

Book Reviews

Sound

The Effects of Noise on Man. KARL D. KRYTER. Academic Press, New York, 1970. xx, 634 pp., illus. \$19.50. Environmental Sciences series.

Nearly anyone who has had any serious interest in the noise problem is familiar with Karl Kryter's 1950 monograph *The Effects of Noise on Man*. In that now classic review, Kryter summarized the existing knowledge in three main areas—the effects of noise on speech communication, its deafening action, and its effects other than on hearing (nonauditory effects). It is only natural, therefore, to expect that this new book, bearing the same title as the earlier monograph, should represent a scholarly attempt to update the same three topics. Indeed, this was the stated aim. Some 4000 articles were surveyed, nearly 1000 of which are cited in the text, and this book is the final distillate. In some places, Kryter has achieved his goal. In others, however, his strong personal convictions seem to have run away with him; curious assumptions, bizarre proposals, and acceptance of questionable research (“unpublished results,” house-organ articles, and, in the case of foreign publications, authors' abstracts) are often interwoven with the otherwise objective critical analysis.

For example, consider a crucial issue in regard to noise and hearing, the question of tolerable limits for noise exposure (damage-risk criteria, or DRC). Chapter 5 is devoted to a discussion of past and present DRC. Their bases, shortcomings, and inconsistencies are presented, and one is left with what I believe is a correct assessment of the situation—namely, that most DRC are based at least as much on political considerations as on scientific evidence, and that considerable research is still needed before we can have much confidence in any future DRC. But then in chapter 6, caution is thrown to the winds, and Kryter's notion of what a correct DRC

ought to be is presented, a DRC that is based on distant extrapolations of scanty data and on assumptions that are either contrary to fact or highly controversial. Included are such propositions as these: (i) the temporary hearing loss caused by a given noise exposure on a single day is equal to the permanent hearing loss that will follow 20 years of near-daily exposure to that same noise (this is controversial, particularly for noises so weak that only a few decibels of temporary loss are produced); (ii) the permanent hearing loss increases decibel for decibel with the noise level, regardless of the pattern of the noise exposure (also controversial); (iii) the loss increases 20 decibels for each 10-fold increase in duration of the noise, regardless of the spectral characteristics or level of the noise (utter nonsense; the growth with time depends on the level and spectral distribution of the noise). Despite these and other oversimplifications, Kryter's final proposed method for determining whether or not a particular noise exposure is dangerous is so exquisitely complicated that nobody but Kryter is likely to be able to understand it, much less use it. Thank goodness, I might add.

Similarly, in the first of three chapters devoted to “subjective responses to noise,” Kryter points out the pitfalls that abound when one tries to pin numbers on percepts, in this case on the judged loudness of sound. Yet in the next chapter he implies that all problems are overcome if one merely uses his system, the so-called “perceived noisiness” scale, in which sounds are said to be scaled in terms of “annoyingness” and expressed in “PNdB.” Actually, it is difficult to determine just what sort of scale PNdB really is. The original work involved only the word “noisiness” as part of the instructions, but now it is said that the terms “disturbing,” “unacceptable,” and “objectionable” are the only ones actually mentioned—and yet

Kryter would have us believe that the end product here is nevertheless a scale of “annoyingness.” The fact of the matter, as the astute reader can deduce from evidence cited in the 150-page final chapter of this section, “Environmental noise and its evaluation,” is that *all* schemes thus far devised that purport to predict, on the basis of physical measurements alone, the aversive reaction of people to noise, work only indifferently well. PNdB are, in the long run, no better than a host of other systems, such as dBA, dBC, NC, NNI, SIL—or, for that matter, loudness.

The final section of the book, on the nonauditory effects of noise, is indeed what I had hoped to find throughout—an objective assessment that is equally critical of all the evidence, presented in a style that can be understood by scientists other than specialists on noise. Kryter points out, for example, that although it is clear that vasoconstriction of the extremities is caused by high-level noise, there is no convincing evidence that such autonomic activation is *ipso facto* debilitating; although several studies, mostly from Russia, have reported a higher incidence of circulatory, digestive, metabolic, neurological, and psychiatric problems in noise workers than in others, these differences can just as well be ascribed to differences in general working conditions (ventilation, heat, light), danger from accidents, anxiety over job security, and personnel selection (inferior workers are given noisier jobs). His tentative conclusion, therefore, is that “other than as a damaging agent to the ear and as a masker of auditory information, noise will not harm the organism or interfere with mental or motor performance.” This, of course, will not endear him to the alarmists who are crying that noise is driving us all batty or to an early grave.

In summary, I can only say that it is a pity that Kryter could not be as critical of his own work as he is of that of others. Had he been, the book would have been much less technical, and so would be of benefit to scientists outside the field. It would also have been at least one-third shorter, so that perhaps Academic Press would have been willing to contribute sufficient proofreading time to the finished product. It bodes ill for the general accuracy of a book when one reads on the first page of the first chapter that “1 dyne/cm² = 10¹⁶ μ bar,” and the foreboding is abundantly confirmed, the inaccuracy reaching a culmination on

page 170, where there are eight typographical errors. Perhaps some of the other puzzling statements one finds in the book are also printer's errors.

