Prometheus, Vol. 22, No. 4, December 2004

Carfax Publishing
Taylor & Francis Group

Book Reviews

The Economics of Knowledge

Dominique Foray

Cambridge, MA and London, England, The MIT Press, 2004, 288 pp., US$35/£22.95, ISBN 0 262 06239 9 cloth

This is an important, but also partly frustrating and disappointing book. It is important because its author has been intimately involved with the OECD's work on the knowledge-based economy (almost all of the 11 chapters are based on Foray's earlier publications, usually written with co-authors), and because it is advertised as the currently most comprehensive and cohesive book on the emerging 'economics of knowledge'. It is frustrating and disappointing because of Foray's views about the scope of the subject. If it were taken seriously as the definite book on a new discipline, it might pre-empt or at least distort the discussion about its appropriate scope, a discussion, which I feel, has yet to take place. It is also frustrating and disappointing because, as a revised version of a book first published in French in 2000, the references to the literature are often not as up-to-date or comprehensive as would have been desirable. For example, the supposedly 'most recent' knowledge investment data are for 1998 (p. 24).

In the introduction Foray states that the book focuses on two new developments that constitute the dual nature of the economics of knowledge, i.e. the development of a new academic sub-discipline and the historical development of the knowledge-based economy. I find the choice of the word 'new' unfortunate. In important respects, neither development is particularly 'new'. Both have a long history.

I have major reservations about Chapter 1, entitled 'An Original Discipline'. Foray subscribes to a 'narrow view' of the economics of knowledge that focuses on research, education, growth impacts, learning, cognition and competencies, but deliberately excludes the vast fields of the economics of information and decision theory. Leaving aside the problem of excluding the economics of information and decision theory, there are, arguably, elements of other important disciplines dealing with aspects of a 'modern economics of knowledge' that are missing. For example, Foray states that the economics of knowledge should not be confused with the economics of research or the economics of innovation. But surely important parts of the existing discipline of the economics of science, technology and innovation

Prometheus ISSN 0810-9028 print/ISSN 1470-1030 online © 2004 Taylor & Francis Ltd
http://www.tandf.co.uk/journals
DOI: 10.1080/0810902042000303242

(STI) should be included (e.g. the branch dealing with national, and other, innovation systems). Foray admits as much (on pp. 13–4), but nevertheless excludes a discussion of these topics.

The same applies to other branches of economics and closely related areas. They are mentioned much too briefly, if at all. Examples include core topics from labour economics (i.e. human capital theory), or research on innovation and entrepreneurship, or telecommunications economics, or institutional economics. The treatment of the latter is especially curious, given that Foray sees the economics of knowledge largely as part of institutional economics: 'The goal of the economics of knowledge is … to develop a framework in order to devise and compare socio-economic institutions that can be relied upon to create and exploit knowledge in an efficient manner …' (p. 19). However, there is no chapter surveying the relevant contributions from the established sub-discipline of institutional economics, nor does the index contain the words 'institutions' or 'institutional economics'.

Also, there is little discussion of major areas of the relevant empirical economics literature. Foray seems to take a lot for granted. The importance of R&D and learning for growth is taken as self-evident throughout much of the book, despite the statement (on p. 9) that there is no production function that can forecast the impact of an increase in knowledge on economic performance. Important questions raised by prominent applied economists (for example the late Griliches) about the severe shortcomings of the econometric methodologies employed in empirical work on the impact of R&D on output and productivity growth are not mentioned in any detail. The related empirical literature on R&D and knowledge spillovers (between firms, industries, countries) is barely mentioned. But then, this is not a book presenting much quantitative evidence, despite discussing the importance of quantitative aspects in general terms. Many of the very general statements, taken in isolation, seem like mantras or overstatements rather than considered insights from an economics of knowledge.

The book also creates the impression that the author is somewhat schizophrenic about knowledge measurement issues. He seems to dismiss the issue of empirical measurement of knowledge stocks and flows too lightly, i.e. on several occasions he points out the difficulty, if not impossibility, of measurement, without surveying the many efforts that are being made in economics and other disciplines of measuring them. Then again, he states that knowledge inputs and outputs, especially those associated with R&D, can be measured (see pp. 9–10).

Although the book is advertised as interdisciplinary, it contains few or no references to contributions from communication and information sciences, the sociology of knowledge, bibliometrics, cyber-geography, political science, philosophy etc., all of which analyse aspects of knowledge creation, diffusion and absorption that arguably should be included in a modern economics of knowledge.

Another irritating aspect is Foray's discussion of the pioneers of the field. In Chapter 1 he misinterprets Machlup's work (and then repeats the misinterpretation in Chapter 2). Under the heading 'From Specialized Sectors to the Entire Economy' he identifies Machlup only with the industry or sectoral approach to the measurement of the knowledge economy, stating that it was Eliasson who broke away from it. That completely ignores Machlup's second approach, i.e. the occupation approach. That approach acknowledges and attempts to measure knowledge producing activities in all sectors of the economy by identifying knowledge workers.

In Chapter 2 the author tries to capture the main historical features of knowledge-based economies [the growth of intangible capital, knowledge-intensive

activities, information and communication technologies (ICT), attempts to measure accelerated change, the high costs of creative destruction and depreciation of knowledge, etc.]. It is a useful, yet dated, survey of the issues. For example, there is by now a sizable literature on the productivity performance of ICT producing and more intensively versus less intensively ICT using industries which is not discussed in the book (most of it did not exist at the time of publication of the French edition).

The following three chapters focus on the main forms of knowledge production, reproduction, and the role of knowledge spillovers. Chapter 3 revolves around two dichotomies that can be used to classify different forms of knowledge production. First, there is 'off-line' knowledge creation, which occurs separately from regular production and consumption of goods and services (mostly through formal R&D conducted by researchers) versus 'on-line' learning-by-doing, which captures the wider dispersion of knowledge production to a variety of actors. Secondly, Steinmueller makes the distinction between two main knowledge-creating activities, i.e. the search model versus the coordination model (the latter produces 'integrative knowledge' such as norms, standards and common platforms). Foray emphasises the need for off-line research in order to preserve the basis for innovation and growth over the long-run and states, 'the pendulum has probably swung too far toward a research entirely devoted to the solution of current business problems' (p. 54).

Chapter 4 contains a thorough discussion of the many critical issues associated with the trend towards the increasing codification of knowledge (as well as the role of tacit knowledge), which is at the heart of the knowledge-based economy. The advantages and limitations of codification as well as its direct and indirect costs are highlighted. Chapter 5 focuses on knowledge externalities and especially intended and unintended knowledge spillovers. Issues such as the importance of absorptive capacity and other limitations to spillovers are emphasised. However, Foray discusses only nonpecuniary spillovers, thereby neglecting the by now large literature on pecuniary knowledge spillovers (i.e. knowledge spillovers embodied in goods and services).

