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BOOK REVIEWS

Technology's storytellers: Reweaving the human fabric by John M. Staudenmaier, S. J. The MIT Press, 28 Carleton Street, Cambridge, MA 02142, USA, 1985, pp. 282, $ 40.25.

Staudenmaier is a catholic priest who lived and taught amongst American Indians on the Fine Ridge Reservation which is one of the poorest and backward areas of the United States. He was moved by the extent of suffering and levels of suicide and drunkenness brought about by the Procrustean demands of modern technology on a people who traditionally interpreted the universe from a different perspective and sense of kinship with reality. He came to recognise the myth of progress, a myth that has been one of the underpinnings of the ideological justification of western colonialism and later to be enthusiastically embraced by the technologically colonised. This myth perhaps received its most explicit if somewhat crude articulation in the motto of the Chicago International Exposition of the thirties, 'Science finds, industry applies, man conforms'. In seeking to understand the ideology of technology he was alarmed by what he found was the tendency to talk of technology as if it was an autonomous force carried ever onwards by its own laws of development and progress with little connection if any to the human fabric or historical situation.

This book is a result of his attempt to assess the value of a scholarly historical approach to evolve a way of talking about technology different from the imaginative and conceptual constraints of the 'progress talk' he finds dangerous. He has reviewed the twenty year output of 'Technology and Culture' the journal of the Society for the History of Technology, to examine the way people have thought and written about the history of technology. One of the growing number of books on the history of science and technology reflecting concern of the influence and interaction of technology in human affairs, this study does not concern itself directly with examining the various issues *per se* but at how they are talked and written about and the attitudes people bring when confronting particular issues.

The range of interest of the articles published in 'Technology and Culture' is vast and for the purposes of this book are grouped together in categories varying from the emergence of technology and the processes of technological creativity, the relation between science and technology, technology and its cultural ambience, the processes of technology transfer, the debate over technological determinism, to the integration of design and ambience and the constituencies of technological change. As one turns over the pages dozens of problems spring to mind crying out to be looked at in our Indian context. India is in many ways an ideal laboratory where the historical changes in technology are taking place very rapidly, a society with its own rich scientific and technological heritage, struggling with problems of indigenising modern technology.

Such apparently disparate problems as the availability of our power station equipment, the incidence of deaths on our roads several times higher than international levels or even the percentage of caesarean operations in urban maternity homes are all connected to the problems of technology in our ambience and need to be discussed and analysed in a framework reflecting our own perception of social and national aims. This book can be an admirable aid in clarifying the type of issues involved and evolving the grammar of discourse in their resolution.

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IBM's early computers by Charles J. Bashe, Lyle R. Johnson, John H. Palmer and Emerson W. Pugh. The MIT Press, Cambridge, MA, USA, 1986, pp. 716, $ 31.63. Indian orders to Affiliated East-West Press, Madras and New Delhi.

This book is an excellent chronicle of the technical history of the development of computers at the International Business Machines Corporation (IBM). The book covers in fair detail the technological innovations which took place at IBM during the period 1945–60. The reviewer found the book fascinating, particularly, as he had used the early IBM machines starting with IBM 650, 704, 1620, 1401 and finally 7044. At their time these were excellent machines known for their reliability and computing power. The book gives in great detail the history of the development of each of these machines. Of specific interest are the discussions on why certain design decisions were taken at various stages. Such information is not found in text-books and students of computing will find these discussions informative and useful even today. The authors are senior technical employees at IBM Research Laboratory at York Town Heights, New York, with extensive research and managerial experience at IBM. They had access to all the internal memos and technical notes of IBM and thus the history is authentic. Besides technical information, the book also provides an insight into the role of IBM management in planning and decision-making at crucial stages during the development of various computers.

The book consists of fourteen chapters and four appendices. It has over 90 pages of references and notes and a very good index. The first chapter describes early development of punched cards, tabulating and accounting machines using punched cards. The chapter ends with a description of IBM's automatic sequence-controlled calculator built with relays (Harvard Mark I) presented to Harvard University in 1944.

The second chapter chronicles the beginning of the vacuum-tube era and the wartime work on vacuum-tube based calculating machines. The chapter ends with a discussion on the development of IBM 604 electronic calculator and its use in an electronic card programmed calculator, a forerunner of electronic computers.

