

BOOK REVIEWS

Japan science and technology outlook Fuji Corporation Busicen Bldg., [5-29-7 Jingumae, Shibuya-Ku, Tokyo 150, Japan, 1983, pp. 246, \$ 65.

This book, which is actually a slightly abridged and edited version of a White Paper published by the Japanese Science and Technology Agency in 1982, is not so much an Outlook as an Argument. It is chiefly a compilation of statistics (some of it fascinating) about science and technology in Japan and elsewhere, accompanied by some textual commentary and leading to suggestions for future policy in Japan.

The Argument—and this may come as a surprise to readers who have marvelled at the extraordinary products that Japanese technology has offered in recent decades—is motivated by what appears to be a serious worry about that technology, *not* concerned with its alleged destructive powers. It is noted that while Japan developed rapidly after World War II, both socially and economically, chiefly due to progress in science and technology, and while in some areas Japan is now world leader, nevertheless, this development has depended *unduly* (and *this* is the worry) on technology introduced from abroad, rather than on creative or pioneering developments within the country.

The statistics drive home these points effectively. Japan is now the largest producer and exporter of automobiles in the world ; its steel technology is the most efficient ; its consumer semiconductors have succeeded spectacularly in the international market ; its 'mechatronics' (for mechanism + electronics, such as numerically-controlled machines, robots, flexible manufacturing systems and the like) is a world-leader. But the technological trade balance of Japan is still adverse : the value of exported *technology* (*i.e.* ideas, not products), in relation to imported technology, was only 0.31 in 1981, compared to a ratio of 8.03 for the US and 1.29 (in 1979) for England. (An interesting sidelight is that in spite of the decline in many traditional British industries, partly because of the superiority of Japanese products, the technological trade balance of Britain has, if anything, *improved* over the last ten years). In the period 1901-82, the US won 126 Nobel prizes, Britain won 63, but Japan won only 4. This, and a variety of other statistics, are marshalled to show that Japanese technology is excellent at adapting and improving, but not so good at originating.

The book goes on to discuss how creative science and technology can be promoted in Japan. More government support is sought for R & D (about three-fourths of which is now funded by the private sector—contrast India !), more cooperative effort between private, academic and public research institutions is recommended, and more collaboration between different nations is suggested. Interestingly, certain Japanese cultural characteristics—which have even been seen by some as virtues—are now attacked ; Japan's 'vertically oriented social structure and life-time employment' are seen as impediments to the creative life.

The areas of technology that appear marked for attention in the report are atomic energy, space, electronics, materials, biology, oceans and extreme-conditions (low temperature and high pressure mainly).

Given the well-known ability of the Japanese to set national goals and achieve them, it is likely that in coming decades Japanese science and technology will 'cut a new path' as the White Paper so ardently desires.

Although the book will seem dry to some, its wealth of tables and charts are full of revealing nuggets of information; the book is strongly recommended to all those who worry about science and technology in India, with the warning that their worries are only likely to increase after reading it!

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The rocket team by F. I. Ordway III and Mitchell R. Sharpe, Foreword by Wernher von Braun. The MIT Press, 28 Carleton Street, Cambridge, Massachusetts 02142, USA, 1982, pp. 462, \$ 11.44.

This excellent book contains keen insight into the happenings of the early rocket era of the World War II. In a certain sense, it represents a portrayal of the work of Wernher von Braun (treated as a prime personality, justifiably) and his colleagues in Germany as well as in the USA. The Russian benefits of the war, their methodology of using the men and materials of the war has also been brought out succinctly. This book goes beyond the earlier books in the similar category, the well-known amongst them being Willy Ley's *Rockets, Missiles and Men in Space*, a book which has appeared in the paperback edition the world over. The research going into the contents of the book seems quite elaborate and understandably long drawn (~ 10 years).

The first part of the book covers the work connected with Peenamundee and the struggle to get funds for rocket research, a portion found in similar detail in Willy Ley's book as well. The personal struggles between various officers and the key men namely, Wernher von Braun and General Dornberger have been brought out quite succinctly in many parts.

Apparently, von Braun knew how to 'offer less pay, harder work and longer hours at Kummersdorf with considerable logic and charm' to get over people to work for him. The details of the production of V1's and V2's in Mittelworks and their problems are discussed in such detail as may not be found anywhere else. This part will be of considerable interest to rocket engineers. These are the known details of the methods adapted for preventing alcohol being diverted from the useful purpose of propelling rocket engines (to gastronomic purposes).

