Biological Radiation Effects

Over the past several decades, public concern over exposure to ionizing radiation has increased. This concern has manifested itself in different ways depending on the perception of risk to different individuals and different groups and the circumstances of their exposure. One such group are those U.S. servicemen (the "Atomic Veterans" who participated in the atmospheric testing of nuclear weapons at the Nevada Test Site or in the Pacific Proving Grounds, who served with occupation forces in or near Hiroshima and Nagasaki, or who were prisoners of war in or near those cities at the time of, or shortly after, the atomic bombings. This book addresses the feasibility of conducting an epidemiologic study to determine if there is an increased risk of adverse reproductive outcomes in the spouses, children, and grandchildren of the Atomic Veterans. Biomaterials repair, reinforce or replace damaged functional parts of the (human) body. All mechanical and biological interactions between an implant and the body occur across the interface, which has to correspond as nearly as possible to its particular function. Much of the progress in adapting polymer materials for use in a biological environment has been obtained through irradiation techniques. For this reason the most recent developments in four key areas are reviewed in this special volume: (1) the analysis of the topology and the elemental composition of a functional surface, (2) the chemical modification of the surface which results in highly pure, sterile and versatile

surfaces, (3) the sterilisation of implantable devices via ionising radiation and its possible effects on the structural mechanical properties of polymers, and (4) the radiation effects on living cells and tissues which are of particular importance for radiation protection and radiotherapy.

This book, now in its third edition, aims to promote a deeper understanding of the scientific and clinical basis of nuclear medicine and the new directions in medical imaging. The new edition has been revised and updated to reflect recent changes and to ensure that the contents are in line with likely future directions. The book starts by providing essential information on general pathophysiology, cell structure and cell biology as well as the mechanisms of radiopharmaceutical localization in different tissues and cells. The clinical applications of nuclear medicine are then presented in a series of chapters that cover every major organ system and relate the basic knowledge of anatomy, physiology and pathology to the clinical utilization of various scintigraphic modalities. The therapeutic applications of nuclear medicine are discussed in a separate chapter, and the final chapter is devoted to the biologic effects of ionizing radiations, including radiation from medical procedures.

The author is ready to assert that practically none of the readers of this book will ever happen to deal with large doses of radiation. But the author, without a shadow of a doubt, claims that any readers of this book, regardless of gender, age, financial situation, type of professional activity, and habits, are actually exposed to low doses of

radiation throughout their life. This book is devoted to the effect of small doses on the body. To understand the basic effects of radiation on humans, the book contains the necessary information from an atomic, molecular and nuclear physics, as well as from biochemistry and biology. Special attention is paid to the issues that are either not considered or discussed very briefly in existing literature. Examples include the ionization of inner atomic shells that play an essential role in radiological processes, and the questions of transformation of the energy of ionizing radiation in matter. The benefits of ionizing radiation to mankind is reflected in a wide range of radiation technologies used in science, industry, agriculture, culture, art, forensics, and, what is the most important application, medicine. Radiation: Fundamentals, Applications, Risks and Safety provides information on the use of radiation in modern life, its usefulness and indispensability. Experiments on the effects of small doses on bacteria, fungi, algae, insects, plants and animals are described. Human medical experiments are inhuman and ethically flawed. However, during the familiarity of mankind with ionizing radiation, a large number of population groups were subject to accumulation, exposed to radiation at doses of small but exceeding the natural background radiation. This book analyzes existing, real-life radiation results from survivors of Hiroshima and Nagasaki, Chernobyl and Fukushima, and examines studies of radiation effect on patients, radiologists, crews of long-distant flights and astronauts, on miners of uranium copies, on workers of nuclear industry and on militaries, exposed to ionizing radiation on a

professional basis, and on the population of the various countries receiving environmental exposure. The author hopes that this book can mitigate the impact of radiation phobia, which prevails in the public consciousness over the last half century. Explores the science of radiation and the effects of radiation technologies and biological processes Analyzes the elementary processes of ionization and excitation Summarizes information about inner shells ionization and its impact on matter and biological structures Discusses quantum concepts in biology and clarifies the importance of epigenetics in radiological processes Includes case studies focusing on humans irradiated by low doses of radiation and its effects