In chapter III the development of magnetic drums, the realization by IBM of the importance of scientific computations, besides business accounting functions, and the subsequent developments leading to the announcement of IBM 650 in 1953. It is now a historical fact that IBM 650 was a runaway success for both business data processing and scientific computations and lasted till 1962.

In chapter IV the advent of magnetic tapes and the search for other memory devices

for computers is described. In chapter V, the development of IBM 701, 702 and a fast calculator for defence needs is discussed. The building of the Naval Ordnance Research Computer (NORC) demonstrated in 1954 is discussed in detail. Chapters VI, VII and VIII are fascinating sections devoted to the development of magnetic tape memories, core memories and disk memories respectively. These memories led to breakthroughs in computer design. Of particular interest is the chronicles of various experiments, mistakes, modifications, patents and final product design. It is rare to find such a wealth of detail about technological innovations and motivations of researchers, research managers and marketing managers.

Chapter IX is devoted to the important topic of programming. Developments in assembly language, the idea of subroutines and early work on monitors and operating systems are discussed. Of specific interest is the early work on FORTRAN when IBM realised the importance and the high cost of software. The beginning of IBM's SHARE user group and their important contribution towards the development of good assemblers and operating systems is discussed.

Chapter X is on the advent of transistors and IBM's work in this area leading to in-house manufacture of transistors and reliable circuit modules.

Chapter XI is on project STRETCH the most ambitious and innovative project in its day (1955 to 1961). It was billed as a super computer but did not fully meet its design specifications. However, the project led to a large number of new ideas which were later used in the IBM 360 series machines, the most successful of IBM product lines. This project signalled the end of the second generation of computers and the advent of the third generation.

Chapter XII deals with the development of the very successful IBM 1400 series business machines. The thirteenth chapter describes the early realisation of IBM of the need for strong research and development in the emerging computing field, close interaction between product designers and researchers and the setting up of laboratories at Yorktown Heights, Zurich and San Jose. The book concludes with a chapter on computer architecture and problems of growth within IBM.

The book has many excellent photographs, drawings related to patents, early design drawings and details of experiments. Overall, this is an excellent book and is highly recommended for those interested in computer design, management of technical innovations and the history of technology.

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Ada – A life and a legacy by Dorothy Stein. The MIT Press, 28, Carleton Street, Cambridge, Massachusetts 02142, U.S.A., 1985, pp. 321, $ 22.94.

This is an engrossing book about Augusta Ada Byron, daughter of the poet Byron, and later, Countess of Lovelace, who became a figure of romance and fascination within her own lifetime. What makes this biography strikingly different from the numerous other

accounts of Countess Lovelace, is that the layers of myth surrounding Ada Lovelace's reputation have been stripped away, to reveal a turbulent and complex woman, of diverse talents and interests, of extraordinary ambitions, and frustrated hopes. Stein has delved deep into letters and memoirs to produce a well documented and convincing narrative of the eventful life of Ada Lovelace, and has, in the process, uncovered some interesting episodes of the social, intellectual and medical history of Victorian times.

Lady Lovelace appears to have been the close friend and associate of many of the leading scientific and literary figures of the early Victorian era. Through a scrutiny of some of her correspondence with Faraday, Wheatstone, Babbage, De Morgan and some other less well-known individuals, Stein has managed to piece together a fascinating portrait of an individual who strove to develop her ambitions under the shadow of a domineering mother and a mysterious father. Some distressing physical and mental ailments that were to plague her throughout her life, are brought to light. However, Stein throws some doubt on the conclusion that her mental instability adversely affected her intellectual career. Some letters to De Morgan, and Mary Somerville, a contemporary, clearly point to a lack of ingenuity in the manipulation of symbols. This, combined with her lack of persistent application, observes Stein, may have prevented her from acquiring sufficient knowledge to turn her philosophical speculation into fruitful ideas for investigation. Stein thus argues that Ada's achievements do not quite deserve the recognition accorded to them. Her report on Charles Babbage's Analytical Engine is shown to be more of a mystical tract, than a scientific document, and Babbage is alleged to have used the Countess to make exaggerated claims for his Engine. Apart from her scientific interests, Ada went through phases where she showed an obsessive interest in music, and demonstrated a fitful religiosity. She also occasionally wrote about extraordinary powers and abilities she believed herself to possess, which symptoms, the author notes, closely resemble those of a manic-depressive condition which might have been hereditary.

