# Book Reviews

## Carcinogens in the Workplace

**Quantification of Occupational Cancer.** Papers from a conference, Cold Spring Harbor, N.Y., March 1981. RICHARD PETO and MARVIN SCHNEIDERMAN, Eds. Cold Spring Harbor Laboratory, Cold Spring Harbor, N.Y., 1981. xx, 756 pp. $89. Banbury Report 9.

Four years ago the Occupational Safety and Health Administration (OSHA) conducted hearings on proposed regulations concerning the management of carcinogens in the workplace. At that time, ten Department of Health, Education, and Welfare (DHEW) scientists submitted a report to OSHA that attempted to quantify the fraction of cancer in the United States that is related to occupational factors. This issue was clearly of political interest from a regulatory standpoint and evoked keen interest from various industrial and labor groups. However, it became clear that the available scientific methodology was not capable of contributing much in the way of concrete, reliable estimates. The DHEW scientists, in their report, reached two main conclusions: that cancer has a combination of causes, which cannot be divided into percentages totaling 100, and that previously published estimates that 1 to 5 percent of all cancers are attributable to occupational exposures are low and an estimate of at least 20 percent appears much more reasonable.

Though the first conclusion has been largely disregarded, the second set off a controversy that tended to polarize researchers into either "life-stylers" or "environmentalists." The DHEW group arrived at the 20 percent figure by attributing 14 percent of occupational cancer to exposure to asbestos and 6 percent to collective exposures to arsenic, benzene, chromium, nickel, and petroleum products. Although the 20 percent figure may or may not be accurate, the calculations used by the group for individual agents, especially asbestos, have subsequently been shown to be unrealistically high.

In hindsight, the DHEW scientists would have been less subject to criticism if they had simply stated that the 20 percent figure was suggested by their collective intuition, which is basically the approach that most other investigators seem to have employed in such attempts. The DHEW document prompted the Office of Technology Assessment (OTA) to review the situation. OTA considered nearly all known risk factors, including occupational exposures to carcinogens, and commissioned an independent analysis by Doll and Peto. OTA issued a report (*1*) suggesting that 10 ± 5 percent of cancer is attributable to occupational exposures. Doll and Peto (*2*) suggest that the figure should be 4 percent. Since the publication of the DHEW report, there have been lively discussions between the proponents of the lifestyle view of cancer as represented by Peto (*3*) and the occupational-environmental view as represented by Epstein (*4*).

With this background, scientists at Cold Spring Harbor Laboratory organized a Banbury conference on the quantification of occupational cancer. The scientific justification for the conference is not entirely clear. Nevertheless, an excellent group of epidemiological investigators were brought together to present papers on the issue. The original coordinator of the DHEW report, Schneiderman, and one of its greatest critics, Peto, jointly chaired the meeting and have edited the proceedings. The reproduction of the original DHEW report as an appendix to the book indicates the central focus of the conference.

Two basic approaches have been used in attempts to clarify the issue. The first is the identification of various occupations and the estimation of numbers of exposed individuals and levels of carcinogenic risk associated with typical exposures. This approach requires knowledge of all occupational carcinogens in order that the total cancer burden not be underestimated. The second approach relies on the study of cancer incidence and mortality rates as they vary in time and location. Scientific papers taking both approaches are contained in the proceedings.

The first section of the book deals with asbestos, which in both the DHEW report and other studies is estimated to contribute greatly to the occupational cancer burden in the United States. Estimates made by conference participants seem to fall in the range of 1 to 3 percent. Of particular interest is a paper by Selikoff in which he discusses the difficulties of estimating the occupational cancer burden.

The second section, on ionizing radiation, is the only other part of the book that deals with a specific agent. Even though a considerable quantity of data on ionizing radiation exists, the use of different methods of analysis leads to varying risk estimates, as is illustrated by the differing interpretations of the data on Hanford radiation workers.

In addition to those on asbestos and radiation, a number of other interesting environmental and occupational cancer studies are presented. Included among these are studies of cancer incidence among workers in the rubber, petroleum, and brominated chemical industries and of cancer incidence and occupations in an area of low air pollution.

Most papers, however, focus on methodological issues. A wide range of approaches, such as high-risk population monitoring using body fluid assays for genotoxicity, industrial mortality surveillance, occupational classification, and use of tumor registry data and statistical techniques of data analysis are explored. Although the papers generally skirt the question of how much occupational cancer, they do provide a useful and comprehensive review of the current methods and problems in occupational epidemiology.

There are several very interesting papers on the analysis and interpretation of cancer trends in the United States. The rationale for special attention to trends is the argument that if cancer rates have been constant over recent times then the increasing occupational exposures to carcinogens must not contribute significantly to the cancer burden. Although this conclusion does not logically follow, it is generally fairly convincing. The incidence of lung cancer, however, is rising rapidly. There are some major difficulties in interpretation of the available data on lung cancer, since both cigarette smoking and exposure to many occupational carcinogens are associated with it. In studying the trend data for cancers other than lung cancer, investigators used differing portions of the data, for example incidence versus mortality, and rates for various age categories. As a result, the interpretations in the book of

the U.S. cancer data as they supposedly reflect the occupational cancer burden are disparate.