The description of the intelligence of Great Britain involving scientists and service personnel to unravel the warhead and other features of the new demonic weapon (V2) is scintillating and deserves wide reading. 'Prof. Jone's memory is quite correct. Although I was at that time relatively young, I had acquired some experience with both academic and government bureaucratic structures and their capacity for bloodless tribal warfare. But I had never been present at, let alone presided over, a meeting with more emotional tension than that centred on the size of the V-2 warhead. What emerged was a reasonably solid intelligence case for a 1-ton warhead against a deeply emotional conviction among the British rocketeers that if they had been backed by their government, they could have produced a rocket with a 10-ton warhead.

The later parts of the book contain a moving description of the way German scientists integrated themselves into the life in the United States.

In summary, this exceedingly good work deserves wide reading by rocket engineers and those interested in the early history of rockets.

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Contact mechanics and wear of rail/wheel systems edited by J. Kalousek, R. V. Dukkipati, Waterloo, and G. M. L. Gladwell. Solid Mechanics Division, University of Waterloo, Ontario, Canada N2L 3G1, 1983, pp. 600, \$ 48.

One of the most important clues to railway accidents often lie at the level of rail-wheel interactions. Scientists, technologists and engineers have been interested in such interactions for a long time and studies of such interactions have brought in many disciplines of applied mathematics, mechanical engineering and metallurgy, together. Today the field has broadened considerably and it is realised that only a multidimensional inter-disciplinary approach can tackle a problem as complex as this.

Essentially the problem is one of determining what happens to a wheel as well as a rail when the wheel 'rolls' over a rail. The interaction needs to be analysed at micro i.e., asperity level as well as at a macro level which gives the changes in geometry of the rail and wheel as well as the development of the contact patch. Hertzian mechanics can be used to analyse the stress and strains at both these levels for a highly idealized system of interactions and media. While this forms the corner stone, extension of this theory to real interactions and materials brings in studies related to analytical elastostatics, subsurface inelastic deformations, and initiation and propagation of cracks. These studies throw light on contact geometry, slippage, friction and wear of rail-wheel interactions. Such studies are backed by experimental work on load-compliance at an asperity level to microscopic studies on surface and subsurface deformation as well metallurgical changes in the wheel material. However, these studies are of limited use unless their usefulness is validated in real life. Extensive work is

thus in progress firstly to develop realistic models of carriage-rail interactions in laboratories to test the conclusions of more fundamental studies and secondly to analyse data related to deformation, wear and fracture of rails as obtained from actual railway tracks.

The proceedings of the international symposium on 'contact mechanics and wear of rail/wheel systems' contains material which give the reader a view of the panorama of research and development work going on in this area. The symposium commemorating the birth of Heinrich Hertz, the pioneer of this field attracted the best exponents of this subject from the western world. The proceedings commences with the exposition of classical equations of Boussinesq, Hertz and Galin and their more modern variations developed to tackle a wider range of boundary conditions using various families of harmonic functions. Numerical and FEM solution of contact mechanics as well as the difficulties of analysing the situation when the contact as well as the subsurface becomes wholly or partially inelastic are discussed. The latter studies have direct application in analysing propagation of cracks as well as in understanding the mechanism of rail wear. Microslip within the zone of wheel/rail contact is termed creepage. The proceedings points to the extensive theoretical and experimental work going on in relating different types ; longitudinal, lateral and spin creepages to creep force and in isolating the effect of these components on specific types of wear and surface damage. Adhesive, abrasive and delamination types of wear are observed in rail/wheel systems and the relationship of these to metallurgical structures and subsurface deformation is discussed. Further, light is thrown on the response of the rail wheel/system to dynamic loading in giving rise to corrugated surface damage of the rails. Morphological studies of the corrugated surface point to the possibility of surface fatigue by creepage forces. Another important contribution of this proceedings is a discussion of how new designs of rail/wheel systems are evolving through an understanding of the problems of the existing designs. Self-steering trucks and conformal wheel profiles are two examples of such evolution.

All in all the proceedings is highly informative and makes excellent reading. It takes a reader from purely mathematical approaches to contact mechanics, step by step, to evolution of hardware design of the rail/wheel systems. The proceedings is of interest not only to a railway engineer but to tribologist in general. New developments in studies of contact mechanics, subsurface stresses and deformations, metallurgy of wear are also of interest to workers in many fields such as metal forming, engines and bearings and goes a long way in keeping them up-to-date with recent developments.

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STRUPL 1 : User's manual by M. Z. Cohn, F. Erbatur, and A. Franchi. University of Waterloo Press. Waterloo, Ontario, Canada, 1982, pp. xii + 231, \$ 30.

