

BOOK REVIEWS

THE CHEMICAL BASIS OF RADIATION BIOLOGY
C. VON SONNTAG
Taylor & Francis, London, viii + 515 pp, July 1987, £ 49

Radiation chemistry is fundamental to a real understanding of radiation biology, a topic of ever increasing importance in a world facing risks from radioactive contaminants in the environment and pondering such problems as to how the irradiation of food can be detected and quantitated. This book, written by an expert radiation chemist, provides an up-to-date and readable survey of the relevant radiation chemistry, and the studies are related wherever possible to biological systems.

The book begins with a survey of sources of ionizing radiation and an explanation of several fundamental radiochemical concepts, such as "G value". This leads on to a discussion of the radiation chemistry of aqueous solutions, and an examination of the chemical properties of inorganic and organic oxygen radicals, including a good account of the formation and reactivity of $\cdot\text{OH}$, O_2^- and HO_2 radicals. There is a particularly valuable tabulation of the reactions of ascorbic acid and ascorbate anion with various radicals (page 79).

Chapter 5 discusses the "targets" that are damaged in irradiated cells, with (as expected) particular emphasis on DNA, although I was surprised to see no mention of "lethal NAD depletion" as a mechanism of death in cells with severely damaged DNA. Chapters 6, 7 and 9 discuss in detail the products of radical damage to DNA bases and to the deoxyribose moiety. Techniques for measuring DNA damage are reviewed in Chapter 8, which is particularly useful in that many of these methods are being applied, or will shortly be applied, to biological systems.

In Chapter 10, the author considers the mechanism of the well-known "oxygen enhancement" of radiation damage, and the mechanism of action of radioprotectors. There is a particularly-good account of thiol compounds as radioprotective agents, from which it may be seen that, in the case of GSH at least, no single mechanism can account for their radioprotective actions (Chapter 11 discusses in detail the various sulphur-containing radicals that can be generated). Nitroaromatic radiation sensitizers are also reviewed in a clear way. Chapters 12-14 discuss radiolysis of carbohydrates, amino acids, peptides and proteins, including enzymes. Again, there is a useful table (page 431) of the ability of different radicals to inactivate enzymes. Chapter 15 discusses studies upon lipids, including membranes, which again includes a great deal of useful chemical information (e.g. Table 15.14 summarizes studies that have been performed on radiation-induced changes in biological membranes). The book ends with a Chapter on "radiomimetic" radical generating systems, including

ultrasound, Fenton-type systems, UV irradiation and radical-generating anti-cancer drugs. This is followed by an adequate index.

Overall, this is an excellent book. I enjoyed reading it and I recommend it to others.

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ADVANCES IN FREE RADICALS IN DISEASE
CORONGIU, F.P., TOMASI, A. and VANNINI, V. (Eds).
Cleup padova (1987), pp. 135.

This small paperback booklet contains 24 short multidisciplinary contributions by Italian groups engaged in free radical research. A national project, supported by the "Ministero della Pubblica Istruzione", has been started in Italy to disseminate knowledge on free radicals in biology and medicine between groups. Twenty-one different groups from 13 universities have participated in the first meeting to produce this booklet. However, several eminent Italian free radical research groups, known to the reviewer, are conspicuous by their absence.

Few would disagree with the statement in the Preface that "Free radical research today is an exciting frontier" and the organisers should be congratulated on their far-sightedness in planning co-ordinated research and problem solving in this fast growing field. A wide range of topics are covered and these include: carbon tetrachloride and ethanol toxicity, lipid peroxidation, spin trapping, reactions of metal ions, aspects of cancer, oxidant stress, shock, exercise and ischaemia. As might be expected, most papers are brief and have already been reported elsewhere in greater detail. The booklet is a useful record for those participating in the Italian project and serves to remind us all of advantages to be gained from better communication and collaboration through similar policies.