The conference provided an interesting and worthwhile collection of papers on occupational cancer epidemiology. Some of the most enlightening reading is the discussion material included after most of the papers. As one might expect, the question of what estimated percentage is best is not resolved. One positive suggestion by Peto merits consideration. He proposes a very large case-control study of lung cancer, which might aid in sorting out quantitatively the individual and synergistic impact of each of the suspected risk factors. The papers and discussions contained in the Banbury report will no doubt convince the reader of the difficulty of quantitatively estimating an occupational cancer burden with present data and methodologies.

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**References**

1. *Assessment of Technologies for Determining Cancer Risks from the Environment* (Office of Technology Assessment, Washington, D.C., 1981).
2. R. Doll and R. Peto, *J. Natl. Cancer Inst.* **66**, 1191 (1981); reprinted as *The Causes of Cancer: Quantitative Estimates of Avoidable Risks of Cancer in the United States Today* (Oxford University Press, New York, 1981).
3. R. Peto, *Nature (London)* **284**, 297 (1980).
4. S. S. Epstein and J. B. Swartz, *ibid.* **289**, 127 (1981).

## Music and Psychology

**The Psychology of Music.** DIANA DEUTSCH, Ed. Academic Press, New York, 1982. xviii, 542 pp., illus. $49.50. Academic Press Series in Cognition and Perception.

Helmholtz's 1863 treatise *On the Sensations of Tone as a Physiological Basis for the Theory of Music* identified response characteristics of the auditory system as the basis for the evolution of certain musical structures and compositional conventions. This early work, coupled with later increased precision in sound production and measurement of behavioral responses, generated an extensive literature on the relations between acoustic and sensory representations of sound. Both musical and psychological considerations, however, suggest that explanations based on peripheral mechanisms are limited. Such accounts are at odds with the diversity found in music cross-culturally, as well as with the explorations of novel pitch structures and timbres in 20th-century Western composition. Moreover, music-theoretic treatments of traditional Western music extend well beyond and sometimes contradict the constraints implicit in the view established by Helmholtz. Physiological acoustics, in addition, provides an inadequate framework for psychology's broadening conception of musical behaviors, which includes the skills exhibited in performance, the rich perceptual and cognitive aspects of the response to music, and the influence of cultural and social factors.

From these concerns has emerged what might be called a new psychology of music. The volume edited by Deutsch is the first comprehensive collection of papers on a wide range of musical topics treated from the perspective of empirical psychology. Each contribution considers a different topic, and, though different experimental methodologies are employed, interesting connections among the approaches represented become apparent. The application of concepts from physical acoustics to the subject of the listener in the acoustic environment is balanced with a concern for the measurement of subjective variables. Psychoacoustic treatments of pitch and of the physical and sensory basis for intervals, scales, and tuning systems consider the experience of the listener as well as general perceptual and cognitive factors. Detailed analyses of the physical correlates of instrumental and vocal timbres are provided with reference to expressive and other musical functions of performance. Measures of the perception and production of temporally structured musical patterns reveal complex associations between motor movements in performance and perceptual organization of meter, stress, and rhythm. Thorough reviews of the literature on memory for music cover absolute pitch and variables that affect the ability to organize, recognize, and remember tone sequences. Abstract conceptual systems are described that represent pitch in terms of hierarchically organized temporal and tonal-harmonic relations. The diversity of musical functions is apparent in the treatment of individual differences in ability, developmental changes in perception and memory, and the dissociations observed in clinical cases of musical dysfunction. Music is considered in its emotional and social context, and the relation between recent developments in the psychology of music and contemporary music composition and theory is evaluated.

This collection is an invaluable source for the reader interested in music from any perspective. The papers are of uniformly high quality, and the selection of contributors properly reflects the diverse activity in the field. Extensive lists of references provide excellent guides to the widely scattered literature.

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## A Barrier Reef

**The Atlantic Barrier Reef Ecosystem at Carrie Bow Cay, Belize, I.** Structure and Communities. KLAUS RÜTZLER and IAN G. MACINTYRE, Eds. Smithsonian Institution Press, Washington, D.C., 1982 (distributor, Superintendent of Documents, Washington, D.C.). xiv, 540 pp., illus. $18. Smithsonian Contributions to the Marine Sciences, no. 2.

The barrier reef off the shore of Belize is the second largest in the world. Yet, aside from early expedition studies and infrequent visits by shipboard scientists, the region is largely unknown. The reef complex includes not only the extensive barrier but also the only atolls in the Caribbean. As a reservoir for increasingly endangered coral reef organisms and as a site for research on pristine reefs, the Belizian barrier reef is unequaled. This volume presents the first extensive series of investigations on the barrier reef, carried out at the newly established research station at Carrie Bow Cay.

The volume is primarily descriptive: the reefs are mapped, the tides and currents monitored, the flora and fauna surveyed. Systematic accounts include works on the Belizian hydroids, diatoms, algae, sea grasses, scleractinians, octocorals, sipunculids, isopods, pycnogonids, crinoids, and ophiuroids. The primary reef habitats are described, zonations are established, and reef structure is compared with that in other well-known Caribbean localities. The strength of the volume lies in this rich empirical foundation.

The volume suffers from some obvious omissions. Most glaring is the lack of any description of the vertebrate fauna. There is insufficient discussion of the distribution and abundance of sponges, echinoids, and gastropods. Many of the ecological studies are of very specialized interest and add little either to the overall description of the reef or to a more general analysis of processes regulating reef structure and function. Excepted from this criticism are the studies of Norris and Fenical on chemical defense in algae and of Graus and Macintyre on