Stein has thus managed, very successfully, to present a critical, and yet not unsympathetic portrait of a somewhat unusual woman, and her struggle to realize her intellectual and artistic ambitions without violating (too flagrantly) Victorian norms of womanly conduct. There are no wild speculations, no romantic flourishes and no undocumented claims. The account is altogether very convincing.

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Artificial intelligence: The very idea by John Haugeland. The MIT Press, Cambridge, Massachusetts, U.S.A., 1985, pp. 287, $ 17.19.

Artificial intelligence (AI) is concerned with building machines which can think. 'The fundamental goal of this research is not merely to mimic intelligence or produce some clever fake but to build machines with minds in the full and literal sense'. Consequently, some of the topics of interest are: problem solving, natural language understanding, perception and learning. Acquisition, organization and utilization of knowledge plays a

central role in all these areas. There have been several books written in the past; for example, a book by Nilsson[1] which includes first-order logic and its relevance to the above problems. Another useful book is by Winston[2], which, extensively deals with the key problem of knowledge organization and utilization. However, the book under review is unique with the following aims: 'first and foremost, to explain, clearly and with an open mind, what AI is really all about; second, to exhibit the philosophical and scientific credentials behind its enormous appeal, and finally, to take a look at what actually has and has not been accomplished'. It is clearly an ambitious task dealing with literature which spans psychology, linguistics, information and computer science disciplines. The author has succeeded in achieving this ambitious task to a large extent.

This book is organized in six chapters excluding introduction. It starts with a good introduction to artificial intelligence and its relation to symbol manipulation. Chapters 1 and 2 deal with the historical facts of the origin and early developments in AI. Chapter 3 on semantics elaborately deals with 'meaningfulness'.

Some of the significant developments in this area are highlighted in chapters 4 and 5. Chapter 4 deals with turing machines, McCarthy's LISP machines and Newell's production systems. LISP is referred to as a new kind of computer . . . by McCarthy (p. 147). However, LISP is well-known as a list processing language (a programming language) than as a computer.

There is a typographical error in Box 1 of chapter 4 (pp. 131–132). The sample program listed here computes the value of 'ar^m+r^n' but not 'ar^m-r^n' as indicated in the box. So either 'ar^m-r^n' must be changed to 'ar^m+r^n' or the step '$V_5+V_6\rightarrow V_8$' (add the two terms) (p. 132) should be changed to '$V_5-V_6\rightarrow V_8$' (subtract one from the other).

On the whole, it is a valuable addition to the literature in AI dealing with most of the significant contributions in this area.

References

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2. P. H. WINSTON *Artificial intelligence*, Addison-Wesley, 1984.

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The correspondence of Charles Darwin. Volume 1.1821–1836 edited by F. Burkhardt and S. Smith. Cambridge University Press, Cambridge, 1985, pp. 702, £ 30.

This delightful book contains full authoritative letters from and to Charles Darwin, the great English biologist who is well-known for his Theory of Evolution. The first volume of the edition contains the letters of the years 1821–1836. They begin with one written to Darwin at the age of twelve and continue through his school studies in Edinburgh, the undergraduate years at Cambridge, and his five years of exploration and learning during the voyage of the ship, Beagle.

The letters bring new and fuller knowledge of his family – his father, brother and sisters, for whom he had an affection as deep as could be found even in India. They also tell us of his character and his assiduousness in pursuing his collection of materials for his study of natural history. We learn that he abhorred the system of slavery then practised by England. We also learn that during his voyage on the Beagle he was often seasick up to the point of exhaustion, and while he could have left the ship back to England any time he wanted, he avidly collected minerals, plants, marine invertebrates and insects whenever he felt well, from all the places, mostly in South America, which the ship visited.

