biotechnology. Also, the nature of the university or government laboratory interactions with companies is very different, being shaped largely by the fact that, up until recently, research laboratories have been a major customer of parallel computing. The authors report that, as parallel computing is finding a wider market, the importance of industry university connections in that field is diminishing.

The authors expressly note two different kinds of benefit that the companies they interviewed drew from universities and governmental laboratories: knowledge, and assistance in solving particular kinds of problems. In the case of biotechnology and ceramics, there apparently were a number of cases in which materials developed at university or government laboratories were of direct use in industry.

The Faulkner–Senker study is a useful contribution to the growing understanding of scholars of technical advance about industry–university linkages. In my view, the study contributes to, and reinforces, two basic themes that increasingly have been highlighted by scholars working in this field. First, it is misleading to talk about industry–university interactions in general: these differ greatly from field to field. And second, the notion that the principal role of universities in research is to generate 'inventions' that subsequently are developed by industry is almost completely wrong, at least in most sectors.

The book provides a much broader context and more detail, than does the article in *Research Policy*. However, even in the book the reader has the sense that the authors know a lot more about the subject than they are telling the reader. In particular, this reader would have welcomed much more in the way of detailed case studies. In my view, the authors have tried too hard to develop a 'scientific' research design and to present their findings in clear cut 'scientific' form. It would appear that they would have been happier had they been able to obtain and present their findings in the form of numbers. In the end, they present their verbal qualitative findings as if they were 'number like'.

However, perhaps the most interesting unit of observation for studies like this is the 'case history'. A case history often can be summarized in terms of a relatively small set of 'variables', but the history itself is much richer than any such description. And the presentation of only the 'summary statistics', without also providing the richer detail in the case histories, may leave the reader with the feeling that he or she does not really understand what is going on. This is a good and useful book. I think it would have been even more useful and more interesting had the authors included in it a number of the detailed cases that their interviews must have been about.

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Peter Swann (Editor) *New Technologies and the Firm* (Routledge, London, 1993) 383 pp., £45.00, ISBN 0415 08128 8.

This book gives details of a research conducted in the UK with the main objective of finding explanations for Britain's economic decline related to the management of technological change. This work discusses themes of great interest for scholars of technological change and for policy makers. The work is divided into five parts which cover the following themes:

– the organisation and contractual framework of the firms dealing with technical change;

– the role played by firms' 'visions' and 'culture' in shaping the trajectories of organisational change;

– the interactions between 'technological visions' or 'business paradigms' and the evolution of market structure;

– the patterns of diffusion of process and product innovations and the marketing strategies of high-technology small firms;

– the comparative advantage of small and large firms in innovative activities;

– the sources of firms' innovative activities (including the collaboration with users and co-specialised firms);

– the constraints on innovation in the labour market and the financial market;

Chapters 1 and 2 describe the theoretical approach and report on some original empirical evidence. The authors claim that the firm's ability to manage innovation and to sustain long-term performance relies both on technical expertise and organisational design. Chapter 1 argues that the contractual and organisational architecture of the firm should be based on 'relational' or loosely defined structures, implicit contracts, appropriate incentive mechanisms and flexible interfaces between functional groups. Chapter 2 reports on some case studies showing that in the UK, 'relational' architectures and inter-functional integration are diffused among young, fast growing firms in the electronic sector. The role of organisational design in the management of innovation is discussed again in chapter 4 where the concept of 'strategic paradigm' is introduced as an intellectual construction based on technological design, organisation and the managers' vision of competitors. Strategic paradigms affect the accumulation of skills/knowledge and the direction of R&D activities. Like Nelson and Winter's organisational routines, business paradigms are selected in the technological and market competitive arena. The long run performance of the firm depends on its ability to discover and maintain a 'good' business paradigm.

Chapters 6 and 7 discuss the economic implications of three stylised facts: a. the training needs are increased by the adoption of new technologies and firms lack the resources and private incentives to invest in training; b. training policies are decentralised at the regional level even in large, multinational firms; c. the employment of scientists and engineers at the top management level is positively correlated with the firm's technological and economic performance. The authors suggest that public policies directed to the training of human capital should have a regional basis (e.g., local training co-ordinating agencies) to meet local requirements for skilled personnel. These policies seem particularly important for countries like the UK where firms appear to underestimate the training needs associated with the introduction of new technologies. This 'myopia' may be associated with the low professional qualification of corporate managers and administrators in the UK (less than 20 per cent have a degree or equivalent qualification). Another related explanation could be the organisational architecture of the firm. Hierarchical holding companies, managed by non-technical chief executives may be less committed to the accumulation of skills. Future research in this area could benefit from a more explicit analysis of the links between the training policies described in chapter 6, the employment of scientific and technical skills (chapter 7) and organisational design (chapter 2).

