. Some of the examples are famous (the tests of general relativity early this century), some are obscure (the sex life of the whiptail lizard), others just plain embarrassing (the story of cold fusion). From this disparate cross-section, Collins and Pinch draw their thesis: that science is an untidy, blundering creature, like the Golem from Jewish mythology, that rests upon craft knowledge, incomplete data and the all-too-human motives of ego and power. The sting comes in the concluding chapter, which draws together the lessons of the case studies. The most important purpose of the book, the authors say, is to change the public understanding of the political role of science and technology. Scientists are merely a particular kind of expert. Their area of expertise – the physical world – may evoke greater awe than that enjoyed by other experts, but "their knowledge is no more immaculate than that of economists, health policy makers, police officers, legal advocates, weather forecasters, travel agents, car mechanics or plumbers." (p. 145).