Chapters 6–8 discuss incentive and institutional issues that insure the 'efficient' production and exploitation of knowledge. Chapter 6 focuses on what Foray describes as the main dilemma in the economics of knowledge, i.e. the tension between the need for private reward and the socially efficient use of knowledge, and the advantages as well as shortcomings of the various institutional mechanisms used to solve it. The chapter ends with a simple but useful model highlighting the nexus between public versus private funding of knowledge production and the extent of social versus private benefits. Unfortunately, the relevant figure (6.2) is mislabelled.

Chapter 7 is devoted to the important and complex issue of intellectual property rights. For good reason it is the longest chapter in the book: the near consensus that existed on the topic amongst economists in the past has mostly gone, with many now being much more sceptical of the patent system. Forey surveys the changing patent systems of a number of countries as well as developments in the economics of patents. On balance, he joins other sceptics in doubting that the changes have necessarily been for the better. However, the economic importance of intellectual property is rising, and so is the importance of the legal system for regulating intellectual property rights. Lawyers are undoubtedly in the best position to kill off the bright future many economists predict for the knowledge-based economy!

Issues concerning the 'open organisation of knowledge', i.e. how to encourage individuals to freely reveal their knowledge without discouraging the inventor, are

the subject of Chapter 8. 'Knowledge openness' is concerned with areas in which exclusive property rights cannot be granted, and in which rapid disclosure of new knowledge is predominant. The virtues and possible problems of knowledge openness are discussed, as are the institutional features required to support its varied forms. The chapter finishes with a somewhat speculative discussion of virtual knowledge-based communities, or what Foray poetically describes as 'new kinds of machineries of knowing', which he sees as becoming of much wider relevance in the knowledge society.

The last three chapters deal with policy issues arising from the uneven development of knowledge across sectors, the importance of knowledge management, and the public dimensions of the knowledge-based economy. Chapter 9 highlights the fact that different models of knowledge accumulation apply in different sectors of the economy at different points in time. To simplify, in some sectors the science model is predominant, in others the learning-by-doing model. The former gives a more prominent role to codified knowledge compared to the latter where tacit knowledge looms larger. Moreover, the extent of knowledge spillovers varies between sectors. All of this makes for a great diversity in knowledge accumulation and diffusion, and epistemic cultures (i.e. ways of identifying 'best practice'). Some of the main differences and likely change trajectories are highlighted using the education and health care sectors as examples.

I am not certain that Foray's view is correct that policy has to implement proper strategies to fill the gap between sectors that have faster and slower knowledge accumulation processes, especially as he identifies the former with those sectors that have fully implemented the science model, despite also stating elsewhere that sectors that do not use that model do not necessarily exhibit slow knowledge accumulation. I wonder whether these somewhat contradictory statements are at least partly due to existing government activism that is pushing the science model as the only relevant one for accountability purposes, as is done in various 'research assessment' exercises that rely mostly on codified knowledge outputs.

Chapter 10, on 'knowledge management', begins by discussing the reasons for new management practices. They seem mostly due to a clash between the requirements of the greatly increased importance of innovation and commercialisation of knowledge, the perceived opportunities offered by ICT, and the negative impacts of rampant managerialism, the latter of which has led to the widespread destruction of long-term attachment, trust and loyalty of employees (managers and workers) to their organisations, be they in the private or public sector. In that sense, one cannot help but wonder whether knowledge management for the most part is like the ambulance at the bottom of the knowledge cliff, i.e. a poor but necessary substitute for past institutional arrangements that preserved organisational memory. As in much of the literature, an explicit discussion of power relationships that affect knowledge management is missing.

The last chapter further elaborates on some of the major challenges impacting on the future of the knowledge-based economy. They have to do with the balance between the public and private domains (e.g. commercialisation of basic functions of the universities, or 'academic capitalism'), issues arising from the increased rate of speed by which knowledge is created and depreciated, issues of memory, integration, search and trust arising from the distributed, or rather fragmented, nature of knowledge, and the empirical problems of measuring the knowledge-based economy. All of them emphasise, according to Foray, the need for a 'new public economy', i.e. less reliance on privatisation and markets.

Missing from the chapter is a detailed discussion of different knowledge economy futures. Much of Foray's book argues the importance of the public dimension of the knowledge-based economy to the extent that he sees it as constituting THE future of capitalism (p. 245). This might well be the case, but comments on the likely varieties of knowledge-based capitalism are confined to some very general and brief statements on the last page-and a-half of Chapter 11. It is surprising and regrettable that important contributions to that subject, like those by Stiglitz and Hodgson, to name but two, are not mentioned.[1] Also, a discussion of rent seeking and the nature of opportunities open to talented individuals in society, which are by now topics even included in mainstream macroeconomic textbooks, would have been useful in this context.[2]

Relatedly, the low level of ICT access in poor countries and the 1998 World Development Report 'Knowledge for Development' are mentioned only very briefly in one paragraph (on pp. 236–7). There is no specific discussion of issues concerning the emerging knowledge-based economies in developing countries. This should come as no surprise, given the author's focus on OECD economies. However, one would expect any comprehensive book on the economics of knowledge to include a chapter on issues concerning the functioning of the knowledge-based world economy and its constituent parts. Also, statements like 'even a journey through the stacks of a real library can be more fruitful than a trip through today's distributed virtual archives' (p. 241) give the impression that the author wants to have his cake and eat it too as far as some fundamental issues about the role of ICT in the knowledge-based economy are concerned.

The major themes of the book are pulled together in a short conclusion. In my view Foray has only partially achieved his major aim of providing 'a coherent frame based on an original discipline … for linking up all the changes related to the production and distribution of knowledge in modern societies' (p. 247). This aim was simply too ambitious. The economics of knowledge as perceived by Foray is too narrow. We need an extended debate among academics and policy makers about what elements from other disciplines to include in it. In many respects we need a modern version of Machlup's monumental and pioneering work. We are only at the beginning of this important disciplinary re-figuring, which is itself a prime example of the difficulties of knowledge management. I would argue we have not yet created the appropriate 'integrative knowledge', to use Foray's terminology, necessary for a modern economics of knowledge.

Finally, although I found the shortcomings of the book irritating, I do not want to give the impression that the negatives outweigh the positives. There is much in this book that is important for a critical reflection on the nature, direction, and future prospects of the knowledge-based economy. It raises readers' awareness of many of the complex and multi-faceted issues associated with it, and introduces them to the work of one of the most prolific writers on the knowledge-economy closely associated with the OECD. I therefore recommend the book to anyone interested in these issues, subject to the caveats mentioned earlier.

Notes and References

1. See Joseph Stiglitz, *Whither Socialism?*, MIT Press, Cambridge, MA, 1994; and Geoffrey Hodgson, *Economics & Utopia: Why the Learning Economy is not the End of History*, Routledge, London and New York, 1999.