This publication presents the culmination of collaborative effort between specialists in the wide range of disciplines concerned with the effects of ionizing radiations on nucleic acids. The authors belong to a group formed under the aegis of the Com mission of the European Communities some eight years ago with the object of facilitating the exchange of ideas and inforrration between European scientists working in this field. The Commission'S aim was not to replace traditional information channels, but to strengthen the various links between the scien tists in the group, as if they were working together in a single team. In addition to the annual meetings of the group, contact was maintained by individual visits, exchanges of young scientists, experiments using mutual equipment, and the regular publication of a Newsletter, mainly to announce the availability of preprints. Bruxelles, December 1977 A. J. Bertinchamps

Commission of the European Communities. Preface Mankind today is faced with a choice of cardinal importance, namely, deciding on the source and quantity of energy to be made available for tomorrow's world. If, as is probable, the energy is to be mainly of nuclear origin, we must expect a marked ex pansion of the nuclear industry, which could well become the world's leading industry in the not-too-distant future. This would carry with it the problems caused by the presence of enor mous quantities of radioactivity, despite the stringent precau tions taken to date and those to be taken in future.

The biological action of radiation undoubtedly constitutes an issue of actual con cern, particularly after incidences like those in Harrisburg or Chernobyl. These considerations, however, were not the reason for writing this book although it is hoped that it will also be helpful in this respect. The interaction of radiation with biological systems is such an interesting research objective that to my mind no special justification is needed to pursue these problems. The combination of physics, chemistry and biology presents on one hand a fascinating challenge to the student, on the other, it may lead to insights which are not possible if the dif ferent subjects remain clearly separated. Special problems of radiation biology have quite often led to new approaches in physics (or vice versa), a recent example is "microdosimetry" (chapter 4). Biological radiation a9tion comprises all levels of biological organization. It starts with the absorption in essential atoms and molecules and ends with the development of

cancer and genetic hazards to future generations. The structure of the book reflects this. Beginning with physical and chemical fundamentals, it then turns to a description of chemical and subcellular systems. Cellular effects form a large part since they are the basis for understanding all further responses. Reactions of the whole organism, concentrating on mammals and especially humans, are subsequently treated. The book concludes with a short discussion of problems in radiation protection and the application of radiation in medical therapy. These last points are necessarily short and somewhat superficial.

This book focuses on the conventional and emerging applications of radiations, which include radio waves and ultraviolet and gamma radiations. It discusses new techniques in radiation therapy and the effects of ionizing radiations on biological systems. The applications of radiations in the synthesis and use of nanoparticles along with the effects of hypergravity indicate a new trend. The book offers a concise account of the latest studies carried out so far and shows the new initiatives to be undertaken in the field of medicine and biology. It covers the medical use of radiations, such as ferrous sulfate–benzoic acid–xylenol orange dosimetry, Co-60 tomotherapy, radio-electro-chemotherapy, and fractional radiotherapy, and radiobiological effects, such as the effects of cell phone radiations on human health parameters and the combined effects of radiations and hypergravity on plants.

Biological Radiation EffectsSpringer Science & Business Media

This book provides a thorough yet concise introduction to quantitative radiobiology and radiation physics, particularly the practical and medical application. Beginning with a discussion of the basic science of radiobiology, the book explains the fast processes that initiate damage in irradiated tissue and the kinetic patterns in which such damage is expressed at the cellular level. The final section is presented in a highly practical handbook style and offers application-based discussions in radiation oncology, fractionated radiotherapy, and protracted radiation among others. The text is also supplemented by a Web site.

Biologists and radiotherapists present their experimental work and clinical data in the field of radiation injuries of normal tissues and organs. Particular regard is payed to the relevance of biological mechanisms in clinical situations. Principles of radiation damage and combined treatment toxicity in radio-chemotherapy are being explained. The main topics discussed are the importance of microvasculature, time, doseand fractionation and factors modifying clinical radioresponse for early andlate radiation effects. Tissues and organs considered in this volume are mucosa and skin, lung and heart, bladder and muscle, CNS and eye. Special problems of pediatric radiotherapy, TBI, IORT and second malignacies are also mentioned.

This book is the seventh in a series of titles from the National Research Council that addresses the effects of exposure to low dose LET (Linear Energy Transfer) ionizing radiation and human health. Updating information previously presented in the 1990

publication, Health Effects of Exposure to Low Levels of Ionizing Radiation: BEIR V, this book draws upon new data in both epidemiologic and experimental research. Ionizing radiation arises from both natural and man-made sources and at very high doses can produce damaging effects in human tissue that can be evident within days after exposure. However, it is the low-dose exposures that are the focus of this book. So-called “late” effects, such as cancer, are produced many years after the initial exposure. This book is among the first of its kind to include detailed risk estimates for cancer incidence in addition to cancer mortality. BEIR VII offers a full review of the available biological, biophysical, and epidemiological literature since the last BEIR report on the subject and develops the most up-to-date and comprehensive risk estimates for cancer and other health effects from exposure to low-level ionizing radiation.

