

by the move, hence it is not justifiable to claim that the move is socially an improvement. Little therefore proposed that the move should be regarded as an improvement only if the distribution is not worsened.

In the context of the state of the literature in the 1950's, these points were extremely timely. But much has happened since 1957 and both aspects have been extensively researched. Even by the late 1960's substantial changes had taken place, excellent testimony to which is available in Amartya Sen's classic *Collective Choice and Social Welfare*, first published in 1970 (San Francisco : Holden-Day). If anything, the tempo quickened in the 1970's, the major contributor being Sen himself (see his *Choice, Welfare and Measurement*, Oxford : Oxford University Press, 1982). The present book is not a new edition, only a reissue. It is therefore not expected that these substantial subsequent developments be incorporated in the contents. However the nagging question that will not go away is this : exactly who will be asked to look up Little's 1957 book? The new preface by the author makes no attempt to put the arguments in the perspective of subsequent developments, and whatever comments the author has to offer are anecdotal and cursory, and confined to debates of the fifties and sixties. Since there are no references to subsequent literature, new readers may conclude that welfare economics of the post-1970's period took a direction that had nothing to add to the concerns dealt with in Little's book.

That would be very misleading.

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***Perspectives on Industrial Ecology*** by D. Bourg and S. Erkman (Eds.) (2003)  
Sheffield : Greenleaf Publishing. 384pp. £40.00, US\$75.00.

As growing evidence of the ecological unsustainability of economic activities accumulates, the major share of the blame is being borne by the industries. Starting from the period of the Industrial Revolution, the industrial sector has been accused

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as the main culprit, as the source of pollution. These frequent allegations, in the face of rapid environmental degradation, were perceived as a barrier to continued development in the globalisation process. Understandably, the main concern for the industry was to generate a pathway towards sustainability. It was in response to this search for sustainability, that the concept of Industrial Ecology was advanced as a powerful metaphorical alternative to the business-as-usual approach to industrial growth. The book under review, *Perspectives on Industrial Ecology*, edited by Dominique Bourg and Suren Erkman, is a compendium of papers presented at the Troyes Conference held in September 1999. It is an effort to consolidate this emerging concept further.

An emblematic foreword by President Jacques Chirac of France acts as a presage for the readers; to warn them of the impending dangers when nature's regenerative capacity is exceeded or endangered due to its excessive consumption by the global economy. The impressive prologue thus initiates the momentum of the endeavour with which this book has been crafted. 'The honour of the human race lies in being capable, when in danger, of surpassing itself in intelligence, of inventing solutions even when they appear unattainable, of opening up new ways forward, of transforming problems into opportunities' (p.12). The sections that follow include contributions from eminent professionals from diverse disciplines, some of whom have been instrumental in shaping the concept of industrial ecology as it stands today.

Modelled on the natural ecosystems, the concept of Industrial Ecology has been developed as an idea which looks for synergistic benefits through transformation of the linear materials or energy flows to closed ones. It thus optimises these flows within a firm. Split into three conceptual segments, the first part of the book deals with the diverse ideas of industrial ecology that forms part of the existing literature on the subject and essentially points out the conceptual difference between 'industrial metabolism' and 'industrial ecology'. The opening chapter by Stefan Brinzeu points out that, in order to understand the structure, quantity and quality of the industrial metabolism, analyses of material flows from resource extraction to final waste disposal becomes an imperative (p.22). Hence, the strategy adopted by industries has been to either reduce the impact potential per unit of material flow

(detoxification) or reducing the volume and structure of material flows (dematerialisation).

The article by Marina Fischer-Kowalski in the subsequent chapter, opens up another dimension to the existing picture of 'metabolism', in that her exposition progresses from the metabolism in a biochemical perspective, as in a cell or organism, to the metabolism that is taking place in an ecosystem. She adds that, 'it is not just society and technology that mould the natural environment; it is as much the environment, however modified by human action, that in turn moulds the opportunities and the problems society faces' (p.44). This means that, any efforts to change the metabolism of industrial societies would mean 'profound socio-economic change' also. Playing a major role in this catalysation process have been the inimitable advancements made in the technological field. Being a powerful vector of global change, technological expertise thus, has undoubtedly led to massive fluxes in matter and energy. But, it has now simultaneously become 'part of the problem as well as part of the solution' and this inherent 'paradox' has been the subject of examination by Arnolf Grubler in Chapter 3.

The second part of the book clubbed under the section 'Ideas in Action', views industrial ecology as part of large industrial systems and essentially starts off with the idea of creating an economically recyclable solution for industries by physical characterisation of sub-micron size residues (wastes) aiding in separation and recovery of individual components. The article by Thierry Kazazian in Chapter 7 leads us from the end of pipe approach of treating wastes to the pragmatic concept of Ecodesign, which internalises environment into the product design and fabrication process itself and involves a 'holistic multicriteria approach to environment' (p.82). The succeeding chapters 8 and 9 by Jean Francois-Valles and Judy Kincaid respectively, deserve special mention. The former cites case studies of firms, which have cooperated to manage their wastes collectively. The latter indicates the potential cost-saving partnerships between organisations in the same neighbourhood having complementary needs for material and energy. In Chapter 12, Colin Francis presents a similar perspective from the chemical industry sector by citing the case for the production of polyvinyl chloride. The flow diagram and the figures chart

out the possibilities of cooperative arrangement between organisations, when one company's by-product features in the raw material list of another.