Chapter 8 provides empirical support for the idea that the lack of information and the uncertainty surrounding the adoption of a new technology delay the diffusion. Moreover, it is shown that the diffusion of innovation is affected by differences among potential adopters. Large firms may lead the adoption process if there are economies of scale in the use of new technology. As the cost of acquisition of technology falls over time, new (smaller) adopters will adopt the new technology (even though the expectation of the fall in price delays the diffusion). An interesting implication is that in geographical areas and industries where there is little asymmetry between firms and low market concentration one should expect to find small rates of diffusion. Public policies targeted to the diffusion of information on new technologies should be particularly recommended in such conditions.

Another important issue raised in this book concerns the links between innovation and market structure. Previous empirical studies have studied this theme by trying to test the two 'Schumpeterian hypotheses' without reaching congruous results. This book contributes to this debate in two ways.

First, chapter 3 indicates that British small firms have a marginal role in the production of innovation and the economic growth at the local level. Their innovations are limited to few sectors (e.g., electronics and medical equipment) and address niche markets. Moreover, their post-innovative performance varies across sectors and regions. These findings cast some doubt on the potential impact of technology policies aiming to provide a generalised support of small firms. Second, chapter 10 provides a model which relates the evolution of comparative advantages of large firms and their smaller counterparts to the nature of technical change. Unexpected technical change, that is the emergence of new trajectories that contradict the 'technological visions' of incumbent firms, opens 'windows of opportunities' for new

entrants and results in reduced market concentration. By contrast, anticipated technical change favours incumbent firms and has a concentrating effect.

To conclude, if it is true that any piece of art can be interpreted according to the observer's perspective, this is particularly so for this work because of the variety of issues and approaches which it encompasses. The editor is aware of the fragmented picture proposed in his work ('much work remains to integrate these many fragments..', p. 367). However, I agree that this heterogeneity reflects the variety of 'multidisciplinary perspectives' which characterises the economic and social research on technical change.

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Ove Granstrand (Editor), *Economics of Technology* (North Holland, Amsterdam, 1994) 496 pp. ISBN 0444815066, $128.50.

Economics of Technology is a collection of essays, which are carefully organised to highlight that this is now an established discipline. Two features of the essays must be emphasised. First, they reflect the inter-disciplinary nature of this subject. The economics of technology draws from history (the essays by Hughes, Lindqvist, Wengenroth), economic history (Dahmén, David, Rosenberg), evolutionary economic theory (Dosi and Orsenigo), international trade (Soete), industrial economics (Carlsson et al., Phillips et al, Scherer), business studies (Fransman, Hakansson), bibliometrics and technology studies (Grupp), industrial management and economics (Eliasson, Granstrand). Second, unlike many other fields in economics, this one is inherently 'cosmopolitan'. The assorted origins of the authors that appear in this book attest to how the field has nicely merged the scholarly traditions of countries like Sweden, Italy, Germany, and of course Britain and the US.

Ove Granstrand's introduction helps the reader realise the multi-faceted, cosmopolitan nature of this subject. Apart from his historical recollection of the origins and developments of the field, his bibliometric exercise of the most cited authors in economics of technology is more than a curiosity. Citations of technology scholars have grown over time, which suggests that the field has expanded, and it has gained increasing recognition. Moreover, any established field has its own 'gurus'. Ranking of citations shows that Mansfield, Nelson, Rosenberg, Griliches, Arrow, Freeman, and Dosi (apart of course from Schumpeter) are its 'pilgrim fathers'.

Some of the essays in the book address issues that have been at the core of this field for quite a few years now. We find analyses of the relationships between technical change and market structure or long-term growth (Phillips et al., Wengenroth, Yakovets, Lindqvist), technological competition (Scherer), technology policy (Soete), technology and the theory of the firm (Eliasson), system analysis for understanding technological and economic dynamics (Granstrand). Among the 'classical' topics I would include 'evolutionary theories', which has been one of the most important attempts to provide an analytical framework for understanding the dynamic relationships between economics and technology. The chapter by Dosi and Orsenigo illustrates how the tools of evolutionary theory can be employed to explain a set of 'stylised facts' of modern macroeconomic theory. Finally, the book includes some essays that look at new important areas of enquiry, like the economics of science (David, Rosenberg), the economics of technological relationships (Hakansson), the role of knowledge as an asset (Grupp) and its relationships to patterns of integration and division of labour (Fransman). All in all, the book is a successful attempt to provide insights into old and new questions in the field, and it is a 'must' for those who would like to know where we are and where we are going in technology studies.

Books like this also prompt thinking about some broader questions – does the fact that we can now celebrate a well-defined set of achievements imply that economics of technology has left its pre-paradigmatic phase, and it is entering into its 'normal science' trajectory. In part, this is so, and the book points out how and why. Yet, we are still left with