

Engineering stories of success

Donald S.L. Cardwell

From Compass to Computer.

By W.A. Atherton.

Macmillan Press, London/San Francisco Press, Box 6800, San Francisco, CA 94101: 1984. Pp. 337. Hbk £20, \$30; pbk £9.95.

DR ATHERTON'S account of the rise of electrical and electronic engineering is the first attempt at a general history since Dr Dun-sheath's *A History of Electrical Engineering* was published over 20 years ago. It is an ambitious undertaking. Following an introductory chapter dealing with progress before 1800, there are chapters on the electric telegraph, the experimental and theoretical advances of the nineteenth century, electric power, electric lighting, radio, miniaturization and the computer.

In the nature of the case Dr Atherton has had to compress so much and cut so many corners that, at times, his narrative comes close to being a breathless recital of names and inventions. Attempts to cope with the complexity of the subject matter have led to other problems. Thus, having described the development of Maxwell's theory up to relativity and quantum theory, the author gives his readers a cultural jolt by taking them back to the invention of the electric telegraph in the early nineteenth century. There is also some, probably unavoidable, repetition: Davy's arc light, Schweigger's "multiplier", the Gramme dynamo are described twice. In fact, so complicated is the story that what we are given is a series of autonomous essays on key historical developments. If the book is read in such fashion, these criticisms lose some of their force.

Dr Atherton explains that he is writing for the engineer and the general reader, not for the historian. Fair enough; but more attention to the historical record would have saved him from some mistakes and some omissions. For example, it was not Faraday but Whewell who coined the words "anode", "ion", etc; Joule's papers on the mechanical equivalent of heat were *not* denied publication by scientific journals; lamination, to reduce eddy currents, was introduced in the 1830s, not in 1870. Had the author used standard sources, such as the *Dictionary of Scientific Biography*, he would have avoided these and some other slips.

On the other hand Dr Atherton does not mention what I have called the "electrical euphoria" that swept Europe and the United States in the late 1830s. It was widely, and plausibly, believed that the electric motor, driven by voltaic cells, could be made more efficient than the best steam engine. This was not the last time that there were great hopes of cheap electric power.

The next occasion — also not mentioned by Dr Atherton — was just over 40 years later.

In this context, the observant reader may be puzzled by the *Punch* cartoon of 1881, reproduced on page 148 of the book and also here. It shows King Steam and King Coal anxiously contemplating a baby in a cradle. The baby has the word "electricity" over his head and is holding a large feeding bottle with "Storage of Force" written on it. Enigmatic though these three words are, the reader is left to infer that the cartoonist foresaw the modern electrical supply industry. This would be quite wrong. In 1881 Faure's improved secondary cell, or rechargeable storage battery, caused great excitement. It was greeted as the invention that would bring about the hoped-for revolution in electricity. It offered complete flexibility, for every little stream, every hill-top open to the winds meant an opportunity to charge and recharge storage batteries that could be used for all practical purposes. But the way ahead was that followed by Edison and Ferranti; and the forecasts of 1881 have not been realized, beyond today's "alternative technology". In short, this work has little to say about false starts and misplaced hopes. It is a success story; a thoroughgoing Whig interpretation of the history of technology.

Dr Atherton writes clearly and wittily



"WHAT WILL HE GROW TO?"

and his book, apart from one or two unsatisfactory diagrams, is well produced. It should interest electrical engineers and in that respect it will serve its purpose. But a rather more modest programme and a little more care with historical material would have meant a better book. □

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Power and power

Eli B. Roth

The State and Nuclear Power: Conflict and Control in the Western World.

By J.A. Camilleri.

Harvester Press/University of Washington Press: 1984. Pp. 347. £25, \$25.