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**NICOTINIC ACETYLCHOLINE RECEPTOR: STRUCTURE AND
FUNCTION**

(NATO Advanced Science Institutes Series H: Cell Biology, Vol. 3)

Edited by A. MAELICKE

Springer-Verlag, Berlin, 1986, 489 pages.

This book contains the proceedings of a workshop on the mechanism of action of the nicotinic acetylcholine receptor (AChR) held in 1986. It is a comprehensive collection of recent studies on this receptor ranging over molecular structure; biophysical and biochemical studies of AChR topography; ligand binding, ion flux studies and reconstitution; electrophysiological studies; AChR associated proteins; ganglionic and brain AChR; molecular genetics; and structural models. The nicotinic acetylcholine receptor was the first neurotransmitter-gated ion channel to have its structure determined. Various nicotinic acetylcholine receptors, both from muscle and from brain, are known. This is an excellent book to delve into the structure and function of these receptors. Advances in molecular neurobiology are suggesting a small number of gene families for neurotransmitter receptors in the nervous system. Recently it has been shown that the glycine and GABA/benzodiazepine receptors share similarities in amino-acid sequence and putative transmembrane domains with the nicotinic acetylcholine receptor (for an introduction, see C.F. Stevens, *Nature* **328**, 198–199 (1987)). The nicotinic acetylcholine receptor is in the forefront of research into membrane proteins functioning as ligand-gated ion channels mediating the transmission of information in the nervous system. Its value as the paradigm of the mode of signal transmission at chemical synapses has always been immense, and its current literature as exemplified by this book is worth knowing.

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MODERN BIOLOGICAL THEORIES OF AGING Aging Series Vol. 31.
WARNER, H.R., BUTLER, R.N., SPROTT, R.L.
 and **SCHNEIDER, E.L.** (Eds.)
 Raven Press: New York, 1987, pp. 324, \$83.50.

'Modern Biological Theories of Aging' critically examines some of the more popular theories of how we, and other species, age in a predictable way. Aging theories can be discussed under two main headings (a) Programmed or genetic theories, (b) Damage accumulation theories. The book attempts to give fair and balanced views on the major theories discussed and in the reviewer's opinion admirably succeeds in its aim.

The contents are divided into six sections and each section is both introduced and summarised by a specialist researcher in the field. These overviews are particularly

useful when presented with plausible but opposing points of view. Part I is the shortest section dealing with the evolution of life span in placental mammals. Part II in contrast is a major section describing developmentally programmed aging with intriguing evidence presented both for and against the theory. The following two sections deal with the best known of the damage accumulation theories of aging, namely the 'free radical theory' and the 'error catastrophe theory'. The free radical theory, first proposed by Denham Harman in 1956, is reviewed by Dr. Harman and postulates that normal aging results from random deleterious damage to tissues by free radicals produced during normal aerobic metabolism. An updated view of the theory is proposed by Dr. William Pryor as a 'disease-specific theory' in which he proposes that many of the life-limiting diseases of later life (which lower life span below the maximum) have a major free radical component. DNA as a critical target for free radical attack is now increasingly recognised and Dr. Bruce Ames's group brings to our attention that there are in excess of 1000 oxidative DNA hits per cell per day. The importance of DNA damage and repair for aging processes is discussed in Part V. The maintenance of DNA integrity is clearly of vital importance for achievement of maximum lifespan and, although aging in some animals accompanies deficiencies in DNA repair mechanisms it is far from clear whether these are a cause or just a consequence of the aging process.

The error catastrophe theory, first postulated by Orgel in 1963, proposes that errors in protein synthesis might accumulate with age and eventually reach catastrophic levels impairing vital functions of life. However, almost all the evidence for the theory, both direct and indirect, is strongly negative and does not support the hypothesis. The last section describes organ systems as pacemakers of aging and includes discussions of the liver, immune system, neural and endocrine systems. Finally, the four editors together discuss 'Where do we go from here'.

The book is a stimulating insight into the universal problem of aging, an area of science only just beginning to attract the serious attention it deserves, and is an important contribution to the field.

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