This book is an essential introduction to the basic principles of radiation protection and aerosol physics, including applications within international and UK law for the protection of the public against the dangers arising from ionising radiation. The text also discusses the difficulties with the monitoring and the health detriment associated with problematic radionuclides.

Radiation Effects: ESR and ENDOR Analysis presents an explanation of the biological effects of radiation. The book discusses the characteristics of the electron spin resonance (ESR) and electron-nuclear double resonance (ENDOR) spectra, such as radiation damage and magnetic

resonance spectroscopy, g values, hyperfine couplings, and other special effects. The text also describes the radiation effects and damage mechanisms; as well as the free radicals produced in the primary oxidative process initiated by ionizing radiation, in the primary reductive process initiated by ionizing radiation, and via excitation effects. The classification of the mechanisms of radiation damage by various other secondary processes is also considered. The secondary processes include reactions of hydrogen atoms; reactions of hydroxyl radicals; electron or proton transfer; conformational changes; abstraction, transfer, migration, and exchange of hydrogen; radical addition reactions; and radical pair formation. Some examples of overall mechanisms, such as the overall radiation chemistry of carboxylic acids and the radiation chemistry of protein and nucleic acid constituents, are described. People involved in energy and cancer research will find the book invaluable.

This book reevaluates the health risks of ionizing radiation in light of data that have become available since the 1980 report on this subject was published. The data include new, much more reliable dose estimates for the A-bomb survivors, the results of an additional 14 years of follow-up of the survivors for cancer mortality, recent results of follow-up studies of persons irradiated for medical purposes, and results of relevant experiments with laboratory animals and cultured cells. It analyzes the data in terms of risk estimates for specific organs in relation to dose and time after exposure, and compares radiation effects between Japanese and Western populations.

This book is designed to convey as much information as possible in a concise and simple way to make it suitable for students, researchers and clinical medical physicists. Better meanings, codes and examples are included. Most of the basics are also covered for easy reference

along with a glossary of objective-type questions. Upon completion of this textbook, the readers will gather knowledge about the physics, chemistry and biology of the human body towards cancer treatment using radiation.

The application of radiation to medical problems plays an ever-increasing role in diagnosis and treatment of disease. It is essential that medical physicists have the knowledge, understanding and practical skills to implement radiation protection as new techniques are developed. Practical Radiation Protection in Healthcare provides a practical guide for medical physicists and others involved with radiation protection in the healthcare environment. The guidance is based on principles set out in current recommendations of the International Commission for Radiological Protection and methods developed by a variety of professional bodies. Written by practitioners experienced in the field this practical reference manual covers both established techniques and new areas of application. This new edition has be fully revised and updated to cover new requirements linked to the increased knowledge of radiation effects, and the development of new technology. Each specialist area is covered in a separate chapter to allow easy reference with individual chapters being assigned to different types of non-ionising radiations. Tabulated data is included to allow the reader to carry out calculations for situations encountered frequently without reference to further texts.

This book features papers presented at a workshop discussing current knowledge about the biological effects of low level exposures (BELLE). The book is designed to help establish a scientific base for future BELLE initiatives and is focused on the issue of the toxicological implications of biological adaptations. Hormesis is considered in a broad, conceptual manner, as well as at molecular and biochemical levels. Other topics covered include the effects of low

levels of radiation on biological systems, how the liver adapts to genetic insults, biostatistical considerations when designing studies that address issues associated with biological responses to low doses of chemicals and radiation, and the issues that surround the interpretation of findings from such studies.

During the last 35 years, there has been considerable develop ment and increase in the number of devices that emit nonionizing radiant energies. These energies such as radiofrequency including microwaves are used in all sectors of our society for military, industrial. telecommunications, medical, and consumer applications. This increase in sources of nonionizing radiant energies has resulted in growing interest on the part of government regulatory agencies, industrial and military physicians, research workers, clinicians, and environmentalists. Although there is information on biologic effects and potential hazards to man from exposure to microwave/radiofrequency energies, considerable confusion and misinformation has permeated not only the public press but also some scientific and technical publications. Because of the complexity of the interactions of nonionizing radiation in biological systems, an inter-disciplinary approach is necessary to assess and elucidate the problems that evolve as this field advances and as the use of these energies expands. It is important to maintain a proper perspective and assess realistically the biomedical effects of these radiant energies so that the worker or general public will not be unduly exposed nor will research, development and beneficial utilization of these energies be hampered or restricted by an undue concern for effects which may be nonexis tent or minimal in comparison to other environmental hazards.