2. See, for example, David Romer, *Advanced Macroeconomics*, 2nd edition, McGraw-Hill, New York, 2001.

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Leonardo to the Internet: Technology and Culture from the Renaissance to the Present

Thomas J. Misa

Baltimore, The John Hopkins University Press, 2004, xx + 324 pp., ISBN 0-8018-7809-8 pbk (John Hopkins Studies in the History of Technology)

A wonderfully rich book, it discusses many different social, economic and technical developments within the contexts of what the author terms 'distinct "eras of technology and culture"'. There are eight eras, more or less consecutively dated, but with increasing overlap in more recent times, and he progresses from place to place, to wherever these eras seem to be originating. He goes from the Italian city states through the Dutch to England and Empire, to Germany but mainly to the US, each the location of a society or a segment of society which has created a range of technologies or a technique which he sees as being a major influence on, or the main driver of, the era.

The wealth of the descriptions of specific technologies and eras are fascinatingly interesting, informing as well as supporting—or not—his theme. The theme is not entirely clear although he believes that 'this notion of distinct eras provides a kernel for a new practical insight into our own social and cultural prospects'. He does not consider that technology is some external force blindly impacting on society and culture. Rather

> if technologies come from within society and are products of on-going social processes, we can, in principle alter them—at least modestly—even as they change us. This book presents an extended evaluation of this question (p. xi).

Inevitably, I quickly assumed that he owed something to Braudel, but on page 34 after suggesting that the many parallels between the Dutch Republic in the seventeenth century and Renaissance Italy led Braudel to 'posit long-term "secular trends"', he remarks

> Yet such a view suggests a troubling inevitability about historical change and undervalues how the Dutch developed new technologies to capture the leading economic role in Europe and construct a trading empire of unprecedented global scope.

What on earth he means by inevitability is beyond this reviewer especially since he appears to show some commitment to Braudel's concept. He early (p. xvii) uses the phrase, 'the longer duration eras of technology discussed in this book' and then much later (p. 269) 'these long duration patterns, or eras, of technology'. These

phrases are somewhat reminiscent of Braudel's longue durée. His view is that in each era

> the asserting of a distinct purpose for technology, and a desirable direction for social and cultural development, displaced alternative purposes and directions (p. 269).

Undoubtedly, the British used telecommunications and railway technologies in their domination of India. They made it so much easier to identify points of unrest and to move troops. The final suppression of India might have been even bloodier without them, but it was inevitable. The real point is that gaining an empire provided a market for technologies which had already entered other markets. They were not displaced from other uses by imperial ambitions whether British or US and the phrase desirable direction is open to different interpretations.

Misa does not write of the bankers and merchants who in the Italian city-states invested in trade and manufacturing to create wealth. They traded across the known world and their cities became what Braudel termed world-economies. As dominant financially and economically they led economic and technical development in the Western world of their day as the US has today, or is it yesterday as the US abandons productive investment for speculation and seeks domination of markets and societies other than by market means? This role of Renaissance cities is virtually ignored by Misa. His thesis here is that Leonardo simply used his genius to create entertainment and war machines for his patrons, not for wealth creating ends, and that he was not a stand-alone genius but borrowed many ideas from his peers, a far from unusual characteristic of a dynamic society. One thus becomes aware of Misa's narrow interpretation of culture. His is an Anglo-American approach, culture as the expression of a social elite and consisting in beautiful things in literature, music, and art more generally, rather than a view of culture as a shared value system, the social capital of a society. Culture in this alternative understanding, as the shared value system of a community, is a complex concept. It creates and is created by the interactive personal exchanges of everyday life. It shapes and is shaped by its members. It is the factor which binds a community into a cohesive and dynamic whole in which there is trust and reciprocity in the exchanges between members, the constant interchanges of technical, commercial, financial, market opportunity and other information which lead to constant innovation and leadership. It is the culture of a community in which care for the common good is paramount. This care characterises a society which is technologically, economically and aesthetically dynamic and is a true republic. The Netherlands achieved its seventeenth century dominance because it was a republic with a shared value system.

Amsterdam was its leading city centred world economy but with many towns and rural areas participating, usually by specialising in some activity of processing and manufacturing, so that the wealth produced was widely distributed through society. Misa gives a wonderful description of the many activities and technological and other developments resulting from the shared cultural capital, but fails to see their dependence on such a culture. His reference to culture is that even modest shopkeepers had a collection of paintings.

Interestingly he tries to play down the role of Amsterdam which Braudel had highlighted as a city centred world economy yet plays up the role of London which Braudel did not see as one. Braudel saw the many centres of specialisation and

their dynamic middle class societies and mistakenly assumed London to be an observer and not a driver. In contrast to the Dutch there was no general concern for the public good. Low wages, low quality and low skills, together with the high degree of centralisation of finance and increasingly of virtually all decision making in London, were and are the means of a non-cohesive culture and of one shared only between an elite, used to gain wealth for a relatively small minority.

Jumping to the later point of Macdonalds as an example of globalisation brings up an issue which was apparent in Misa's first era. What is technology as an instrument in cultural change? Macdonalds is not an example of a technology but of the management technique of centrally controlled intensive selling, in this case largely to children, of a mass-produced product albeit that it is locally produced. Its cultural impact is somehow softened by this localisation or so Misa strongly asserts, but its current attempts to move away from its 'obesity' image illustrate what many now believe to be a distinctly negative cultural impact. It is not of course the only multinational changing the food culture of many countries. Its low wage and low skills mode of operation distinguish it from the Dutch dynamic republican culture with its high quality, high skills and high wages, which Misa uses as a contribution to his theme with high praise for its mode of operation.

There are more good sample cases but too often with the same half understanding of the reality of what is being demonstrated by these cases, yet the book, clearly the result of wide ranging search and reading, is both a good read and a source book.

One can only conclude, however, that in the Dutch case change comes from within society and the culture of society and is multifaceted. The Macdonalds case is one facet of change. It may have come from within one society but is very difficult to change in societies into which it has introduced itself, in spite of Misa's belief in its localisation.

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The Digital Sublime: Myth, Power and Cyberspace

Vincent Mosco

Cambridge, MA, and London: MIT Press, 2004, ix + 222 pp., ISBN 026213439

Vincent Mosco's book, *The Digital Sublime: Myth, Power and Cyberspace*, touts itself as an exploration of the 'myths constructed around the new digital technology, and why we feel compelled to believe in them' (jacket notes). In six chapters, he aims to probe the myths of cyberspace, trying to cut through the hype and jargon, to tell it like it is, to compare today's myths to those of the past. He admits that 'it is beyond the scope of one book to provide a complete cultural analysis of cyberspace' but he will focus on myth, 'one important dimension of cultural analysis', not only because '… myth is the starting or entry point to a valuable understanding of computer communication, but [because] it leads to, requires, and (…) is mutually constituted with a political economic perspective' (p. 7). He writes that 'myths are stories that animate individuals and societies by providing paths to transcendence that lift

people out of the banality of every day life. They offer an entrance to another reality …' (p. 3).