IN *The State and Nuclear Power*, Professor Camilleri's thesis is that the pro- and anti-nuclear elements in society present a new destabilizing and potentially fatal challenge to the State. By "the State" he means "capitalist" countries, taking the United States, France, Britain, West Germany, Sweden and Brazil as specific cases. He explicitly excludes from his analysis centrally-planned, "non-capitalist" economies, otherwise known as authoritarian states. The reason, he says, is brevity, but one might suspect a more important reason to be the difficulty in getting dependable data from such nations.

Camilleri notes of the countries he has chosen for discussion:

The actual strategies adopted by each state in response to the ethical challenge posed by anti-nuclear activism varied considerably from country to country. A critical factor in all cases was the distribution of power in the political system, that is, the degree of centralisation in the exercise of state authority. As a broad generalisation, it would appear that where the state apparatus operated as a cohesive, well-

coordinated, monolith entity faithfully reflecting the interests of a dominant power group, its actions tended to dismiss the relevance of normative considerations and to reinforce the supremacy of technical rationality [p.115].

This tendency to criticize or ignore technical problems and solutions is one of the shortcomings of the book, and may also explain why Camilleri omits Canada from his list of case studies. Canada is as much of a capitalist country as any of the other nations he does examine. But while Canada generated in 1983 a larger percentage of its electricity from nuclear power plants than the United States, Britain or West Germany, it has suffered no noticeable internal political strains because of it. The most obvious distinction between Canada and the others lies in the type of reactor programme followed, one based on the home-grown CANDU plant which is fundamentally different from the power plants used by his chosen examples.

The book raises some crucial questions about the impact of possibly faulted, ill-conceived or incomplete nuclear programmes on democratically-run governments. Camilleri asks, "What factors account for the commitment of major western governments to commercial developments? . . . To what extent, and in what respect, has the performance of these [economic and administrative] functions varied from state to state? How may those differences be explained?". The questions are especially well-formulated in his preface, while the case-histories which

follow are clear and well researched. Of special value is the brief chapter dealing with elements of uranium supply and demand, enrichment, reprocessing and nuclear waste. Here Camilleri juxtaposes with considerable clarity the history of the growth of nuclear power programmes in each of his six chosen countries; together with some of the other material in the book, this account will be a valuable reference source.

In contrast, the treatment of international nuclear politics touching on non-proliferation matters is sketchy, and at times misses the mark, mixing cause with effect or ascribing the wrong motives to policies. For example after going into substantial detail (pp.253–267) to describe the actions taken by the United States in support of the non-proliferation regime under President Carter's leadership, Camilleri dismisses the performance as "a situation from which US nuclear export policy sought to derive maximum advantage [p.288]". This evaluation runs contrary to most informed judgements that the Carter policy was, in fact, a colossal misapplication of means to ends — although with commendable motives — in support of the NPT. In fact, the United States lost nuclear-power-related business in international markets to other supplier countries which could furnish the technology and which got the orders as a direct result of Carter's policies.

Because Camilleri explicitly excludes from his book the nuclear power programmes behind the Iron Curtain, we do not get the full benefit of his considerable talents at digging out and organizing the events of recent history. Had he done so, I wonder whether he would not have stressed the West's *democratic* institutions instead of focusing on their *capitalistic* economies as the root cause of the troubles with their nuclear programmes — to my knowledge, there is no case where popular objections have been reported as having interfered with the prosecution of the nuclear programmes in the states with "centrally-planned economies".

This is a substantive and provocative book which deserves a wide audience. As an academic and an economist, however, Camilleri seems to be writing exclusively for his peers, while his ponderous style with its overload of jargon demands a high degree of perseverance on the part of the reader. Equally, a shoddy publishing job — including proof-reading errors and uneven, over-compressed typography — has made the book uncomfortable going. But none of these points should be allowed to detract from Camilleri's scholarly analysis of some of the most pressing problems now facing those democratic nations pursuing nuclear power programmes. □

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Growth of an infant science

S.D. Wratten

Insects on Plants: Community Patterns and Mechanisms.

By D.R. Strong, J.H. Lawton and Sir Richard Southwood.

