"no leisure activities without massive technological underpinning" (p.213). For someone who repeatedly cites Gershuny, it is strange to ignore the possibility of continuing to go for walks, play string quartets, read books and cook dinner for friends.

Ultimately, I think, *Wayward Technology* should be judged as an essay. Scholarship and pedagogy are there in the background, but they are not dominant. I hope it is not too pretentious for me to say that this book is an attempt at *belles-lettres*. Some people, I know, find it difficult to accept the notion that *lettres* can be *belles* when the subject is technology. I find no such difficulty. My three word summing up would be a phrase which literary critics use of books that don't rank as quite serious enough to deserve the full scholarly treatment: 'a good read'. In using this phrase, I am aware of the danger that some may misinterpret it as damning with faint praise. That is not what I intend. Not at all. There are not many books on technology that can truly be described as 'a good read'.

Fred Jevons
Deakin University

Knowledge: Its Creation, Distribution, and Economic Significance, Vol.III, The Economics of Information and Human Capital *by Fritz Machlup* (Princeton University Press, Princeton, N.J., 1984) pp. xix + 644, $US 50.00., ISBN 0 691 04233 0.

This is one of the great economics books of the 1980s. Let me quote from the foreward by T.W. Schultz because I thoroughly agree with him:

> In breadth and depth, this is a unique book in economic scholarship. The historical roots of the ideas are richly documented. The analysis is based on theory and evidence. What is said is lucid. The advances in the economics of information, and in human capital, are presented clearly both for economists and for intelligent general readers who are not concerned about the technicalities of economics . . . .
>
> The hallmark of the work of Professor Fritz Machlup is in its comprehensive scholarship, in relating each of his specific studies to the general core of economics, in seeking the linkage between theory and evidence, and in his command of the art of writing. I think of Alfred Marshall, Joseph Schumpeter, Jacob Viner, and Harry Johnson for a corresponding set of talents.

Machlup was a pioneer of information economics, although he himself stressed the strong roots to be found in old writings. This volume, completed before his death in 1983, is the third in the revised and much expanded version of his work, *The Production and Distribution of Knowledge in the United States*, published by Princeton University Press in 1962. The earlier work inspired much of the empirical thrust of information economics. This Volume III can be expected to influence greatly research and teaching in information economics.

Volume III of *Knowledge* examines in clear and elegant prose the roles of knowledge and information in economics. Part One analyzes the effects of

new or uncertain information on market performance, examines the formation and successive revision of expectations, and provides a classification of literature and an extensive bibliography. The problems of technological innovation, the provision of public goods, and attempts at central planning on the basis of widely dispersed information are given special attention. Part Two treats private and public investment in human resources and in productive knowledge as 'formation of human capital'. It discusses private and social valuations of education and training, the controversy over 'nature vs. nurture', the issue of 'credentialism', and the depreciation of human capital.

In this brief review I shall attempt to discuss only two aspects of the role of information in economics and in the economy as it has been analysed by Machlup; first, the wide scope of information economics and the pervasiveness of the effects of information on the economy; and second, the linkage between information and forms of organisation.

Having followed closely the development of information economics for many years, I understand all too well Machlup's remark that "a good many economists are not aware of [its] wide scope". He went on to catalogue what they think 'it' is. These approaches range, in all too familiar fashion, through the optimisation of a communication system, the decentralised use of widely dispersed information, and the creation and use of new technology, to the measurement of the information sector relative to GNP. As he pointed out, "all these concerns are part of the total, but none can reasonably be regarded as the sole concern of the specialty". (p.6, n.2).

He saw two major influences upon economics. Theoretical work is changing to place increased emphasis on knowledge, ignorance, uncertainty, and information and is being changed by new 'technology', e.g., computerized methods of simulation. Empirical work now has more data and greatly enhanced capacity to process masses of data.

The so-called information revolution has considerable impact on the economy: a changing pattern of investment in equipment and skills, more rapid communication and revision of expectations, and "the increasing dependence of the information economy on the uninterrupted supply of electricity"! (p.41).

Machlup develops a classificatory system for information economics that reflects this wide scope and pervasive impact. His new classification is as follows:

The Economics of Knowledge and Information: General
Production and Distribution of Knowledge: Knowledge Industries, Information Services, and Information Machines
Ignorance, Chance, Risk, and Uncertainty as Factors in the Explanation of Individual Choices and Particular Economic Institutions and Phenomena
Uncertainty, Risk-Aversion, Venture Spirit, Innovativeness, and Alertness as Factors in the Explanation of Entrepreneurship and Profit
New Knowledge (Invention, Discovery) and Its Application (Innovation, Imitation) as Factors in Economic Growth
The Transfer of Knowledge and Know-How
Economic Forecasting
Cost and Value, Private or Social, of Information and Alternative Information Systems
Decision Theory and Game Theory

Decision-Making by Consumers with Incomplete and Uncertain Knowledge
Decision-Making by Workers and Job Seekers with Incomplete and Uncertain Knowledge
Decision-Making by Private Firms, in Various Market Positions, with Incomplete and Uncertain Knowledge
Policy-Making by Governments and Public Agencies with Incomplete and Uncertain Knowledge
The Formation and Revision of Expectations and Their Role in Economic Dynamics
The Role of Information, Knowledge, Expectations, Risks, and Uncertainty in the Functioning of Markets and the Formation of Prices
Prices as Information System for Resource Allocation and Product Distribution in Market Economies and Planned Economies; National Programming and Planning
Human Capital: The Accumulation of Knowledge and Skills

This broad approach has caused a leading scholar to take the view that information economics is this generation's general framework for the analysis of any question of economic efficiency.[1]

The other aspect I should like to touch upon is the linkage between information and forms of organisation. Machlup acknowledges that the information revolution can change the organisation of firms (p.39), but neither the classification system nor the lengthy sample bibliography (Chapter 11) pursues this theme. The Williamson-type work on organisation, for example, does not rate a mention and while some of K.J. Arrow's contributions are mentioned, there is no discussion of his thesis that specialisation in information gathering is the most important instance of the economic benefits of organisation.[2] I touch on this linkage aspect because I believe it is becoming the leading edge of research in information economics.[3] Perhaps Machlup's treatment reflects his opinion that the market mechanism is "the largest and most effective information system in existence".[4] From that viewpoint it would have been difficult to develop analysis of the organisation as a variable, bringing the advantages of co-operation but also the disadvantages of organisation obsolescence.

D.McL. Lamberton
University of Queensland

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