Chapter 1, 'The secret of life' is Mosco's introduction to and rationale for, his book. In Chapter 2, 'Myth and cyberspace', he defines and sets out his terms of reference, including an exploration of 'What is myth?'—'a captivating fiction, a promise unfulfilled and perhaps unfulfillable' (p. 22). He discusses how myths are made and perpetuated, and why it is that we are, apparently, so ready to believe them. He names, among others, Al Gore, Bill Gates, Esther Dyson and government generally, which 'plays an enormous role in manufacturing cyberspace magic' (p. 43). Chapter 3 is an exploration of 'Cyberspace and the end of history', wherein Mosco revisits the work of Francis Fukuyama, Daniel Bell, Nicholas Negroponte, Pierre Teilhard de Chardin and McLuhan. We get the weary feeling that we have wandered through this particular library more than once before. In this chapter, Mosco spends some time discussing the work of Ray Kurzweil, named by MIT as Inventor of the Year in 1988, and whose 1990 book, *The Age of Intelligent Machines*, won the Association of American Publishers Award for 'the Most Outstanding Computer Book of the Year' (p. 75). In 1999, Kurzweil wrote *The Age of Spiritual Machines*, in which he predicted, Mosco paraphrases, that 'human beings will overcome death as we know it by scanning and transferring their minds to computers, literally digitizing themselves as the world of their atoms erode' (p. 76). It is hard to understand why Mosco has bothered to elevate such twaddle to the level of 'myth'. Or why he fails to consider that there may be some who, while not having escaped physical death, already live on through their works and the records they have left behind: authors, composers, artists, philanthropists, etc. To be fair, Mosco then goes on to cite the philosopher John Searle, who writes that Kurzweil has mistakenly identified 'advances in computational power … with advances in thinking and indeed consciousness itself' (p. 77). This in turn leads Mosco on to John Polkinghorne, former Cambridge physicist turned theologian, and his 2002 book *The God of Hope and the End of the World*, in which Polkinghorne suggests that 'God will preserve souls in the form of information-bearing patterns and eventually bring them back to life' (p. 79). Most people probably do not conceive either cyberspace or immortality in quite these terms, and so this raises the question of whether what Mosco is exploring is the truly mythical, or whether it is merely the somewhat eccentric writings of a few theologically-inclined physicists.

Chapter 4, 'Loose ends: the death of distance, the end of politics' is Mosco's exploration of the myth of the end of geography and the myth of the end of politics. In this chapter there is, as we might expect, a review of Frances Cairncross's *The Death of Distance*, as well as Kenichi Ohmae's *The Borderless World*. But we are soon back to the realm of the supernatural, as Mosco concludes the first part of this chapter with a discussion of Margaret Wertheim's *The Pearly Gates of Cyberspace*, where he tells us that Wertheim maintains not only do we 'move through the round of quotidian material life but also live in … the spiritual and transcendent realm of cyberspace'. Wertheim, he says, believes that our 'culture of space today is most reminiscent of medieval Europe' (p. 94). Mosco finds himself in agreement. He describes medieval Europe as 'always comprised of two spaces—the space of the world, of the struggle for daily existence and the space of the spirit, the Kingdom of God' (p. 95). This leads him on to a discussion of how the Renaissance, through its growing emphasis on the 'natural sciences and their positivist methods' led to the rise of materialism, quite often at the expense of the spiritual; that we have witnessed the ascendancy of a 'neo-spatial worldview' (p. 96). But nowadays, Mosco

maintains, (and I don't think he is paraphrasing here) 'computer communication opens the very real possibility of returning to a dual world where the physical and the spiritual enrich human experience' (p. 98). Spiritual perhaps, but not in a medieval or a theological sense, surely. The second part of this chapter concentrates on a discussion of the end of politics, but gets rather bogged down in long and at times esoteric, discussions of the Strategic Defense Initiative and the Progress and Freedom Foundation.

Chapter 5, 'When old myths were new; the never-ending story' ought really to have been the opening chapter for the book. When Mosco writes, 'Almost every wave of new technology, including information and communication media, has brought with it declarations of the end' (p. 117), we feel that this is where the book ought really to have begun. He continues, and describes the 'remarkable, almost wilful, historical amnesia about technology, particularly when the talk turns to communication and information technology'. We would like much more of this punchy, to the point style, comparing the old myths about radio, electricity, cable television, etcetera, with the current ones about computer and information technology. He makes very good use, among other sources, of Carolyn Marvin's excellent *When Old Technologies Were New*.[1] And he writes, 'Put simply, we want to believe that our era is unique in transforming the world as we have known it. The end is preferred to more of the same; the transcendent to the routine; the sublime to the banal. So we not only view our age as revolutionary. We forget that others looked at earlier technologies in much the same way' (p. 118).

In Chapter 6, 'From Ground Zero to cyberspace and back again', Mosco re-explores the myth of post-industrial society, using for very large part, the real-life metaphor of the twin towers of the World Trade Centre as the basis for his exploration. He shows how the construction of the towers changed the economic character of Manhattan, that what were many small businesses contributing to a vibrant, mixed local economy were levelled in order to allow the construction of the towers that would, in turn, provide an 'office monoculture' for a post-industrial age. One interesting and perhaps little known fact is that on the day before the September 11 attack, there was '8.9 million square feet of vacant office space available in Lower Manhattan alone' (p. 154). But this overly long discussion of the architectural history of the twin towers seems insufficiently justified, and it doesn't really illuminate Mosco's discussion of cyber-mythology, but tends more to obscure it. And both the chapter and the book rather peter out, ending with some rather limp reflections on Salman Rushdie's essay on *The Wizard of Oz*. Mosco writes that 'Dorothy learns that technology puts on a good show, with all the trappings of magic, but it doesn't really get you where you need to go' (p. 183). We can agree, up to a point. Dorothy does indeed have her eyes opened to the wizard's mechanised pyrotechnics, but the myth of the magic is not entirely expunged: she does, after all, return to Kansas courtesy of the red shoes given to her by Glenda, the Good Witch of the North.

