Free Boundary Problems: Theory and Applications. Colli, P., Verdi, C. and Visintin, A. (eds). International Series of Numerical Mathematics, Vol. 147. Birkhauser Verlag, P. O. Box 133, CH-4010, Basel, Switzerland. 2004. 346 pp. Price: US $129.

Physical laws describing many natural phenomena are formulated in terms of partial differential equations. In hydrodynamics, for example, a fluid is described by the space–time-dependent density, velocity and temperature fields, and the well-known Navier–Stokes equations describe the time-evolution of these in terms of coupled partial differential equations. In order to solve the equations, we need to know the boundary conditions. However, in many cases, for example, the motion of ripples on the surface of a liquid, the boundary of the fluid is itself not fixed and moves according to some rules. Such problems are called free boundary problems.

This book is a collection of papers presented at a meeting on free boundary problems at Trento in June 2002. The different problems addressed include the mathematical theory which studies the existence and uniqueness of solutions, the numerical techniques for solution such as the finite element method, and applications of the method in fields ranging from polymer structures formed by solidification from melt by random nucleation, image processing, modelling of crystal growth from melt, spread of farming technology in a model of interacting populations of hunter-gatherers and farmers, etc.

It seems difficult to give a flavour of all the different topics discussed, specially by a reviewer, who thinks that proving the existence of solutions and finding them numerically using computers is best done by others: men and women, whose tireless pursuit of such problems has brought them fame and acclaim, or failing that, by industrious graduate students, who have no choice in the matter. To the credit of the editors, while the different articles necessarily vary in style, content and difficulty of material, they are all reader-friendly. They introduce the problems and present their results in jargon-free terms, so that readers with diverse backgrounds can follow the material and let the beauty of the subject speak for itself.

Consider, for example, the engineering problem of design of the shape of a cantilever. One wants the structure to be able to support a given amount of load, but minimize the material used. As is well-known by now, one can save material without sacrificing strength, by designing in holes in the structure. One sets up an initial trial shape of the structure with some holes, and then moves them, or changes their sizes in small steps, computing the stresses at each stage, to decide the amount and direction of variation. This is chosen to make the holes in wrong places shrink, and they are made bigger in favourable places. One tries small changes of the boundary of the holes to change the shape of holes. After some iterations, one gets a near-optimal structure. More generally, the quantity to be optimized need not be the amount of material, but some calculable number for each shape. As with other optimization searches, what one gets is a local optimal solution. A different starting structure could give a different result.

In hydrodynamics, if one pushes a light, low-viscosity fluid hard from a nozzle into a dense, high-viscosity fluid, initially the light fluid would form a bubble near the point of injection, but if the injection pressure is large, one gets a 'viscous-fingering instability', in which the light fluid breaks out into the space occupied by the other in a few thin irregular branches, which branch out into more fingers, giving rise to a tree-like structure. Conversely, one could have a blob of viscous oil surrounded by a lighter medium (water), and we remove the oil by a syringe. It is observed that the initial smooth shape of the blob changes abruptly by forming irregular fingers of water growing inwards as the oil is removed. Another example of finite-time singularities developing in moving surfaces is a soap-film formed between two circular hoops in the shape of a curved surface of a cylinder. If the distance between the hoops is increased slowly, the minimal surface develops a 'neck', which becomes narrower and narrower, pinching-off to form two disconnected surfaces.

As another example, consider the formation of a solid from a melt. The solid-formation occurs by nucleation, which may be assumed to occur randomly at a uniform rate throughout the liquid. Once a nucleus of the solid phase is formed, liquid near it is changed to solid, so that this will grow outward, at a uniform, perhaps orientation-dependent velocity. This continues to occur, until the boundary of growing solid grain meets that of another growing grain, at which point the growth stops locally. Elsewhere, in the region of space still occupied by the liquid, new nuclei continue to be formed, and grow, until all the material becomes a solid. The final resulting pattern consists of a conglomeration of a large number of crystallites of different sizes. This seems to describe well the structure of several polycrystalline materials. Experimental data from real materials about the mean density of interfaces, distribution of sizes of grains, distribution of lengths of edges, etc. can be fitted well using such models.

There are many topics discussed here. The book is certainly recommended for those whose work involves moving boundaries: it will make them aware of how the same ideas show up in many different places, and help them use the insights of one field into others. Others would find a casual browsing of the book useful. Given the increasing cost of books, and the reduced budgets of most libraries, there is justifiable reluctance of librarians towards conference proceedings. Presumably, most of the material is available elsewhere but scattered in different places, and not a pleasure to browse, which this book certainly is.

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Technology Transfer: Strategic Management in Developing Countries. Goel Cohen. Sage Publications India Pvt Ltd, B-42, Panchsheel Enclave, New Delhi 110 017. 2004. 336 pp. Price: Rs 550.