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Limit and Convergence

The Development of the Foundations of Mathematical Analysis from Euler to Riemann. I. GRATTAN-GUINNESS. M.I.T. Press, Cambridge, Mass., 1970. xvi, 186 pp., illus. \$10.

This compact volume is an austere critique, addressed to those with background in advanced calculus, of certain specific problems truly pertinent to foundational questions in analysis. It is as difficult to read as it is rewarding, for it offers few facile generalities, concentrating instead on the details of deep theorems. Topics treated include definitions (for functions of a real variable) of limit, continuity, the derivative and the integral, and the convergence of infinite series. The account opens abruptly with a controversy of the mid-18th century on the general solution of the "wave equation" for vibrating strings. D'Alembert insisted that a solution should be differentiable, Euler held that it need be merely continuous, and Daniel Bernoulli expressed it as an infinite series of sines. When in the early 19th century infinite series of trigonometric functions again arose in Fourier's work on heat diffusion, Cauchy questioned their validity. The crux of the matter was a theorem enunciated in Cauchy's *Cours d'analyse* of 1826:

When the terms of a series are continuous functions of x in the vicinity of a particular value x_0 for which the series is convergent, the sum of the series is also a continuous function of x in the vicinity of x_0 .

Cauchy had been one of the early analysts to give attention to conditions for the convergence of infinite series, and his *Cours* included the first batch of tests, several of which still bear his name. Nevertheless, not distinguishing adequately between series of constant terms and series of functions, he failed to achieve the concept of uniform convergence. Abel, who studied the behavior of a series of functions at the end points of its range of convergence, suspected that Cauchy's theorem ad-

mitted of exceptions; and in a paper of 1848 Philip Seidel, a student of Dirichlet, corrected the theorem through the introduction of what he called infinitely slow convergence, an idea hit upon independently by Stokes, who published it in 1849. More precise and comprehensive were the views expressed by Weierstrass in his lectures during the 1850's in which he specifically introduced uniform convergence through the delta-and-epsilon technique. Thus the "Age of Rigor" came to maturity in the "Weierstrassian analysis" which his students presented to the world.

The penetrating arguments by the author make a stark distinction between what he calls the "limit-achieving" concept of the 18th century and the "limit-avoidance" of the 19th. The latter view, akin to the later Weierstrassian "epsilonotics," is attributed by Grattan-Guinness to Bolzano in an attempted arithmetization of analysis in 1817; and our author is perhaps over-ready to presume that Cauchy saw this paper and "learned from Bolzano how to reinterpret and reformulate the basic components of analysis in terms of limit-avoidance." He adds the ungenerous comment that, "needless to say, the name of Bolzano appears nowhere in the *Cours d'analyse*: Cauchy would have had more sense than to make Bolzano's work known to his rivals" (p. 78). Unlovely aspects of Cauchy's character have been noted by others, but disingenuousness ordinarily is not among them; and a contrary view holds that "of all the mathematicians of his period he is the most careful in quoting others" (see the article on Cauchy by Hans Freudenthal in the *Dictionary of Scientific Biography*, vol. 3, 1971, p. 134). When one considers cases of simultaneity of discovery during that period—non-Euclidean geometry, non-commutative algebras, complex integration and double periodicity, conservation of energy, and many others—the independence of Bolzano and Cauchy would appear to be unexceptional. One wonders also if the author may not have overstated the case for originality of "limit avoidance," for this is an arithmetization which is not far removed from the ancient geometrical integrations which the 17th century misguidedly called the "method of exhaustion," whereas in reality it might more accurately be described as "exhaustion avoidance."

The backbone of this book is the convergence of series, and a much-

appreciated appendix (pp. 131–51) appropriately describes "The search for convergence tests." Somewhat less prominence is given to the steps by which successive refinements transformed Cauchy's concept of integration into the "Riemann integral" of the 1850's. On the basis of this and other developments described in this volume, the reader will agree easily with the author that by the time of Cauchy's death in 1857 the center of mathematical activity had shifted from Paris to the Göttingen-Berlin axis, with Riemann at the one end and Weierstrass at the other.

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Alchemy in Antiquity

The Origins of Alchemy in Graeco-Roman Egypt. JACK LINDSAY. Barnes and Noble, New York, 1970. xii, 452 pp., illus. \$10.

This work, which is a continuation of the series of studies Lindsay has devoted to Greco-Roman Egypt, is certainly an important addition to the literature of the history of alchemy and will be welcomed by historians of science for its rich documentation, diversified bibliography, and references to many sources not touched upon by the earlier historians of alchemy. Because of his general knowledge of the history of the period, the author draws his material from many facets of Greco-Roman life and civilization, from metallurgy and cooking to mystical rites and philosophy.

The first four chapters of the book serve as a general introduction, in which the author discusses Platonic, Aristotelian, Neoplatonic, and Stoic natural philosophy and physics and the elements within them that in his view are responsible for the cosmological and philosophical background of alchemy. He stresses especially Aristotelian and Stoic ideas and draws much from the recent research in Stoic natural philosophy by Sambursky and others. In the author's view alchemy came into being from a mixture of Greek philosophical ideas and practical processes and techniques, among which he stresses cooking and brewing. He implicitly disregards the central importance in the genesis of alchemy of metallurgical rites and practices going back to Babylonia and ancient Egypt, which have been stressed by Eliade and