On the whole, Mosco's book reads more like a literature review than the essay on cyber-mythology it sets itself up to be. He doesn't so much share his own insights with us, as describe those of other writers, and in so doing, he may be helping to perpetuate some of the very myths he was aiming to expose. At the beginning of his book he writes, 'cyberspace may not be bringing about the end of history, of geography and of politics, but there is much to be gained from studying why it is not doing so and why people believe that it is' (p. 14). But this contradiction is never really explored. Nor does he ever get close to addressing what is potentially the far

more interesting question of whether our *actual* use of computer and information technology in any way supports or refutes the myths that have built up around it. The book also demands considerable foreknowledge of the many primary sources Mosco cites. But if already in possession of such foreknowledge, why should any reader of information studies wish to find themselves bored rigid, yet again, by one more account of Daniel Bell's vision of 'post-industrial' society? After a certain point—and I believe that point is now long past—writers like Mosco are just going to have to take it on trust that we know a little bit about Bell.

The book has many good ideas, but many of them seem never to get off the ground in a way that is either stimulating or truly convincing for the reader. Perhaps the book was too long in production—Mosco says in his own introduction that he began to think about writing the book in 1996—when the Internet as a public domain was still in comparative infancy. Perhaps the project just went on a little too long, and he tired somewhat of it, because this is what some of the editing, if not the material itself, would appear to indicate. And for a writer who asserts that myth is 'mutually constituted with a political economic perspective' (p. 7) it is surprising that Mosco spends little, if any time examining the phenomenon of cyber-mythology in relation to the world's developing economies, with their imbalances of informational and computational provision and access. Equally, he seems almost entirely to overlook the rampant forces of advertising and consumerism that now drive much Internet activity. His concentration on cyber-myths is, in this sense at least, a partial denial of the increasingly economic, transactional reality of cyberspace. The myths he explores have become old and out-dated and they no longer correspond to much of the current reality. There is a sense in which, while this would be an inconvenient acknowledgement for the purposes of this book, it is also entirely in keeping with the essential nature of myth: here today, gone tomorrow, grandiose at first view, minuscule in hindsight, and more often than not, rather mundane in its ultimate reality.

Notes and References

1. Carolyn Marvin, *When Old Technologies were New: Thinking about Electric Communication in the Late Nineteenth Century*, Oxford University Press, USA, 1990.

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Off Course. From Public Place to Marketplace at Melbourne University

John Cain and John Hewitt

Melbourne, Scribe Publications, 2004, 234 pp., $A30.00, ISBN 1-920769-09-9

What has our society done to its universities? Is it really true that universities in the Australian state of Victoria offer a discount of 25% to students who pay their fees up front rather than take out government loans (p. 109)? As if this reward to wealth is not enough to entice the middle classes to university, it seems that the rich can enter the hallowed halls with qualifications 10% more dismal than those of the poor (p. 194)? That *Off Course* makes these assertions only in passing, as if they

could hardly surprise anyone, makes them all the more telling. John Cain—yes, once premier of Victoria—and John Hewitt, both from the Department of Political Science at Melbourne University, have investigated the translation of one of Australia's most prestigious universities (their own) from public institution to commercial business. They narrate a story of incompetence, arrogance and dereliction of duty. The authors have taken care in their investigation, delving into committee minutes and interviewing extensively. This book is a serious one with a serious message, but the plot is worthy of Tom Sharpe or David Lodge, and Tom Wilt, Morris Zapp and Philip Swallow would not be out of place among its ludicrous characters.

Let us set the sorry scene. Melbourne, like nearly all universities in the Western world towards the end of the last century, began to reap what it had sown. Universities had failed to mount even a token defence of the ivory tower: they had flung open their gates and welcomed in the barbarians. Inevitably, the strongest and most vicious barbarians (politicians and employers) seized most, leaving little for the poor and weak (university staff, students and the public at large). Cain and Hewitt complain that universities no longer produce public goods, goods that benefit everyone, and for which everyone pays, but then they never did. Universities have always allowed the rich to rob the poor. What else were they doing when 100% of the population paid for 5% or so to attend? What has changed is the scale of the robbery, and popular acceptance that robbery is right. We have even come to expect that students from developing countries should subsidise the degrees of students from rich countries. Australia has increased its intake of foreign students 13-fold since 1980.

Universities are now supposed to satisfy market demand rather than increase public good. Universities train students for work. There is a market demand for such training and there is no comparable market demand for education. Governments preside over this destruction of ideal by market mechanism, delighting in the ease and economy with which the market allows the production of more and more graduates. In the UK, public funding per student has declined 37% since 1989, but student numbers have grown by 94%. Almost half of all school leavers now go on to university and, at least in Australia, pay for the privilege. The seduction of scale economies has also encouraged the amalgamation of educational institutions. Such size and such change are to be presided over not by bumbling academics struggling to tie their own shoelaces, but by proper managers, managers with vision and mission and MBAs, managers who fly business class and who really do buy business books from the airport bookshop, managers trained in management method, managers for whom a loose shoelace holds no fear. Such managers run a university like any other organisation with workforce, product and market. And thus is the stage set for farce.

With so much more expected of universities, and so little extra cash from the public purse, it is argued that universities had to make good the shortfall through money-making ventures. Rubbish of course; like the frugal housewife, they could have reduced expenditure to match income. Instead, they chose to increase income to match expenditure, a course that satisfied the twin needs of university managers to prove themselves, and to demonstrate in market terms that the university was now producing something of value. The same course also allowed the seizure of twin opportunities: to sell a product that could be represented as almost anything, and to do so unhindered by the legislation, regulation and standards of corporate governance and ethics that fetter companies in the world outside the university. Consider the second first in the behaviour of managers at Melbourne

University. What sort of organisation floats a company, allows its own senior managers, with insider knowledge, to buy the shares, and then conducts an internal inquiry to show that there was nothing at all questionable in these dealings? And the first: what university does not describe itself as the biggest and bestist, not just the finest in the world, but also world class; not just global, but international as well? In an abuse of language and logic, universities tout themselves as excellent in everything. Quality teaching by qualified intellectuals in award-winning courses gives bottom-line results. Cutting-edge research slices its way through all problems, often before they arise. Graduates emerge from a dynamic learning experience fulfilled and personally-developed, well on the way to becoming leaders, team players and pet owners. This is marketing mania, a disease common in university managers and brought on by a combination of greed, stupidity and university training in Management Studies. The afflicted are beset by the conviction that they can create their own reality.

Off Course details several of Melbourne University's most spectacular commercial failures. There was Melbourne IT, a provider of domain names holding a monopoly in the Australian market. An ill-judged issue sold its shares for $A2.20 in a market that immediately valued them at $A8, and in the dot.com frenzy at $A17. The University may have lost a fortune, but at least members of the University Council buying shares at the offer price made one. Then there was Bio21, intended to market the University's medical research capacity (allowing 'one of Australia's highest-ranked research-intensive universities' to contribute to making Victoria 'one of the world's leading biotechnology centres') (p. 128). This particular delusion was to cost the University $A80 million, nothing compared with the losses of Melbourne University Private (MUP), a University company using the University's resources to sell education privately. MUP seems to have started life as a property company seeking $A250 million in the private sector to develop University Square (p. 157). MUP failed to raise the cash, and saddled Melbourne University with the debt. The company was then re-invented to use the Melbourne University brand to sell 'client-driven' masters courses (p. 166). Branding is big at Melbourne. This from the *University of Melbourne Strategic Plan: Perspective 2000*:

> What in other industries would be called 'branding' and 'brand value' will become the primary determinants of industrial competitiveness and student choice. As Disney CEO Michael Eisner has put it more broadly: 'When the choices become vast, the only things that matter are brand names' (p. 188).

