

REVIEWS

Noise and Acoustic Fatigue in Aeronautics. Edited by E. J. RICHARDS and D. J. MEAD. Wiley, 1968. 512 pp. 150s.

Spurred by the ever-increasing problem of aircraft noise, aeronautical acoustics is expanding rapidly and there is bound to be great interest in this, the first book on the subject. Its scope is broad, covering the theory and practice of flow induced sound and vibration together with a comprehensive treatment of sonically induced structural fatigue. A great deal of useful practical data is presented in an accessible form, a point that will undoubtedly make the book a standard reference for aeronautical acousticians.

One might look to the book for a considered assessment of the way in which the field is evolving, for an indication of the current open issues and for an authoritative checking of the several false leads that have inevitably occurred. But in this one would be disappointed. The book is remarkably uncritical and on the whole fails to convey the excitement of the subject. It also perpetuates some of the false leads, the most notable being the failure to recognize that an infinite plane rigid surface reflects incident sound and cannot drastically improve the radiating ability of nearby turbulent flow.

To some extent the book is a parochial account of work originating at the University of Southampton. This detracts from its value as a comprehensive reference text though it does contain an immense amount of material, a point that emphasizes the very considerable contribution that the subject has received from the group that E. J. Richards founded at that University. The book has evolved from a series of lectures given by 17 different authors, 16 of whom were then operating from Southampton. Some sections were obviously completed several years ahead of publication and consequently lack the topicality evident in others.

The first 70 pages deal with the basic theory of sound generation and propagation. The overriding impression one gets from the first chapter is that the analysis is not yet rounded off by regular use. The presentation is insufficiently convincing to form a useful reference work, very largely, but by no means entirely, on account of extensive misprints. The fact that $p(\mathbf{x}, t)$ is *not* the pressure at (\mathbf{x}, t) is said to be important and the radiation resistance is said to be proportional to the average value of the *fluctuating* pressure. These two statements are typical of many points of confusion that are in themselves more humorous than harmful. Other points are more serious. On page 32 it is asserted that the principle of reciprocity is valid for arbitrary boundary conditions, the proof being attributed to Rayleigh. Such a general principle may well be true—but it is stronger than the cases treated by Rayleigh. In a similar category is the statement that scattering objects can be represented by equivalent images. The opportunity of verifying this point was unfortunately missed. The general theory is continued in chapter 5 with the Lighthill–Curle description of low Mach number aerodynamic sound. The chapter is a well-written account of basic theoretical work.

There is a section devoted to comparisons between experiment and theory—a comparison in which *no* experiment is cited. The chapter is concluded by an erroneous approach to boundary-layer noise, the final sentence promising in chapter 8 a discussion of the equation in the light of experimental results. The author of that chapter wisely ignored the lead. But then all the theory, together with its underlying physics, is largely ignored when jet and rocket noise is discussed in chapters 7 and 11. What references are made are often made in error. From these chapters one gathers the probably accurate picture of the subject as one dominated by *ad hoc* experimentation into phenomena that are very far from adequately understood.

The chapters on fan noise and sonic bangs are written with real authority. The splendid section on the subjective assessment of aircraft noise points to the importance of turbulence in the lower atmosphere in determining the subjective reaction to sonic boom. This subject has advanced a great deal since publication of the book.

The chapter on pressure fluctuations in a boundary layer is a good presentation of fundamental data measured on boundary layers of well-defined characteristics. The section dealing with propeller, helicopter and hovercraft noise is similarly a collection of data but of more transitory value being, one might suspect, characteristic only of the particular test configurations reported.

The basic theory of sonically induced vibration and its consequent influence on the sound field is built up carefully over three chapters. The pace of this work is much slower, dealing at length with simple harmonic motion in chapter 13, and is quite a contrast with the complex multipole analysis of chapter 1. The scheme used to describe random loads is incapable of dealing with fields of zero integral scale, a great pity since so many aerodynamically induced loads are of this type. The latter section is marred by the quotation of formulae containing undefined symbols, a trend continued in the chapter on the response of practical structures to noise which is one of the weakest sections. Formulae are quoted in a blind cook-book approach based on practical situations of unknown generality. But of course the problem is difficult with the basic principles remaining unformulated. The chapters on the design of fatigue resistant structures and test facilities demonstrate that in the understanding of the problem these are still very early days.

The chapter on damping treatments is a convincing discourse based on long experience. This will form a useful engineering reference text. The fundamentals of fatigue are also very satisfactorily dealt with though one might have wished to see them earlier in the book than the applied fatigue sections. The final two chapters on internal noise levels and soundproofing methods are weak and show little insight into the basic principles.

On balance, the merits of the book outweigh its faults. One can certainly glean from it an accurate picture of engineering practices currently used in aeronautical acoustics, and it is a substantial store of useful data.

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