The book is of interest both to the lay reader and the naturalist. The letters to Darwin, especially from his sisters and two delightful, witty, Shropshire girls, Sarah and Fanny Owen besides telling us a good deal about Darwin, are rich in details of the social life of the English country gentry during the 19th century.

For the naturalist the book is a mine of information about the work in progress of a creative genius who produced an intellectual revolution. Letter writing was of crucial importance to Darwin's work, not only because his poor health isolated him from direct personal communication with his scientific colleagues, but also because the nature of his investigations required communication with naturalists in many fields and in all quarters of the globe. These letters trace his line of thinking which led to a conclusion he expressed in his Autobiography: "Nothing before had ever made me thoroughly realise . . . that science consists in grouping facts so that general laws or conclusions may be drawn from them".

In an age like ours when radio and television have destroyed the art of letter writing, the correspondence of Charles Darwin lets in a fresh breath of air which the general reader as well as the naturalist will heartily welcome. This book is a must for inclusion in the personal and institutional libraries.

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Reshaping life by G. J. V. Nossal. Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 2RU, 1985, pp. 158, £6.95

The aim of writing this book is to present the basic concepts of genetic engineering in a concise manner to be understood by non-biologists without much expertise in this field. It is addressed to the policy-makers, politicians, economists, community leaders and academicians who do not have any background in biology. The author has set himself to a very difficult task which was not achieved. Sufficient knowledge in molecular biology is essential to have a good grasp of genetic engineering. However, the concepts could be introduced and explained with suitable analogies and diagrams, if possible in colour. The author has attempted to do this, with regard to the cell, the nucleus of which is compared with the office where all the decisions are made, and the cytoplasm as the shop floor where all the work is done. Also triggering the gene has been compared with the switch,

in an electric circuit. The four letters A, C, G and T of the bases in deoxyribonucleic acid (DNA) are analogous with the alphabets for storage and transfer of information. However, most of the chapters are loaded with technical terms which are understood by specialists only.

The bare bones of organization of the cell are described which is essential to know the processes in life, but not that essential to know the various steps in genetic engineering. The hard-core details required to understand genetic engineering are described with diagrams, which are not of good quality. The author himself recommends to avoid these without which it may not be possible to have a good idea of genetic engineering. The concepts of mobile elements, though very essential to know modern biology, may not be needed to follow the steps in genetic engineering. The nature and function of restriction enzymes, reverse transcriptase, recombinant DNA, complementary DNA, gene, vector, transfection, transformation, to mention a few, should have been discussed in depth. The recombinant DNA technology will be useful for the prevention and cure of many diseases and for improvement of health and pleasure. Development and production of vaccines to be used in medical and veterinary fields, blood proteins, gamma globulins, hormones, multi-functional antibiotics (not mentioned) are some of them. AIDS and the HTLV III (Human T cell Leukaemia Virus) are commented. Creation of new strains of plants, resistant to common pests, faster growth, richer in protein and oil, more economical to grow, less dependent on water may be materialised in future. Much detailed knowledge of the genome organization of crop plants will be achieved by using the recombinant DNA technology. The Australian Commonwealth Scientific and Industrial Research Organization is mentioned without other agencies which are actively engaged in the study of genome organization in other parts of the world.

In the later chapters of the book, the discussion is mainly concerned with biotechnology, genetic engineering being a part of it. Tissue culture, fermentation, biorecovery of uranium and copper, bioenergy and oil industry are discussed. The subjects discussed are too much spread out. Though no harmful effects have been produced by the recombinant DNA technology, adequate precautions should be taken in working in this area. The normal and ethical questions arising out of genetic engineering and biotechnology are dealt with. The development of these technologies in developing countries like India was touched upon without any critical evaluation and assessment of the capability and the contribution. However, they may be off the tangent to genetic engineering, but are esential for the development and application of the new knowledge for human welfare.

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The Cambridge encyclopedia of life sciences edited by Adrian Friday and David S. Ingram. The Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 2RU, 1985, pp. 432, £25.

Here is a useful introductory text on biology. It is both classical and modern: classical in that it presents a beautifully illustrated account of main types of animals that inhabit the earth; modern in that it deals with the problems which the student of life sciences meets with today in his first encounter with living beings.