Blackwell Scientific/Harvard University Press: 1984. Pp.313. Hbk £22, \$35; pbk £11.80, \$18.

ON THE last page of this book, the ecology of insect-plant interactions is dubbed "our infant science". The phrase is a good guide to the excitement and frustrations of working in this research area in the 1980s. The excitement, which the book certainly reflects, comes from the frequency with which a few empirical but well-conducted experiments have produced far-reaching ideas demanding further testing. The frustrations are the familiar ones of having insufficient time and manpower to test the hypotheses which are produced by a burgeoning discipline.

I read the book on an otherwise tedious journey on a slow Spanish train and my attention was held throughout. However, it is the sort of book that also demands that the reader put it down at frequent intervals, simply because, like all good textbooks, it asks questions. Those it asks most penetratingly concern the frequency and importance of competition between plant-feeding insects and the role of coevolution as a driving force in plant-herbivore relationships. Having posed the questions, the authors do not shrink from attempting to answer them, sometimes with a conviction which belies the tender age of the subject.

One of the current debates is over how often plant resources are limited to such an extent that insect species compete for them. The authors consider this inter-specific competition to be a rarity, and are more impressed with the apparent evidence that predators and parasitoids keep insect numbers below levels at which competition occurs. They review published life-table analyses of populations of phytophagous insects and show that even cases of intra-specific competition (a necessary precursor of inter-specific competition) are outnumbered 2:1 by those of predation as factors acting in a density-dependent way, that is factors which increase the proportional mortality they impose as populations increase. Support for the premise that plant-feeding insect species rarely compete is taken also from the "stunningly simple logic" of Hairston *et al.* (*Am. Nat.* 44, 421–425; 1960) who argued that

obvious depletions of green plants by herbivores are exceptions to the general picture that green plants are abundant and largely intact. The only possible remaining general method of control is

predation ... including parasitism. Herbivores are ... therefore not likely to compete for common resources.

What is intuitively logical is not always correct, however, as the statistician G.E. Yule implied when he wrote that "Logic and Mathematics are only of service ... once you have found the right track". Another review of a different set of population analyses has indicated that there is, indeed, a different track which could be followed. J.P. Dempster (*Biol. Rev.* 58, 461–481; 1983) surveyed 24 studies of moth and butterfly populations and concluded that intra-specific competition was the only density-dependence operating in 13 cases, with natural enemies exhibiting density dependence in another three. These cases of intra-specific competition usually involved clear depletion of food resources but recent work (much of which has appeared since this book was written) has added extra evidence that apparent super-abundance of acceptable food may not be the norm.

This topic, given only half a page in the book, concerns the role of feeding-induced changes in plants following insect feeding. If such "induced defences" are common they could lead to an increasing proportion of a plant's leaves becoming unsuitable as grazing by an insect population progresses, forcing competition upon individuals when crude measures of foliage biomass would still indicate an apparent super-abundance. C. West, for example, in a paper to be published (*Ecol. Ent.* 10; 1985), shows that oak leaf miner larval fitness is reduced if the larvae feed on leaves which have earlier sustained normal levels of caterpillar damage. These results point to temporal competitive exclusion between the mining and chewing guilds; if they represent hitherto under-investigated interactions, they cast doubt on the premise that inter-specific competition among phytophages is a rarity.

The ecological importance and topicality of these questions confirm that the time is certainly right for this book. The fact that the authors take definite stances on controversial areas make it stimulating reading. Final-year undergraduates and postgraduates are bound to enthuse about the clarity of writing and the layout, the attractive use of vignettes in the figures and — above all — about the excitement which this book conveys about "our infant science" and its future. □

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Biotechnology in America

Edward Yoxen's *The Gene Business: Who Should Control Biotechnology?*, an examination of the environmental, industrial and social ramifications of genetic engineering, has been published in the United States by Harper & Row. Price is \$15.95. The original edition of the book, a paperback published in Britain by Pan (£3.95), was reviewed in *Nature* 304, 285; 1983.