Physical description of radio and microwave radiation. Radio and microwave

dosimetry and measurement. Radio and microwave dielectric properties of biological materials. Propagation and absorption in tissue media. Criteria for evaluation of biological literature. Molecular, celular, invertebrate biology. Reproduction, development, and growth. Thermoregulation. Neural effects of microwave/radiofrequency energies. Behavioral effects. Neuroendocrine effects. Cardiovascular effects. Effects on hematopiesis and hematology. Effects on immune responses. Biochemical effects. The common integument (SKIN). Cataracts and other ocular effects. Epidemiological and other investigations in the human. Personnel protection, protection guides, and standards.

The largest workshop ever held has produced the most comprehensive review of Radio Frequency Dosimetry and Bioeffects available. Over 80 of the world's leading scientists and technical experts from nine NATO countries and six NATO Partner for Peace countries, and others, review the state of the art in radio frequency radiation dosimetry, measurements and the relationship between SAR, power density and the biological effects of the electromagnetic fields.

The US Environmotection Agency Office of Radiation and Indoor Air asked the National Research Council to evaluate whether sufficient new data exist to warrant a reassessment of health risks reported in Health Effects of Exposure to Low Levels of Ionizing Radiations (BEIR V) in 1990. To respond to this request,

the National Research Council assembled the Committee on Health Risks of Exposure to Low Levels of Ionizing Radiations. The work of the committee was conducted in what was called the BEIR VII phase-1 study. To assist the committee during its deliberations, various scientists were consulted for advice, and a workshop on the impact of biology on risk assessment was held in collaboration with the Department of Energy Office of Health and Environmental Research. The intent of the workshop was to address the implications of new understanding of the biologic basis of radiation injury and carcinogenesis for risk assessment.

University Physics is designed for the two- or three-semester calculus-based physics course. The text has been developed to meet the scope and sequence of most university physics courses and provides a foundation for a career in mathematics, science, or engineering. The book provides an important opportunity for students to learn the core concepts of physics and understand how those concepts apply to their lives and to the world around them. Due to the comprehensive nature of the material, we are offering the book in three volumes for flexibility and efficiency. Coverage and Scope Our University Physics textbook adheres to the scope and sequence of most two- and three-semester physics courses nationwide. We have worked to make physics interesting and accessible

to students while maintaining the mathematical rigor inherent in the subject. With this objective in mind, the content of this textbook has been developed and arranged to provide a logical progression from fundamental to more advanced concepts, building upon what students have already learned and emphasizing connections between topics and between theory and applications. The goal of each section is to enable students not just to recognize concepts, but to work with them in ways that will be useful in later courses and future careers. The organization and pedagogical features were developed and vetted with feedback from science educators dedicated to the project. VOLUME III Unit 1: Optics Chapter 1: The Nature of Light Chapter 2: Geometric Optics and Image Formation Chapter 3: Interference Chapter 4: Diffraction Unit 2: Modern Physics Chapter 5: Relativity Chapter 6: Photons and Matter Waves Chapter 7: Quantum Mechanics Chapter 8: Atomic Structure Chapter 9: Condensed Matter Physics Chapter 10: Nuclear Physics Chapter 11: Particle Physics and Cosmology Exposures at low doses of radiation, generally taken to mean doses below 100 millisieverts, are of primary interest for setting standards for protecting individuals against the adverse effects of ionizing radiation. However, there are considerable uncertainties associated with current best estimates of risks and gaps in knowledge on critical scientific issues that relate to low dose radiation. The

Nuclear and Radiation Studies Board of the National Academies hosted the symposium on The Future of Low Dose Radiation Research in the United States on May 8 and 9, 2019. The goal of the symposium was to provide an open forum for a national discussion on the need for a long-term strategy to guide a low dose radiation research program in the United States. The symposium featured presentations on low dose radiation programs around the world, panel discussions with representatives from governmental and nongovernmental organizations about the need for a low dose radiation research program, reviews of low dose radiation research in epidemiology and radiation biology including new directions, and lessons to be learned from setting up large research programs in non-radiation research fields. This publication summarizes the presentation and discussion of the symposium.