This book comprises seven chapters followed by conclusion. It is an attempt to provide an analytical framework to the understanding of the process of technology transfer. The author has been successful in pointing out systematically the problems (in developing countries) of understanding of technology and therefore its evaluation and assessment. He also sets forth through several sections of the chapters, a good methodology to un-

derstand the actual context of technological change and has opened up through the analytical framework, the nature of the 'technology black box'. He has, by and large, achieved the objectives set forth in the book (see pp. 28–29). He has also addressed the elements of innovation, technological change and development, quite comprehensively.

All through the chapters he has made copious references and thus brought out the historic development of ideas and approach to the issues addressed. He has also pointed out the approaches that are relevant in the current contemporary context. In the author's view, 'Innovation is therefore a term covering everything from invention (the conception of a new device, approach, product, process or system) to its first commercial use, and includes improvements in existing technology'. He further elaborates and defines the concepts of 'major' and 'minor' innovations. While discussing diffusion of new technologies, he points out that particularly in developing countries, minor innovations have a cumulative impact on the technoeconomic system and therefore can lead to greater productivity increases than those initially possible from major innovations. He adds that the capability for small innovations can only stem from the efforts of organized firms to develop these capabilities. If the policy and decision makers for S&T systems in our country had understood this fact, their approach to the programmes of national laboratories would have been different.

The chapter on technology as a process of concepts, perspectives and dimensions is comprehensive and brings out various definitions and concepts. This chapter is a must to understand other methodologies brought out in the book. In the chapter on technology transfer the author specifically states: 'Generally confusion still prevails as to the difference between "technology trade" and "real technology transfer". The former is merely the import of equipment and the execution of projects on a turnkey basis. The latter involves mastering the imported know-how of core technologies and the development and generation of technologies utilizing indigenous scientific and technological capacities.'

Another important feature of technology transfer process pointed out by the author is, 'we must recognize the importance of the more qualitative aspects of process and the difficulties involved in attempting to quantify them. The difficulty is magnified when it becomes necessary to distinguish between the "ability to use" and the "ability to master" a complete process from design and development through to production and marketing. It is this second capacity that characterises a more complete technological mastery'.

The two quotations from the book are to emphasize the need for a total look from idea to market, which is almost totally missing in S&T policy instruments or procedures or other industrial policy or procedure instruments, including those aimed at helping small and medium enterprises. Even some of the technology-funding mechanisms created recently do not allow for such a comprehensive action package. The development banks and venture capitals as well as the special development funds with the Government ministries, have hardly touched the technology mastery aspects; they have more or less been confined to 'technology trade' and at best some training of the staff to operate the new machinery and the new software. Movements such as TQM, Energy Audit, ISO certification, etc. do not fully touch the core of technological mastery. The proof of these statements above can be seen from the fact that most companies have to resort to 'modernization plans' after about a decade, to repeat the whole cycle of 'technology trade' and mineral absorption to be commercially viable in the short run. So is the fate of a few successful technology transfers from our academic institutions or national laboratories to industry. They survive for sometime and the companies often learn to import newer technologies from abroad because, often the technologies transferred from the laboratories are not the most contemporary as is available through trade. The author has addressed the processes of technology mastery well, starting from the initial acquisition.

The book contains a number of relevant details systematically arranged. It is difficult to point them out in a small review. So is the chapter on technology diffusion one of the key chapters in the book. The author arrives at a conclusion: a clear distinction between innovation and diffusion of technology. He logically derives further that 'the developing countries can benefit from the diffusion of technologies without spending the time for and incurring the costs of technological innovation'. Indian S&T and industrial policy makers need to understand this important conclusion. In this chapter he also brings out a characteristic of many developing countries: the dualism between a modern export sector and the traditional sector. He further argues that the gap will not bridge automatically. It requires the transformation of new scientific knowledge and capabilities to services and products. Again a crucial policy issue.

The chapter on appropriate technology is good. It clears a number of populist confusion on this subject. In the next chapter the author gives a few models required for technology planning and attempts a generic integrated model. It can be a good basis for further researches and can also be a good guide for practical managers/leaders of policy to derive insights for decisions/actions.

The last chapter introduces WTO and its implications, and the book ends with conclusion. Especially in this context, even while the book is copious in references, it is a surprise how the author has missed out a number of papers and books by N. S. Siddharthan and his co-authors on technology matters, especially the impact of globalization. He has also missed an important book by Radosevic on technology transfer through the sixties, seventies, eighties and the nineties, where a new perspective of acquiring technological knowledge transfer in a globalizing market is discussed. Maybe as stated by the author, the emphasis is not on commercial technology transfer.

On the whole it is an extremely informative and insight-giving book – a must for scientists, technologists, business persons, government policy makers and academics researching on technology.

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