dence for its toxicity and for the role of superoxide dismutase in providing protection against it. One of the more fascinating aspects of the biology of oxygen radicals is the accumulating evidence that they are necessary intermediates in the utilization of oxygen. Several of the papers deal with the beneficial and perhaps obligatory roles of oxygen radicals in such processes as prostaglandin synthesis, vitamin-K-dependent synthesis of prothrombin, and the bacteriocidal action of phagocytic cells. The fact that many of the papers are reviews rather than limited discussions of a few experimental data make the book especially useful.

This is not to say that only well-established findings are presented in the book. The question whether hydroxyl radicals are generated in vivo appears, on the evidence of the paper by Willson, still to be unanswered. The relative roles of superoxide and hydrogen peroxide in the bacteriocidal action of phagocytes are discussed at length in several papers. Though the book does present differences in points of view, it also contains many superb discussion sections in which the participants attempt to reach as much accord as possible. The book serves the useful purpose of bringing together in one place a variety of approaches to the study of oxygen metabolism, and it is strongly recommended to all who are engaged in research in this field.

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Environmental Carcinogens

Polycyclic Aromatic Hydrocarbons in the Aquatic Environment. JERRY M. NEFF. Applied Science Publishers, London, 1979. xii, 262 pp., illus. $42.

Polycyclic aromatic hydrocarbons (PAH), although structurally quite dull, are biologically interesting because some of them cause cancer when applied to the skin of animals, including humans. Although their structures were not known, their effect was first observed over 200 years ago when it was correctly suggested that scrotal cancer among London's chimney sweeps was due to exposure to soot and its associated organic compounds. It was not until the 1930's that the structure of one of the most carcinogenic PAH, benzo[*a*]pyrene, was elucidated.

Like soot, PAH are produced by the combustion of a great variety of fuels under fuel-rich conditions. Therefore, until recently almost all studies of their environmental occurrence focused on the emissions of combustion sources and their dispersion in the atmosphere. Within the last several years, however, there has been a realization that they can come from sources other than combustion and can reside in environmental compartments other than the atmosphere. This book is a review of much of this recent information, with emphasis on PAH in water, sediment, and the associated biota.

We learn that PAH have several sources. These include direct and indirect biosynthesis, fossil fuels, and natural and anthropogenic combustion. PAH move from these sources to the aquatic environment by a variety of transport mechanisms, and Neff has estimated the magnitude of the inputs of PAH by these mechanisms. He concludes that the input of benzo[*a*]pyrene is 100 metric tons a year from land runoff, 500 metric tons a year from atmospheric fallout and rainout, and 80 metric tons a year from other sources (such as petroleum spillage and biosynthesis). These input rates are nothing more than gross estimates, but they indicate that airborne transport is an important mechanism for the introduction of PAH into the aquatic environment.

Neff points out that the fates of PAH are dependent on their physical distribution and on their chemical transformations. Their distribution in sediment as a function of depth is a historical record that indicates that their major source (at the locations studied) is the anthropogenic combustion of fossil fuels. Information on their chemical transformations suggests that "PAH may persist indefinitely in oxygen-poor water basins or in anoxic sediments." Clearly, PAH can serve as conservative markers of human activity.

The effects of PAH on aquatic organisms have not been throughly studied. We do know that many aquatic organisms accumulate PAH; the extent of this effect is dependent on species, temperature, and salinity. In addition, PAH may induce tumors in fish.

Neff has been exhaustive but not critical in gathering data. The book contains 89 separate tables, many of which are undigested data presented with excessive significant figures. Long sections of the book consist of abstracts of paper after paper. A reader's ability to comprehend this great bulk of information is limited by the lack of chapter or subchapter summaries. A three-page summary does appear at the end of the book, however, and it is excellent. The book has been carefully prepared; the literature coverage seems to be complete through 1977 and spotty for 1978. Assembling the existing data on PAH in the aquatic environment is a truly useful endeavor, and it has been done well. Marshaling these facts into a unified picture would have been even more useful.

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Neurophysiology

Sensory Mechanisms of the Spinal Cord. W. D. WILLIS and R. E. COGGESHALL. Plenum, New York, 1978, x, 486 pp., illus. $35.

This book has appeared at a most opportune time. The last 10 to 15 years have been a period of rapid and exciting advances in our knowledge of spinal cord mechanisms concerned with somesthesis. During this time the microelectrode, which has continued to be the most useful research tool, has allowed the functional organization of the dorsal horn to be clarified; the more recent trend toward working with identifiable neuronal systems has paid off handsomely in understanding of ascending systems taking origin in the cord (spinocervical, spinothalamic, and spinoreticular paths) and of control of access to these pathways by segmental and descending systems; many new techniques have appeared, including a number for tracing anatomical pathways and for injecting dye intracellularly, and these, combined with a second flowering of silver staining and degeneration methods, have allowed a new understanding of structural-functional relationships; finally, the great interest in pain mechanisms has focused attention on the dorsal regions of the spinal gray matter where the first central operations on nociceptive information take place. The book is the first to treat the subject in detail, and it provides a comprehensive and up-to-date account together with an extensive bibliography up to early 1978.