The analysis and design of the present day structures of high degree of complexity has been made possible by the development of automated structural analysis methods. The availability of a large number of general purpose structural analysis programs has enabled the practical designer with little or no experience in computer programming to adopt these methods in his designs. However, most of the currently available programs are restricted to applications in linear elastic analysis.

The computer software STRUPL is designed to facilitate the analysis in the elastic and postelastic ranges. The present book is the user's manual for the first version of STRUPL. It gives the complete description of the capabilities of this software, input instructions and a large number of illustrative examples. This version performs the elastic as well as the postelastic analysis of plane frames and trusses made of steel or concrete structural members. Varieties of proportional and nonproportional loading and unloading can be handled. The analyses can be performed up to any stage of the loading history. The care with which the manual has been prepared can be seen from the fact that the documentation meets the standards of the Association of the Professional Engineers of Ontario. Compared to many other professional programs in the market, the price of this package can be considered to be very low indeed.

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Introduction to computer applications using BASIC by Richard M Jones. Allyn and Bacon, Inc., pp. 595, \$ 14.95.

This is a well written text-book, useful in an introductory computing course. The first half of the book deals with the method of communicating with the computer like how to start, how to enter programs and get printouts. Some of the concepts in the introductory chapters are explained using analogies. This is particularly helpful for the beginners. The second half is mainly application-oriented. The examples are slightly difficult. Some chapters require elementary mathematical background. Some useful topics like data files, ancillary storage devices, direct-access data files and their processing, two-dimensional arrays, etc., are dealt with in considerable detail. The problems at the end of these chapters though useful could have been more application-oriented.

Chapters 1 and 2 deal with the computer and computer printouts. Algorithms and some programs are discussed in Chapter 3. Top-down design, hierarchy charts, flow-charts—narrative and symbolic—are dealt with. Some more examples, however, could have been introduced in this chapter. Some BASIC statements like READ, DATA, etc., are discussed in Chapter 4. Rules for evaluating expressions, assigning values to variables are explained. Chapters 5 and 6 concentrate on the various forms of PRINT

statements. Chapter 7 covers various decision-making statements. The chapter starts with the simplest form of IF...THEN statement. Discussion of ON...GOTO and variations of the IF statement has been deferred to the last two sections of the chapter. This is a very detailed chapter with many worked-out examples. Useful hints on debugging, program testing, etc., are given. Chapter 8 summarises the results. There are some interesting worked-out examples also.

Chapters 9-14 deal with business and scientific applications. Chapter 9 deals with elementary aspects of record-keeping activities and the evolution of BASIC as an important language for data processing activities. Mathematical and string functions form the topic for Chapter 10. Certain common built-in mathematical functions like SQR (X), LOG (X), etc., are listed and explained in the rest of the chapter. The examples are elementary in nature more to familiarise with the functions rather than on problem solving or algorithms.

A very detailed account of arrays, both one-dimensional and two-dimensional, is given in Chapters 12 and 13. Certain array processing routines are given. Variable length arrays, stacks are also discussed. Sorting of one-dimensional array is described. Chapter 14 deals with scientific data processing. This chapter briefly explores the main characteristics of 'number crunching', namely, iterative computation and the use of arrays. There are a few examples intended to make the distinction between direct and iterative computations. The Gauss-Jordan method of solving systems of linear equations and curve fitting with least square approximation are detailed.

In Part III (Chapters 15-18) computer models and simulation techniques are discussed. Chapter 15 describes, with the aid of seven examples, the nature of deterministic models where behaviour of each event of a process is known completely. The fact that such a simulation helps in optimizing various factors to aid in understanding the process is brought out clearly. Chapters 16 and 17 deal with simulation of random processes. The RND (Q) function is introduced and its use in simulating sequences of random events such as flipping coins, rolling dice is dealt with. Card playing with the computer *i.e.*, program to create shuffle and print a deck of cards is explained.

Chapter 18 examines the heuristic techniques in programming. The author has clearly brought out the two conditions in which this approach is sought namely, in (a) large problems having very large number of solutions and (b) ill-structured problems.

The PRINT USING statements, IMAGE statement; string functions and applications are detailed in the appendix. This also covers topics on subroutines, matrix operations, quick sort, printer and video games, etc.

The book assumes minimum or no background on the part of the reader. It is ideal for a 'two-pass' reading with details omitted in the first pass. Such a reading is possible because of the modular structure and simple illustrative example.

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