Biology is believed to have passed through three phases during its growth. First, *Observation*, of nature, which could be said to have reached almost its final stage. There are few organisms or systems of organisms that remain for gross or intimate study. Secondly, *Analysis*, where a resolution and critical examination of the components of organisms were done. This reached its peak some time ago, very valuable, but of rather limited usefulness in understanding the organism. It is said that biology is currently in its third phase of development, *Synthesis*, where a putting together of our knowledge of the components could lead to a comprehension of how a living organism works — a holistic view. The Encyclopedia is an effort in building this third phase of understanding biological systems.

Interactions, that is the key word of the encyclopedia; interactions at all levels: between components within the cell, between cells within a tissue, between tissues within an organism and finally among organisms in their environment, both physical and biological. The environments receive full treatment, a feature of singular interest to the biologist.

Evolution is dealt with objectively and with remarkable caution, candour and competence. The unquestioned acceptance of natural selection as the sole means of evolutionary change, particularly speciation, is becoming a thing of the past and it is refreshing that the editors have had the courage to countenance the admission of alternatives.

However, it is something of a surprise that the encyclopedia views with some credence the Miller–Urey experiment on biogenesis. It has been subsequently shown that this and other similar experiments on the production in the laboratory of amino acids and other organic molecules have little relevance in explaining origins of life. Biogenesis, it now appears, did not take place in this simple manner. Indeed, we are far from certain what kind of atmosphere prevailed on earth at life's origin. There is a view that the average temperature of the earth at the time of the origin of life was around freezing point. We are even less sure of the kind of organic molecules that were produced at the time, and almost completely without any evidence as to how they were put together.

The encyclopedia misses out on several important areas of biology; embryology is a notable example, which is one of the most exciting areas of inquiry, and which is assigned no more than three pages in two different places. Indeed, one is not sure how such a text justifies the title encyclopedia.

The encyclopedia is not a description of the different kinds of plants and animals. It is not even a narrative of the great variety of living organisms that inhabit the earth. It does not claim to outline any philosophy of biology. It is a factual account of living processes, in the context of the environments they happen to operate.

Beautifully illustrated and with many explanatory maps and sketches, the encyclopedia is an introductory treatise on biology.

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Manifolds of nonpositive curvature (Progress in Mathematics, Vol. 61) by W. Ballmann, M. Gromov and V. Schroeder. Birkhauser Verlag, P. O. Box 133, CH-4010, Basel, Switzerland, 1985, pp. 277, S. Fr. 77 (Indian orders to Allied Publishers Pvt. Ltd., Bangalore).

Around 1970 G. D. Mostow proved his celebrated strong rigidity theorem which asserts that a compact locally symmetric Riemannian manifold, which has no local flat or two dimensional factors and whose sectional curvatures are nonpositive, is determined by its fundamental group. Immediately afterwards, this result was extended to locally symmetric Riemannian manifolds of nonpositive sectional curvatures and finite volume (in rank 1 case by the reviewer and for manifolds of rank ≥ 2 by G. A. Margulis as a part of his beautiful result on super-rigidity). Differential geometers have since then been investigating the phenomenon of rigidity of arbitrary complete Riemannian manifolds of finite volume and with nonpositive sectional curvatures. The first comprehensive result was proved by M. Gromov. The book under review is based on his lectures at Collège de France (Paris) and gives an accessible exposition of his rigidity theorem with detailed proofs. Gromov's rigidity theorem is the following: Let V^* be a compact irreducible locally symmetric space of rank ≥ 2, V be a compact C^∞-manifold with sectional curvatures nonpositive whose fundamental group is isomorphic to that of V^*. Then, after rescaling, V is isometric to V^*.

Since the above theorem was proved, W. Ballmann, M. Brin, K. Burns, P. Eberlein, R. Spatzier and V. Schroeder have, using in part the ideas of Mostow and Gromov, established the following very general result: A complete Riemannian manifold of finite volume, with *bounded* nonpositive sectional curvatures, and of rank ≥ 2, and whose simply connected cover is irreducible, is locally symmetric. In particular such a manifold is determined by its fundamental group. Also Ballmann and Eberlein have recently proved, using and generalizing the earlier result of the reviewer and M. S. Raghunathan, that one can determine the rank of a complete Riemannian manifold, of finite volume and bounded nonpositive sectional curvatures, from the algebraic structure of its fundamental group. Some of these recent results have been surveyed by W. Ballmann in the first appendix to the book. There are four other appendices, all written by V. Schroeder, which complement the results of the main text, and supply background material needed for Gromov's proof.