Could this be the very Michael Eisner who has so enraged Disney shareholders, the man whose personal fortune seems to soar as the fortunes of Disney decline, the man who claims to have picked up all his management skills while a teenager at summer camp? Eisner, of course, has been removed as Chairman in an attempt to satisfy critics of his management, not a fate likely to befall Melbourne University managers.

Then there is Universitas 21 (not to be confused with Bio21), a consortium of 16 universities (five have disappeared) in which Melbourne plays a leading role, one bought for $A5 million. The advertisements of this organisation are truly remarkable; bearing 16 university logos, they have little room for anything else. Melbourne University has apparently sketched out a certificate to award Universitas 21 graduates (p. 186), no doubt a collector's piece in every sense. In conjunction originally with Rupert Murdoch and now Thomson, Universitas 21 is to offer lifelong distance

e-learning, or whatever. At least the National Tertiary Education Union, if not Melbourne University, is concerned about the company the University is keeping:

> Thomson will be responsible for course design content, development, test assessment, student database management and translation, while 'U21 Inc.' will contribute brand-name marketing power, quality assurance and multijurisdictional certification, and add Thomson Learning's expansive content and course development experience (p. 193).

Monstrous as Melbourne University's commercial incompetence has been, the authors are less critical of the University for being inept than for embarking on commercial ventures at all. These adventures would still have been wrong had they made the University millions. The purpose of the university, Cain and Hewitt argue, is scholarship, to be demonstrated in teaching and research. Making money undermines this purpose. This stance seems just a mite precious. Consider that Oxbridge colleges have been making money in the commercial world for centuries. Never before, though, has making money been considered the university's main purpose, an end rather than a necessary means. The managers of the modern university have accepted the validity of a crass market economy model in which making money is paramount. There is no place at all in such a model for public goods.

Throughout their account, Cain and Hewitt are amazed that the University Council has not stood up against the University's managers. It has rubber stamped when it should have resisted. More surprising, yet less noticed by these authors, is that academics have not screamed in horror at what has happened to their world. Why have they not risen up as one in protest? Academics hardly lack the means to express themselves. And yet, they have been complacent, complicit in their quiescence. Do they fear for their jobs, or have they been browbeaten into no longer caring? Or has the academic mediocrity hired and promoted under the new order managed to suppress heretical thinking? Such academics desperately call each other 'colleague', they happily wear identity cards and often the beginnings of uniform; they serve the organisation. Increasingly, the university controls the teaching and research of academics: in electronic form, whatever the academic tells the student belongs to the university; and the journals in which research is published are now often determined by the university. Once the invisible college of peers set professional standards, but acting professionally has come to mean doing what the university requires. Whatever next? Victorian vice-chancellors will be supporting plagiarism. Can it really be true that the University of Victoria expects an oath of loyalty from its staff (p. 92)? Can it be that there are Victorian academics sufficiently gutless to give one?

Impressive and timely as it is, this book has limitations. The authors themselves are not clear whether they have written a case study the lessons from which might be applied elsewhere, or an exposé of a particularly famous institution gone bad. The occasional unexplained acronym and mysterious parochialism suggest the latter when their efforts are worthy of the former. They present their account as current affairs, thereby lending urgency, but inevitably condemning the tale to the ravages of time. And they occasionally supplement logic with emotion—'we believe', 'we support' (p. 32)—and pronouncement—'Melbourne has to recognise' (p. 35). But these are quibbles, of little more moment than the curious shortage of full stops in the text.

Inevitably, the commercial imperative has encouraged university managers not only to sell whatever the market values, but also to persuade the market to value whatever the university has to sell. This is marketing. Profits may be low, but turnover is huge—degrees are big business—and productivity has soared. High productivity means that the financial cost of producing a semi-literate graduate is low, as is the cost of yet another research paper written to be counted rather than read. The trouble is that these managers are managing in the only way they know, producing a product that the market will value in the short term. For those running the modern university, what the market does not value and the long term are of no consequence. Public good has no meaning for these managers, and reputation, reputation that was once everything for a university, reputation that has taken decades to acquire, is a function of marketing. Consider this from the Head of Communications at your reviewer's own institution:

> The University is planning to introduce next year a distinctive new Visual identity to help it strengthen its reputation … .

And, ultimately, it is Melbourne University's failure to value and preserve its reputation that so appals Cain and Hewitt:

> In the past six years, Melbourne has been embarrassed and made to look ridiculous by the failure of its commercial ventures. It has squandered its considerable competitive advantage in an increasingly deregulated marketplace. Like other universities, Melbourne was swept along by the free-market culture, allowing what was happening in the wider society to provide the excuse for what it was doing (p. 201).

Posterity will judge the likes of Melbourne University, and posterity's judgement will probably be harsh. The best Melbourne University's managers can hope for is that society will also see a funny side, deeming their absurd behaviour as much farce as betrayal.

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Academic Entrepreneurship: University Spinoffs and Wealth Creation

Scott Shane

Cheltenham, Edward Elgar Publishing Ltd, 2004, 335 pp., ISBN 1-84376-454-7

Although university spinoffs (or spin outs as they are often called) are important in today's economy, Shane begins this text by arguing that there has been no comprehensive study providing systematic explanations for and evidence of the importance of spinoff companies … thus 'our knowledge of spinoff companies and their links to universities and society at large is fragmentary and quite limited' (p. 3). This book aims to address that gap by describing and explaining the formation of university spinoff companies and accounting for their role in the commercialisation of university technology and wealth creation in the United States and elsewhere.

Clearly an ambitious book, it is a good scholarly work. Initially Shane is at pains to provide a clear definition of spinoffs and explains how this differs from other definitions. He draws on a huge amount of empirical research from nine projects over a seven year period in addition to primary data not previously published in scholarly journals. He also utilises a wealth of data collected from the association of university technology managers on spinoff trends in the US and from the empirical work of other scholars. Drawing on both qualitative and quantitative data, Shane is able to provide informative figures and graphs as well as highly illuminating quotes.