An overview of the biological effects of ionizing radiation, including: basic mechanisms of radiation injury; determinants in radiation damage; short-term effects; and long-term somatic and genetic effects, including a summary of human epidemiological studies.

Biological Effects of Radiation, Second Edition aims to present an organized survey of the various experiments wherein living materials have been exposed to ionizing and exciting types of radiations. However, this book focuses on the

effects of radiation to lower organisms, as these have received less attention. It tells how small amount of energy can damage submicroscopic structure and ultimately alter the appearance and abilities of such organisms. Divided into five parts, this book starts off with two introductory chapters in the first part. It explains the effects of radiation. Then, other parts of the book focus on the impact of radiation from cellular to organ level. How the lower organisms response is then discussed. Lastly, the book explains the interrelations between organisms in contaminated areas. Same with the first edition, emphasis is given on the consequences of mutations, as a whole chapter is devoted to this topic. Furthermore, this book covers discoveries from experiments with cultured cells. This book is a good text-reference for students and professionals. Also, it can be of great help to scientists, researchers, and specialists involved in the biological response to radiation.

Concepts in Radiation Cell Biology summarizes current concepts related to the effects of radiation on cell biology, with emphasis on the underlying macromolecular basis for cellular changes in irradiated cells. It explores the effects of non-ionizing radiation, such as ultraviolet and visible light; the use of laser light in cellular studies; and the biological effects of ionizing radiation on cells. Results of ultraviolet studies implicating DNA as the main target

macromolecule responsible for radiation injury, such as division delays, lethality, and delayed DNA replication, are presented. Divided into eight chapters, this volume begins with an overview of ultraviolet irradiation of DNA as well as the physical and biological properties of irradiated DNA. It then discusses methods used in the photoinactivation of viruses; the effects of ultraviolet radiation on bacteria; radiation-induced biochemical changes in protozoa; and techniques for the analysis of radiation-induced mitotic delay in synchronously dividing sea urchin eggs. The book also covers the effects of radiation on mammalian cells; the effects of ionizing radiation on higher plants; and the photodynamic effects of laser light on cells. This book is a valuable resource for cell biologists, as well as students and investigators who are seeking the necessary information for further experimentation in radiation cell biology.

This book provides a qualitative and quantitative exploration of the action of radiation on living matter which leads to a complete and coherent interpretation of radiation biology. It takes readers from radiation-induced molecular damage in the nucleus of the cell and links this damage to cellular effects such as cell killing, chromosome aberrations and mutations before exploring organ damage, organism lethality and cancer induction. It also deals with radiological protection concepts and the difficulties of predicting the dose–effect relationship for low-

dose and dose rate radiation risk. The book ends with separate chapters dealing with the effects of UV light exposure and risk classification of chemical mutagens, both of which are derived by logical extensions of the radiation model. This book will provide the basic foundations of radiation biology for undergraduate and graduate students in medical physics, biomedical engineering, radiological protection, medicine, radiology and radiography. Features Presents a comprehensive insight into radiation action on living matter Contains important implications for radiological protection and regulations Provides analytical methods for applications in radiotherapy

This volume is based on the proceedings of an Advanced Study Institute (ASI) sponsored by the North Atlantic Treaty Organization (NATO) held October 1987 in Corfu, Greece. The Institute received financial support from the National Aeronautics and Space Administration, U.S.A. Armed Forces Radiobiology Research Institute, U.S.A. Department of Energy, U.S.A. Deutsche Forschungs- und Versuchanstalt fur Luft und Raumfahrt e.v., Kaln, Germany The advent of the shuttle era is providing fresh impetus for large space ventures such as communication centers, solar power stations, astronomical observatories, orbiting factories, and space based radar. Such ventures will rely heavily on an extensive and prolonged human presence in space doing in-orbit construction,

maintenance, and opera tion. Among the advantages of location in space are the near zero gravity environment, commanding location, and the reception of solar energy and astronomical signals unattenuated by the atmosphere. Central to long-term manned space missions are the problems associated with the effects of exposure to ionizing radiations on humans. Manned space mis sions in the past have encountered relatively benign radiation environ ments because of their very short duration and orbit configuration. However, crew stay time of up to a year has been recently achieved by the Soviet space program; and Mars missions lasting several years are under serious consideration.