The authors adopt a most successful approach to the many complex problems thrown up by modern work. Each subject is developed clearly and concisely. Initially, helpful definitions are given, and these are followed by descriptions of the peripheral apparatus (receptors and afferent fibers), the structure and func-

tion of the dorsal horn, and the various ascending pathways in the cord and finally by an interesting survey of the sensory channels and descending control mechanisms. Each section is followed by a short summary and each chapter by a list of the main ideas and conclusions. Illustrations are used liberally and are, on the whole, well chosen.

For the present reviewers, more definite statements of the authors' own positions on the various topics of disagreement would have been interesting and useful. The authors have trodden very carefully in certain places, for example in their treatment of the substantia gelatinosa, where more forthright opinions would have been stimulating (even if they turned out to be incorrect). The cautious approach does, however, help to emphasize their many valid comments on the relationship of clinical studies on humans to the basic physiological and anatomical data from other mammalian species that make up most of our current knowledge.

The book will appeal to research workers, especially those just entering this exciting field, and teachers. Advanced students will also find the book most useful. It conveys the excitement that only authors who have been closely associated with some of the important developments in the field can transmit.

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Physicist's Memoir

What Little I Remember. OTTO R. FRISCH. Cambridge University Press, New York, 1979. xii, 228 pp., illus. $14.95.

"I am a lucky man!" Otto Frisch exclaims at the end of *What Little I Remember*. Lucky he was indeed; he lived in exciting times, and times that were particularly so for a physicist. Frisch's life span so paralleled the development of nuclear physics that his autobiographical account brushes on almost every phase of it. Frisch, furthermore, has a felicitous touch when it comes to explaining nuclear physics. His procedure in the book is essentially to alternate chapters that are almost purely autobiographical with chapters that are entirely concerned with physics. Naturally this method dictates a historical approach to the physics involved. His coverage is complete enough and his explanations clear enough that the didactic chapters by themselves constitute an adequate popular account of the development of nuclear physics.

A refugee from Hitler's Austria and Germany, Frisch, with his aunt Lise Meitner, was the first to work out the explanation of Hahn and Strassman's discovery of barium as a product of neutron bombardment of uranium. He even had the privilege of dubbing the process in question "nuclear fission" after he had experimentally demonstrated the high-energy recoiling fragments at Bohr's institute in Copenhagen. Then a little later in Britain, still fleeing the Nazi terror, he joined with other "enemy aliens" such as Peierls, von Halban, Simon, and Kowarski to rough out the first design of a bomb. The amount of uranium-25 they estimated such a device would require was small, and the estimate provided much of the impetus on both sides of the Atlantic for the tremendous effort that eventually produced nuclear explosions. Ironically, the German effort so much feared by the Allied scientists turned out to have been ineffective—leaving a question of moral responsibility for history to answer.

Frisch became a member of the "British mission" when in 1943 the English effort was joined to that of the Americans at Los Alamos in the attempt actually to assemble a bomb. He shows the scientists at Los Alamos working at a frenzied pace in selfless dedication to prevent the unthinkable catastrophe that might have occurred had the Germans succeeded with their own effort, which was known, through Niels Bohr, to have started much earlier. The experience of working in beautiful country with agreeable colleagues was, of course, not completely dreadful, particularly for a person who loved to play and listen to music and who loved good conversation. Frisch's account of his life with the Manhattan Project is similar in many ways to other memoirs and full of the nostalgia that wartime Los Alamosians feel for their sojourn there. Recent books and articles have been critical of this attitude and have insinuated that these people were heartless and amoral scientists who ignored the human suffering resulting from their efforts. Times change and so do attitudes. During World War II the scientists felt that they were working in a great common effort to save the world from the Nazi threat to civilization and to every principle of just government. With the announcement of the devastation of Hiroshima, however, Frisch (along with many others) felt "unease, indeed nausea." Years later, writing his book he regrets that scientists who "are trained to think objectively and dispassionately, an asset in making decisions of any kind," were not more involved in the decision-making.

It might be added that it was not for lack of trying on the part of the Los Alamos scientists that their involvement was not to be greater. Almost to a man they immediately organized themselves to educate the public in the danger presented by the new weapon, the probability of an arms race, and the unique opportunity presented by the new United Nations Organization to control the new force by international agreement.

Despite his modest title, what Frisch "manages to remember" is quite impressive. He loved to tell stories and his many vignettes of his associates (they include nearly every outstanding physicist who worked in nuclear physics) will be a valuable supplement to flesh out the sometimes arid accounts that have already been written. Historians, too, are lucky that Frisch managed to remember and to record so much before his death.

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