The book is split into four sections. The first sets the context and explains why university spinoffs are so important—both to universities and society in general. This incorporates three chapters. The first provides a solid introduction, defines terms and outlines the research base. Chapter 2 then moves on to address why university spinoffs are important economic entities and therefore an important subject for scholarly inquiry. Here Shane gives examples of large and well known companies that began as university spinoffs such as Cirrus Logic, and Genentech. The second part of the chapter offers several different explanations for why university spinoffs are valuable, for example that they enable risky technologies that would otherwise go undeveloped to be commercialised. The third and final chapter of this section focuses on the historical development of spinoff activity and in particular points to the importance of the Bayh Dole Act in the US in 1980 which gave academic institutions the property rights to federally funded inventions. Here, though, lies my only real criticism of the book as I would like to have seen more consideration of other aspects of the social and political context. For example in the UK, consideration could be given to the changes in the way research was financed, an increasingly managerialist approach towards the organisation and management of research funds and various government white papers pointing to the need for research to be useful to industry and contribute to 'UK PLC'.

The second and largest section of the book outlines the factors that impact upon the creation of university spinoffs. This section comprises five chapters. Chapter 4 examines the wide variance across universities in their tendency to produce spinoff companies. Shane argues that these differences cannot be explained by the level of technology production but points instead to other factors such as university policies with regard to issues such as equity investment, time-off for spinoff development, the use of university facilities and access to pre-seed capital; the characteristics of the university's technology licensing office; university culture, the prestige of the university and levels of industry funding.

Chapter 5 considers the impact of environmental forces on the rate of spinoff company formation across geographic locations and identifies four factors which influence the level of spinoff activity in a particular location: access to capital, locus of property rights, rigidity of the academic labour market, and the industrial composition of the geographic area. This is an interesting chapter but it concentrates on the US with some comparison to the UK and Canada, where it may have been more interesting to compare to other European countries where levels of spinoff activity are so much lower.

Chapter 6 examines the types of technologies that lead to the formation of university spinoffs. Because established firms have a number of advantages in commercialisation only certain technologies are appropriate to spinoff companies. In particular, Shane identifies radical, tacit, early stage and general purpose technologies which represent major technical advantages and have strong intellectual property protection as most likely to form the basis for a spinoff company.

Chapter 7 explores the industries where spinoffs are most likely to occur. Not surprisingly spinoffs are most common in biomedical industries—Shane provides a convincing explanation as to why this should be the case. He also then outlines other specific industry characteristics that encourage the formation of university spinoffs. The results seem unsurprising—spinoffs are most likely to occur in industries where: patents are effective; which do not require a great deal of complementary assets in manufacturing, marketing and distribution; where markets are more segmented; where there is a young technology base; where average firm size is smaller.

Chapter 8 moves on to explore the role of people in the spinoff process. An obvious focus is inventors who are obviously important influences on the spinoff process. However they do not always lead efforts to spinoff. Shane identifies two other groups of people who may be important—external entrepreneurs interested in founding companies who licence university inventions through technology licensing offices and investors who bring together inventors and entrepreneurs.

Section three comprises three chapters and details the process of creating university spinoffs. Chapter 9 discusses the process by which a university spinoff is created and developed beginning with the initial scholarly activity that leads to university inventions and ending with the discovery of entrepreneurial opportunities and the founding of spinoff companies. Chapter 10 examines the processes by which university spinoffs develop their technologies and identify and satisfy customer demand. Whilst this may differ depending upon the stage of the technology, Shane identifies common problems which entrepreneurs face at this stage, such as market uncertainty and the difficulties of gaining customer feedback. Perhaps the most problematic issue for many is the focus of the next chapter which addresses the financing of university spinoffs. Here Shane looks at the possible sources of funding and the dangers and difficulties associated with each.

The final section includes three chapters which discuss the various implications of spinoff activity. Chapter 12 addresses factors which impact upon spinoff performance. It particularly focuses on human capital, for example the importance of the involvement of the inventor in order to enhance the transfer of tacit knowledge, financial resources, the efforts of new ventures to meet the needs of customers, the new technology, the form strategy and university support. Chapter 13 goes some way towards providing an antidote to the uncritical approach to spinoffs adopted throughout the rest of the book. Here Shane addresses two broad problems in some depth. Firstly he considers the difficulties of integrating spinoff activity into the traditional model of the university. Here for example lie issues such as a reduction of openness and willingness to share ideas, too high a focus on applied research at the expense of basic research and a diversion away from the university's mission of educating students and conflicts of interest for faculty who may be drawn away from academic duties towards the more lucrative spinoff activity. Second, problems of technology transfer, as research points to the high cost of spinoffs relative to licensing and the financial risks involved. Finally in Chapter 13 Shane usefully concludes with a brief summary of his findings and an assessment of the weaknesses of each chapter and the areas which each points to for further research.

On the whole, it is clear from the book that Shane is a huge fan of university spinoffs. He provides a very well researched account of why they are important, how they have developed and the various factors that impact upon them. The book is very well structured. Shane provides detailed summaries at the end of each chapter

and signposts clearly the arguments he is making. He highlights some interesting and surprising findings—for example regarding the relationship between the ownership of intellectual property and the level of spinoff activity. His focus is almost exclusively on the USA, Canada and the UK, with the former receiving the majority of the attention. This would not be such a weakness if his original aim had not been to explain spinoff activity in the US *and elsewhere*. I couldn't help feeling it would have been more interesting to develop a comparison between the US and parts of continental Europe where spinoff activity is much lower, and that this may have added to his explanation of factors that explained the level of spinoff activity. Perhaps, though, this is expecting too much from one book. Shane finishes with a call for research highlighting areas in need of further development. I hope that his call for further research will be heeded and that as a result we may in future look forward to another book providing such international comparisons. In the meantime I would recommend this text as a good starting point for any serious researcher seeking to understand more about university spinoff companies.

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Inventing for the Environment

Arthur Molella and Joyce Bedi (Eds)

Cambridge, MA, MIT Press, 2003, 424 pp., US$29.95/£19.95, ISBN 0-262-13427-6 hbk

'That Ambitious Project'

Being on the cusp of moving professionally into a new realm of waste engineering and environmentally integrated R&D, this book title caught my eye. It is likely, and rightly so, to catch the eye of others in fields of design and architecture, environmental engineering and (hopefully) engineering generally, science policy analysts, and of course academics in fields as disparate as the hard sciences and history. In fact history is the surprise area for this publication, and one not revealed on its cover. Perhaps the subtext on the cover could have read: 'Perspectives on History, Design, Engineering and Technology'.

This is a book as much for time of reflection and creative insight as it is for reference and a launching point for research, and it purposefully blurs the lines of academic disciplines, so be ready for not wanting to read some of the articles, or being confounded with some, as I found myself.

Being a compendium of articles from mostly current day practitioners or historians, be prepared also for auto emissions policy, eco-house design, solar technology and water purification systems sitting alongside tales of the development of Washington, DC as a city, and Nazi Germany's development of a purpose built industry/village zone, explorations of 'natural capitalism' with, wait for it, straw bale house building (and its community nature) and houses of healing. Sense the connections?