Besides giving a proof of the rigidity theorem, the book also includes a complete proof of an important finiteness theorem due to Gromov which says that the topology of a manifold of bounded nonpositive sectional curvatures is controlled by geometric data. For example, it is proved that if Inj Rad $\rightarrow 0$, then such a manifold is diffeomorphic to the interior of a compact manifold with boundary; in particular its fundamental group is finitely presented and all its Betti numbers are finite.

The exposition in the book is quite clear.

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Guidance and control 1985 (Advances in the Astronautical Sciences, Vol. 57) edited by R. D. Culp, E. J. Bauman and C. A. Cullian. American Astronautical Society, San Diego, California, U.S.A. 1985, pp. 618, $ 50. (Orders to Univelt Inc., P. O. Box 28130, San Diego, CA 92128, USA.)

The volume under review is the Proceedings of the Annual Rocky Mountain Guidance and Control Conference held during February 2–6, 1985 at Keystone, Colorado, USA.

This Conference series began as an informal exchange of ideas and achievements among a local group, but has been formalised since 1977 and now forms an important landmark among the events of significance for guidance and control engineers and scientists all over the world.

Guidance and Control is a continuing series appearing annually, and dealing with theory, design, simulation, actual flight experience and other related aspects of guidance, control, navigation and attitude control/stabilization systems. This particular volume, however, has a very special topic of interest to academic researchers in this area—a whole section with six papers devoted to Guidance and control in the university.

The first of these papers focusses on the anticipated trends in aerospace guidance and control in universities. In particular, it traces both the positive and the negative impact of the microelectronics revolution on the practice of guidance and control in general, and university research in particular. The point is made that while in post-war years, particularly the sixties, universities retained the lead over industry in advanced guidance/control research due principally to their strength in modern control theory and its developments, the lead is now pretty much reversed, with universities unable to match industry in keeping up with revolutionary developments in hardware in this area—microelectronics embracing microprocessors to super computers, and new navigational aids and state-sensing devices of which stellar-inertial systems, ring laser gyros, fibre optic gyros and miniaturized sensors permitting dispersed sensor/actuator locations are examples. Besides, there are areas such as parallel/vector processing of data, expertise on super computer usage, etc., in which the universities and industry seem to be on comparable footing. Universities seem to maintain lead in super computer software. In such a mixed scenario, it is feared that the control-theoretic research in academies might

become irrelevant to the needs of the industry, and that industry may not be able to depend on universities for a proper supply of manpower in this area. Solutions suggested emphasize a closer working between universities and industry according to several proposed models.

Other papers in this section suggest specifics, including providing direct industrial support for graduate students, providing more space-oriented courses in aerospace engineering education and having students build and test the control systems they study. Developments in nonlinear systems theory are seen to be among the very few analytical breakthroughs of the recent past and immediate future, and further into future it is projected that education will be shaped by the availability of 'briefcase size computers that will have the power, speed and memory of a CRAY 1' with individual students.

The foregoing analysis is primarily relevant to the US situation, but useful lessons can be learnt in our context. Although the absolute scale of the problem differs between the US and Indian scenes, one thing is clear: in high-tech areas such as guidance and control, industry/government cannot expect universities to develop programmes out of their internal resources and yet be able to supply their required manpower in quality and number. Positive and specific input and gestation in these areas will be necessary.

The remaining sections of the volume deal with technology aspects of aerospace guidance and control, with particular bearing on the US space program. As in every issue of this series, there is a well developed chapter on high accuracy pointing involving methods, simulation and testing procedure. In the present context, precision pointing assumes a special significance because of the extremely high attitudinal and pointing accuracies demanded by the ongoing US Strategic Defence Initiative (SDI) research, and significant motivation for some of these methods conceivably comes from that source. The specific aspects considered involve payload isolation and precision pointing, actuator modelling and testing, precision pointer for spinning spacecraft, attitude noise assessment and laser communication pointing system design.