To further facilitate the process of reducing the material and energy throughout, organisations now employ a wide variety of tools and methods developed from industrial ecology principles to capture and incorporate knowledge about the environment into their designs and operations. Kjetil Roine and Helga Brattebo have limited themselves to the treatment at post-use phase of the product's life cycle and have proposed a methodology, fairly different from other frequently used systems-oriented approaches like life cycle analysis and cost benefit analysis. According to them, their methodology, in addition to pointing out the environmental burdens, can be used to assess 'additional performance quantities and qualities as well as mechanisms and their dynamics in the system' (p.110).

Departing from the preventive and curative measures adopted by firms, Chapter 13 by Raymond Nyer and Diana Bendz bares the concept of 'enterprise integration' and consolidates the idea through the case study of an IT industry (viz., IBM). Nonetheless, Paul Baudry and Arnaud Ansart have warned that the formal analogy (of industrial systems) with natural ecosystems as a basis for reflection 'represents a restrictive view of industrial ecology, which should be considered on a wider basis' (p.152). As an important segment of the society that produces goods and services, industries are an important, but not exclusive source of environmental damages. In view of this fact, Rolf Marstrander appreciates industrial ecology as a valuable platform for strategic thinking in the metals industries. He further feels that probably the largest single challenge for metallurgy is to raise awareness of alternatives to steel (p. 159), so as to allow a mini-revolution in the area of manufacturing technologies and the understanding of light metals. The oil and gas sector gains representation as well, through a case study presented by Bernard Tramier in Chapter 16.

The third segment of the book as 'Future Challenges' is oriented to dealing with the challenges for the future. Indur Goklany draws attention to the sombre fact that although the indicators for assessing the quality of life reveal a better picture of

humanity today, 'suspicion of new technology (as in genetically modified crops) is widespread'. The need then for environmental policy actions appear all the greater. Jan Nill and Ulrich Petschow provide an exploratory insight into the possibilities of a Green Industrial Policy (GIP) aimed at integrating the negative environmental 'externalities' into a firm's set of activities. The author however, regrets that improper political system has been the major impediment towards the fruitful implementation of GIP and suggests that political agenda setting is quite important in framing expectations and to change R&D priorities.

In Chapter 21, Chihiro Watanabe and Bing Zhu presents a case study, clarifying the rationale behind Japan's dramatic improvements in energy efficiency and technological advancements. The success, attributed primarily to the industry's efforts to substitute technology for constrained production factors (such as energy, labour, capital), bears semblance to processes within ecosystems in which, in order to maintain homeostasis, when one species slows down, another speeds up in a compensatory manner (i.e. by substitution). An important outlook which gains introduction thus, is that 'the best solution in a subsystem is not necessarily the best solution for the system as a whole' (p. 260).

Lately, the importance of the rather nascent field of industrial ecology has further intensified from the aspirations of many, who have been involved in its development. Frequently connoted in literature as the 'Science of Sustainability', in the last few decades, Industrial Ecology (IE) has opened up an entire gamut of activities to bring in the concept of sustainability into the mainstream activities of business and industry. Walter Stahel in Chapter 22 has taken up this question of sustainability. In his opinion, the most efficient strategies for achieving greater sustainability are those based on sufficiency and not efficiency, for which he proffers the prescriptive idea of a service economy, shared utilisation of goods (e.g. car pools), using maintenance free long life products etc. However, Thomas Graedel presents the case of urban transportation system to conclude that we have overemphasised automobiles as products and under-emphasised the transportation system as a whole. He thus recommends the building of new urban transportation system as opposed to making small changes to the existing dysfunctional systems.

As a framework for scientific research and action, the concept of industrial ecology becomes all the more pertinent in a country like India. Chapter 25 by Ramesh Ramaswamy offers insight into this aspect. 'In developing countries, instead of framing environment management plans based on a strategy of just limiting harmful emissions from industrial activity, it may be more appropriate to develop plans that would optimise use of resources' (p.307). Considering the economic size and the considerable constraints on the availability of resources in a developing world, the framework offered by industrial ecology allows a realistic valuation of resources used. And as firms are taking voluntary initiatives to enable the industrial system to manage human activities on a sustainable basis, Helga Brattebo believes that an exposition to the practical orientation of industrial ecology in industries should help in fostering a successful university-based approach towards this emerging 'paradigm'. The institutionalisation process in effect would also act as a catalyst to fashion the normative idea to a functioning principle.

Finally, the concluding chapter by Suren Erkman, one of the pioneering champions in the field of industrial ecology, gives a summarised overview of the understanding that prevails over the concept and admits that the field is, relatively recent. And as a conceptual base for finding solutions, 'the relevance for the industrial system of many concepts and theories such as symbiosis, mutualism, parasitism, population dynamics, ecological succession, trophic chain regulation, etc. remains to be explored' (p. 339). The conception of Eco Industrial Parks (EIP) and Networks (EIN) as attracting a cluster of industries having complementary needs, verily has been an encouraging step forward.

Interspersed with illustrative case studies and figures, the various chapters of the book have been thoughtfully handled by the authors who are particularly qualified to deal with practical issues. The strength of the volume lies in its treatment of various ideas to draw out the wealth of information that constitutes the core concept of industrial ecology. Whilst this book would prove to be useful in the consolidation of the academic knowledge related to the tools and techniques of industrial ecology, it would undoubtedly impart knowledge to the industrial sectors, which have not been mentioned therein. It is expected that the sector-specific case studies, provided in the book would act as a guiding light for students and practitioners alike in

renouncing the profligate ways of the past. To summarise, the purpose of the volume can be summarised in a remark made by Judy Kincaid in Chapter 9 that, 'webs are there in life, but we often don't see them until we look at them in the right light'. For scholars and students of management, time has come to look for that new vision, without which the future of the industrial system is not safe.

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