This book has been put together by Arthur Molella (Director) and Joyce Bedi (Historian) of the Lemelson Centre for the Study of Invention and Innovation in

the US. The Lemelson Centre is based at the Smithsonian National Museum of American History, which does reflect on the content of the book and in my opinion detract somewhat from gaining a broader global perspective on what is a global topic. Eric Lemelson (founder with his partner Dorothy) notes in the Foreword, the genesis of this book arose out of 'exploring the complex relationship among invention, innovation and environment'.

The overall verdict? Worth a look and many will enjoy segments of this book, with qualifications and with expectations of much yet to come in this field. The inside cover describes the book as 'ambitious', which indeed it is, attempting to bring together the litany of professionals outlined above for this presentation, while simultaneously aiming to appeal to an equally broad audience.

It will disappoint those looking for theoretically grounded thinking—certainly of the structuralist type. There are three separate authors who to varying degrees reference Actor Network Theory (Latour, Law, Bijker, Fujimura *et al.*), understandably so given that framework's malleable nature. Do not expect in depth use of either this framework or others however. Indeed I had at times to question the use of not only the frameworks such as ANT, but the claims of a couple of authors on some matters. For instance, there is a claim made by a sociology contributor that there is an inherent link between the building of straw bale houses and the tacit knowledge for this being bound up in the culture of this 'movement'. I didn't feel this case was successfully argued, though I could appreciate why this view was being put forward as a broader concept. Many elements of design knowledge can easily be lost in a compartmentalized and non-community involving world. Indeed this is at the heart of the matter in terms of finding sustainable science applications for the future. Namely, notions of (engaged) community and culture are as essential as economics and planning, as are the technological artifacts themselves. Ignoring any one aspect may lead to failure of uptake in the first place, the ever-present message for planners and designers alike in this age of sustainability.

While I am not one for needing a specific theoretical framework to house such a broad church of contributors as this, I was perhaps seeking more in terms of the signature of the editors on the overall work, which was not forthcoming. While articles were introduced there was not a lot of linking together in a way to coax out a fraternizing across the disciplines, not least of which with the artisan disciplines of architecture and engineering.

So what makes the book work? It intersperses biography (six in all: Jon Coe; Erick Valle; David Hertz; Devra Lee Davis; Subhendu Guha; Robert Socolow), mostly architects or practicing inventors, with history, practitioners in design and engineering, and those involved in policy areas grappling with, for instance auto emissions reduction. This worked well, made it interesting and surprising, practice with reflection. It is after all a difficult challenge to find practitioners who are equally skilled at reflection. This approach delivered the best of both worlds and highlighted that it is still so difficult to find articulate expert artisans.

Similarly the book introduces well the challenges of the 'Industrial Ecology' paradigm, i.e. design and technology based not on 'end pipe' solutions to say waste problems but design based fully on integration *with* the environment, a key for our sustainable future. Hence it is not about reducing a particular waste product but instead treating it all as resource. This is highlighted by the case of the Danish fjord where a power company began using salt water (rather than limited fresh water) which in turn it sent to a local fish farm (beneficially warm of course), while separately processing SO_2 into gypsum for plasterboard, desulferized fly ash for cement

and sludge to farms for fertilizer. This all requires various integrated layers of course, both technically and socially, as well as politically and economically, to achieve success with. We are clearly still at the early stage in the road on this front.

There are some gems of stories within these pages, such as Jon Coe's (architect) process for community and client consultation in all design work, at both micro and macro levels. Coe's process actually drives the technologies and designs they use, seeing this process as their larger 'brain' as practicing scientists—not the usual perspective. Coe, also flexing his creativity in the realm of poetry, notes about the creative process, which can equally equate to production of technologies: 'arrival is only a break between trips'. Having that perspective on any given technology would refocus the real issues around how the next journey (of consultation, exploration, and ensuring culture 'fit') will be experienced (rather than on how great the last technological artifact was).

What I was astounded by, and which belied a degree of lack of editorial discipline, were the views expressed at the end of the publication, most particularly on proposed sustainable human population levels in the longer term. This seemed to contradict and ignore the progressive crescendo that the book had been leading up to, that there will be many as yet undefined ways of living within rather than separately from nature. Similarly the reference at the end to an inherent presumption of a symbiotic relationship between 'intelligent life forms' and sustainability was perhaps a tad too simplistic and reductionist. It doesn't appear to be intelligence per se that we are lacking, so much as effective social, economic and political processes, and surely that is what the publication was intimating all along.

This combined with the choice of the leading two articles almost derailed my ability to progress with the rest of the book initially (as I, like many read the first few and jump to the conclusion). I persisted and am now glad I did. I believe if only for the unfortunate placing of two fairly average and wafty quasi philosophical treatises which by design would never please everyone, this publication ran the risk of not capturing the attention of those most in need of it, the practitioners of science and technology. As I digested the rest of the publication I warmed to it.

So what could be improved? There was clearly a lack of sufficient international focus and related stories. There was also a lack of sufficient interdisciplinary exchanges, and need for more engineering and architectural practitioners being challenged and challenging others with their problems and achievements.

While historians are present, they are modern historians and a perspective from the deeper past would be useful to couch what is not just a modern day issue (but often viewed as if it is). Similarly while dams are mentioned in this book, tackling some of the biggest dams (Three Gorges, BramaPutra, etc.) and the concomitant social and economic issues as well as environmental debates that have ensured would align with the ambitious project that this is. Lastly some distinctly different stories of cultural approaches (not simply middle-class alternative American) would give depth and flavor to this realm of conversation, and indeed is vital for any meaningful global discussion as to ways and means to achieve widespread sustainable and environmentally integrated science and technology applications.

If the publication did have to stay within the focal confines of America, I was left wondering what about the biosphere (I and II) projects. If ever there was need for reflection on issues surrounding inventing for the environment, indeed inventing *the* environment, it has been this group of projects. Perhaps for the next edition, should it come.

So where to from here? Clearly, as is mentioned by a number of the authors, interdisciplinary teaching, thinking and practice is essential for this field (and by design the long term human endeavor) to succeed. What will disappoint me is if this book does not now assist in catalyzing a fresh line of publications addressing these issues, which flow from conferences, workshops and real world attempts at addressing the critical issues outlined within its pages. It will appeal therefore to a wide range of readers and if so this book will have served its purpose.

Almost all readers should not expect to enjoy every article, but therein lies the beauty of edited books with an eclectic range of contributors, and indeed both the challenge and the result of bringing disparate fields of thought and practice together under one roof of practice. Given this is the intellectual cultural challenge for the human species for the twenty-first century, the editors can be forgiven for at least some of the resulting blemishes that occur as part of this natural early adolescent phase of this challenging project.

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