where the cost of workers, technicians and engineers plays a crucial part in competitive advantage" (p.187). Many other manufacturing industries have all or most of these characteristics: many, as he says, have not, and the dragons' strengths and weaknesses in them cannot be easily judged from this book. He has little to say on the dragons' culture and its effects on performance — the issue, as he points out in a discreet endnote to his conclusion, is very controversial, and outside his competence. In view of the nonsense which has been written on the subject, one must respect his reticence and be grateful not to be told, for example, that all the dragons, with Japan, benefit from 'neo-Confuciansim' (Chinese and Japanese culture being at least as different as any two in Europe). But he earlier makes it clear that 'overseas Chinese' culture has a striking effect on management styles in three of the dragons. National culture clearly makes a difference, complex and subtle as it may be. So, one might expect, do managerial practices which have been learnt in the process of industrialisation. As Hiroyuki Itami has shown for Japan, many Japanese managerial practices correspond rather closely to the requirements of latecomers, and such insights could usefully have been combined with Hobday's own on the latecomer firm. There is, finally, one important omission from his policy advice for countries wishing to emulate the dragons. He rightly commends their governments' heavy spending on technically-oriented mass education. But when the mass of the population is impoverished peasants or shanty-town dwellers, spending on education will not educate the poor: their poverty must be eased first. The Taiwanese and Korean governments did this in the early 1950s by radical land reform. That example is much more controversial and at least as important. But these are minor faults. This is a well-written and important book which should be required reading for anyone wishing to understand the pattern of advantage in electronics, the rise of East Asia, and the process of technological catch-up for latecomer countries.

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Science on the Run: Information Management and Industrial Geophysics at Schlumberger, 1920-1940 *by Geoffrey C. Bowker* (MIT Press, Cambridge, MA, 1994), pp.viii+191. ISBN 0-262-02367-9.

It is a pleasure to welcome this latest addition to the excellent MIT series on 'Inside Technology' — which has featured the work of Wiebe Bijker, John Law, Harry Collins, and Donald MacKenzie, and which has already done much good in bringing recent theoretical work in the social construction of science and technology to a non-specialist audience. In this brief but telling account, helped by unprecedented access to family archives and advice, Bowker opens the 'black box' called Schlumberger — possibly one of the most mythic names in oil exploration — to ask what can be learned from its approach and style of 'doing' science. His enquiry takes him to the methodological frontiers between industrial and information science, and between field research and public explanation. He shows how, in the years following the First World War, and through the interwar years, Schulmberger created a new science, and a new way of doing science, in the laboratory of the field, and so gained an almost unquestioned, competitive edge in the world's oil industry. It did so by codifying and putting into practice two measurements — electrical indications of perme-

ability and apparent resistivity of geological strata, measured at successive depths — that improved almost beyond recognition the chances of a wildcatter — or of Standard Oil — in finding oil at a given geological location. The arrival of Schlumberger's teams at a drilling site came to signify the arrival of science, its methods transforming a masculine world graced by lady luck, into a project of almost clinical regularity and precision.

What unfolds is a fascinating story of myth and memory, origins and alternatives, with resolution coming only at the end. In echoing Latourian sentiments, Bowker pays repeated homage to his mentor — in his choice of chapter titles, in his celebration of Paris as a 'centre of calculation,' and in seeing the world as a composite of reasonings, only some of which eventually surface as history. Bowker shows how Schlumberger's two critical measurements made oil exploration a 'science' fit for global consumption. A concatenation of family history and postwar French occupation of Alsace — creating an appropriate location for exploration in the only oil field in France — combined with a interest in electrical methods, a convenient basement at the *Ecole des Mines*, and a semi-military approach reminiscent of the *polytechnicien*, produced a style of research and application that seems eminently Napoleonic. In its application, the Schlumbergers created an empire, and pre-empted their rivals for nearly a generation.

Bowker reminds us that strategic choices in science — in this case, the French, preferring electricity, the Germans, and later the British, preferring seismic measurements — can easily reflect national sentiment and political ideology. In the 1920s, Schlumberger's electrical methods crossed ideological frontiers, helping to 'empower' the Bolsheviks in their marriage of electricity and socialism, and gaining the company a degree of access to the USSR and its oil that its competitors must have envied. Above all, Bowker shows how, in a given setting — in this case, an oil exploration site — corporate circumstances could combine to form a rhetorical and geological space in which infrastructure and measurement converge, resulting in a solution, a service, that is both socially and scientifically constructed, and convincing to the consumer. The Schlumberger solution worked, and was subsequently defended in patent court. In this, Bowker believes, lies the key to Schlumberger's extraordinary success, using its ephemeral product — a system of ideas — as an information technology with which to carve a profitable niche in a competitive world.

