Good vibrations

Colin Gough

The Physics of the Violin.
By Lothar Cremer.
MIT Press: 1985. Pp. 450. $35, £41.95.

FOR over 150 years scientists have been investigating the physics of the violin. Some have been motivated by the hope of discovering the "Stradivarius Secret" — the scientific explanation of the highly-valued tone quality of many instruments of the famous Cremonese violin makers of the seventeenth and eighteenth centuries. For others, such as the author of this book, the attraction has been to understand the acoustical and vibrational physics that ancient luthiers empirically incorporated into their instrument designs, culminating in the "modern" violin around 1550.

In the nineteenth century, musical acoustics was at the forefront of science. People of the stature of Helmholtz and Rayleigh, often through their interest in acoustics, were laying the wave-mechanical foundation of modern physics. And in the early part of this century, Raman, later to win the Nobel prize for his work on optical spectroscopy, published his first scientific papers — on the physics of the violin. But thereafter, with the advent of the exciting new fields of quantum science, musical acoustics became something of a backwater.

In recent years, however, the subject has experienced something of a revival, arising partly from the recognition of a number of interesting problems of "classical" physics still to be solved, and partly because modern experimental and computational techniques now allow a much more realistic modelling of the science involved. Prominent in such activities have been Professor Cremer and his co-workers at the Institute of Acoustics in Berlin. Over the past 25 years, this group has published a succession of important papers on musical acoustics. Now Professor Cremer has summarized that work and has brought together material that was hitherto widely dispersed in the literature. Although no attempt has been made to provide a fully comprehensive coverage of current research, generous space is devoted to closely related work of other authors.

Cremer treats the violin simply as a mechanical structure that is forced into vibration by the bowed motion of the string. Almost half of the 450 pages are devoted to the bowed string problem, reflecting the author's main research interest. The transformation of vibrational energy by the supporting bridge, now widely recognized to be a major factor in determining the tone of an instrument, is discussed in detail, as are the vibrational modes of the instrument as a whole. This logical approach to the energy chain is concluded with a discussion of sound radiation and the way that this sound is modified by the environment.

Professor Cremer hopes his book will appeal not only to the scientist but also to the violinist or violin-maker wishing to understand the underlying science of their instrument. Unfortunately, few musicians or craftsmen are likely to possess the mathematical background to cope with the relatively sophisticated theoretical description of the complex vibrational characteristics of the violin. On the other hand, the book should certainly convince any scientific reader that musical acoustics, and the acoustics of the violin in particular, is a perfectly respectable and fascinating field of applied science; indeed recent research on the violin has led to a number of new ideas that could usefully be applied to many other vibrating systems.

Cremer makes no attempt to relate physical measurement to the subjective assessment of a violin's quality. As he explains in the preface, although modern science can provide a fairly accurate description of the physics involved in producing sound, we simply do not have the necessary language even to start to try and correlate them. This is a challenge which will probably keep physicists, psychoacousticians, players and instrument-makers busy for at least another 150 years.

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Power and penguins

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A Guide to Nuclear Power Technology: A Resource for Decision Making.
By Frank J. Rahn *et al.*
Wiley: 1984. Pp. 1,000. £101.30, $106.

NUCLEAR steam supply systems have millions of parts, far more than Boeing 747s and in their way just as high technology. Describing this technology in a single book, albeit a big one, is a daunting task— some might say impossible. But it is the subtitle, *A Resource for Decision Making*, that is the reason for my concern about this book, of which more anon.

What is there here, in 500,000 words of small print plus 900 figures and tables? In 20 chapters, from basic processes, through radiation, the fuel cycle, reactors, materials, operation, safety, health and environment, regulation, economics, proliferation and intermediate stops, the book describes a particular world of nuclear power, often in more detail than we want. It is mainly an American world, of diagrams, photographs and words about all these subjects. Not wholly, of course, because some topics such as hydrogen flammability limits and radioactive toxicities know no national boundary. But the Canadian CANDU reactor gets a mere eight pages, the British Advanced Gas Reactor four pages and the French reactor standardization one 10-word clause on page 799. Comment on the Far East, where many innovations are taking place, seems to be missing completely.

Even the great specificity about equipment and practices in the United States is not very well matched to the stated task of informing decision-makers. The book describes in great depth how things are now, somewhat mechanically: properties of steel, operation of the latches on a control rod drive, patterns of refuelling a light water reactor, an extractor evaporator for removing water from rod waste and a myriad of other things. Most of this, like the mythical book about penguins, gives the decision-maker more detail than he wants. It isn't wrong, but is it useful?

Decision-makers want to know other things. Why did the system work (or not) before? What are the present options? What are the trends? Compared to what? Here are a few examples.

- Why do nuclear power plants cost so much, when the entire nuclear steam supply system plus the turbine-generator costs only about 25% of the total? And why such large disparities from place to place? The chapter on economics lists increases in material costs, effect of lead time and so on, but still leaves a fuzzy impression.
- What about the prospect of substantially improved light water reactors for the near term? The work proceeds now, principally in Japan, aiming for higher capacity factor, less radiation exposure to workers, easier maintenance, more compatible materials and so forth. But I find nothing of this, only some four pages on such topics as the classic spectral shift idea. If decision-makers in the United States don't watch out, the initiative will pass from them, surely something they should know.
- The potential of smaller reactors is becoming an increasingly lively topic these days. Is there the possibility of overcoming the diseconomy of small size by the economies of serial, factory or modular construction? Such smaller reactors would decrease the financial exposure of electric utility companies. Again, there is nothing on the subject here.

Still, the book has its merits and can be useful, though not principally as a handbook for decision-making, let alone policy decisions or technology assessment. It is descriptive and not overly technical (as its preface says), and fairly well written. Of the twelve groups to whom the authors commend the book, two seem most likely to profit from it: engineers with an interest in but no special training in nuclear technology, and nuclear engineers wishing to get a broader grasp of certain aspects of nuclear technology. □

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