The section on spacecraft attitude control summarises experience from several actual satellites including the Cosmic background explorer, the Venus radar mapper, Combined release and radiation effects satellite, the Orbital manovering vehicle, the Galileo scan platform, Large flexible space structures and Space shuttle payloads. In particular, the RPL experiment dealing with flexible satellite control system represents a step in an area which currently evokes much interest. Classical momentum exchange devices and passive damping mechanisms do not suffice for rapid control of large flexible space structures, and active control is becoming the only viable option.

A section on storeyboard display presents a variety of articles starting from payload experiments, image stabilization, and rendezvous and docking, through in-orbit satellite repair, beam steering element and gyro assemblies, to articles dealing with control system design with personal computers and adaptive control implementation research.

In the guidance and control series, a section on new trends in guidance and control hardware is an usual feature. This section is looked forward to by those seeking authentic accounts of the state-of-the-art on global basis. The current issue deals with algorithms

for sub-arc-second CCD star trackers, a quadrant digicon sensor, rotation sensing for precision pointing, nutation dampers and a solid-state tracker. A particularly interesting problem dealt with is that of random memory interferences caused by stray energetic particles of radiation. Designing for robustness against such stray interferences is a very modern problem that surfaced for the first time only in 1975 and has assumed important proportions in recent memory–intensive space flights.

A section on recent experiences drawn from the US space programme features the Solar maximum mission spacecraft capture and deployment, a four-year assessment of the NASA inertial reference unit in orbital operation, resolution of deployment problems of Defence satellite communication system (DSCS) and performance and manoeuvre results of several scientific satellites.

The overall theme of the Guidance and control '85 volume is one of reporting and analysis of the state-of-the art rather than theory and design. In keeping with its tradition, the exposure in the volume is almost entirely based on the US experience, with hardly any global outlook.

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From Spacelab to space station edited by H. Stoewer and Peter M. Bainum (Advances in the Astronautical Sciences, Vol. 56) American Astronautical Society, San Diego, California, USA, 1985, pp. 259, $ 40. (Orders to Univelt, Inc., P. O. Box 28130, San Diego, CA 92128, USA.)

The volume presents proceedings of the Fifth AAS/DGLR symposium organised by the American Astronautical Society; the Deutsche Gesellschaft fur Lüft-und-Raumfahrt, and the American Institute for Aeronautics and Astronautics, held during October 3–5, 1984 in Hamburg, Germany. It includes 15 papers related to spacelab flight results, space station system architecture and technology and space station plans. The volume begins with some remarks by Dr. Wolfgang Finke on German space policy for 1985–1995. It covers a brief history, the present programmes, and financial and political implications of the future programme. The next paper covering the Eugen Sänger Memorial Lecture by H. E. W. Hoffman describes how Europe has developed the Spacelab during the past ten years. After these two general papers on the past and the future decades, three papers summarize a few flight results from Spacelab-1. The first of these discusses the in-flight performance of Sapcelab-1 including a few examples of performance of its sub-systems. Selected results of experiments from all disciplines represented in the first flight of spacelab are reported in the next paper. The shuttle pallet satellite (SPAS-1) flight experience is summarized through a set of view graphs in the third paper.

The section on space station system architecture and technology begins with a paper discussing technology options for development of a space station. Systems and operations-related technology as well as sub-system technology options are considered. Communications, power systems, life support, and thermal control technologies for the

long-life reliable operations are discussed in the next three papers. Various considerations and alternatives are presented. The last section presents an outline of the NASA's and ESA's space station program plans. The evolution of manned space flight is briefly reviewed from an operational view point. A European view point of the space station user requirements is also included. Some possible uses of the space station by the Office of Space Science and Applications are summarized in the last paper. The volume concludes with a couple of statements from participants of a policy maker's forum discussion and a summary of space shuttle payloads and experiments for 100 flights.

The volume is quite informative and interesting covering a rather wide range. Designers and planners of space systems should find it good for gaining a general appreciation of the systems under discussion. However, as expected, from papers of this kind one does not get much in-depth information on any particular aspect. Also, a more critical evaluation of the alternatives considered would have added to the value of the document.

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