Throughout this fascinating narrative many questions arise, some of which warrant a closer look. That there are historical intersections between technical and organisational infrastructure is not in itself a novel conclusion, nor is it hugely unfamiliar to historians; nor are fuzzy boundaries of definition, however uncomfortable to sociologists of scientific knowledge, rare to students of laboratory life in industry. Nor will historians of science — particularly students of natural history — be surprised by the author's accent on innovations, once seen as local, become global. On the contrary. Moreover, whilst it is easy to accept Bowker's intention to make the case better known among business historians, it is not clear how easily generalised Schlumberger's experience may be. Given that historians of large technological networks have tended to underplay the importance of specialised companies in producing new science (and new convergences), there is growing evidence about the ways in which small, specialised, spin-off companies have managed their (necessarily more specialised) research strategies. What remains poorly defined are the categories of activity which most closely fit this model.

In Bowker's reading, we find an almost everyday, easily understandable practice producing an uncommonly successful product. It does so, in his view, by maintaining a 'zone of appropriate ambiguity' about its practice, appearing to do science, but leaving room for interpretative flexibility. Thus, a coherent strategy is articulated by a family company, which proceeds to diffuse its methods at a time in history when a French-based enterprise is particularly well placed to take the world as its oyster. Its success was, inevitably, context-dependent. This suggestion prompts other, perhaps more historical, questions, which Bowker

does not explore. For example, the invention of sound ranging artillery techniques to improve counter-battery fire during the first world war — the 'acoustics war', as one populariser put it — helped generate widespread interest in both seismic and electrical methods of measuring movements in the earth. Although the Schlumbergers began their work in 1911, it is tempting to ask whether wartime experience of these techniques either advanced their testing, or had a bearing on their reception.

Equally, whilst Bowker attributes the competing (and eventually, more widely accepted) seismic method to Germany, he might reflect on the work of British military geologists (and their geophysicist cousins) who believed they had taught the Germans something; and who in the 1920s, applied their techniques to oil exploration in the vast new realms of the reconstructed Middle East, to make their reserves safe for the Royal Navy. It is instructive that several of the most helpful and clear diagrams Bowker uses to describe oil exploration techniques are drawn from a well-known English textbook of 1938. Whilst the author rightly stresses the huge development of the American oil industry, the needs of Western Europeans and Japanese would also repay attention. Finally, in his skilful analysis of rhetoric and description, the author might have engaged with the effects of the effervescent 'scientism' that coursed through Europe and America in the early postwar period, and which only went flat with the coming of the Depression. An enthusiasm for the peaceful applications of science and a commitment to 'scientific method' seized the imaginations of socialists and capitalists alike, undoubtedly contributed a sympathetic *Zeitgeist* to Schlumberger's strategies, and lent the authority of science to their particular form of corporate internationalism.

For such collateral stories, we must look elsewhere. However, their absence does not mar this subtle account of negotiation between a private company and its public history. While at times Bowker's interpretative tendency leads into dense thickets of sociological theory — a direction not all his readers will find easy — his achievement is to show how a form of laboratory activity developed, outside conventional institutional walls, and defined its 'science' in such a way that it became recognised as such. In this, he has added to our understanding of an innovation that is as much social as scientific, and has demonstrated the value of applying methods drawn from the social studies of science to the circumstances of applied research. He has shown us how, in practice, narrative can become knowledge, and has cautioned us that forgetting or blurring origins, and disregarding failures and alternatives, is a common feature of the history of science. We are reminded, by Schlumberger's singular success story, that outcomes which may appear obvious, are neither necessary nor inevitable — even when, in the real world, they actually work.

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Rethinking Technologies *edited by Verena Anermatt Conley* (University of Minnesota Press, Minneapolis, 1993), pp xv+248, ISBN 0-8166-2215-9.

Rarely has a book done as much of what its title promises as does this book. Not only were the authors "re-thinking technologies" but I found myself being challenged to think in ways in which I had not considered before. As such this book offers a unique and stimulating, if