that it may be used by clients of neutron radiography services, design engineers, and practicing radiographers. Since this is a publication of the Commission of European Communities, information on available facilities and expertise is obviously oriented to the European community. However, as will be discussed, it will serve as a basic reference for anyone interested in the application of neutrons for nondestructive evaluation of materials.

The first chapter provides an introduction to the principles and applications of neutron radiography. The introductory material is primarily oriented toward possible clients of neutron radiography services. Discussions are included of the advantages and disadvantages of neutron and x-ray radiography, neutron sources that can be employed for radiography, types of film and converters for direct and indirect image production, techniques of energy tailoring to increase sensitivity, and test objects that can be employed to determine image quality.

Following the initial material, more detailed information is presented to aid the designer in constructing or analyzing a facility for radiographic evaluation of materials. This section of the text contains a wealth of tabular data on converter foils and their characteristics, collimator design, and choice of the neutron source. The third section of this chapter briefly surveys applications of neutron radiography and includes references that list in detail all current areas of application. Illustrative radiographs are included in this presentation. The introductory chapter concludes with a series of appendixes that, in addition to a reference listing, discuss terminology employed in radiography, provide thermal neutron cross-section data of elements and common materials, and supply equations for the calculation of irradiation and transfer times and void resolution capabilities. The introductory chapter is 90 pages in length, more than one-half of the pages in the handbook, and provides users of neutron radiography with a working knowledge of the basics of this technique of nondestructive testing.

The second chapter describes in detail recommended practices for neutron radiography of nuclear fuel assemblies, a major application area for neutron radiographic techniques. Preferred practices are cited based on data supplied by experienced radiographers. The chapter is very detailed to include, as acknowledged clearly by the authors, American Society for Testing Materials (ASTM) practices. This chapter includes information to be specified on a purchase order for radiography services, information to be logged by the radiography technician, use of image quality indicators, and recommended techniques for startup, marking, and specimen identification. Again, this information is of use to a possible client, design engineer, or practicing radiographer.

Chapter 3 of the handbook discusses indicators (proposed by the Neutron Radiography Working Group) for the testing of beam purity, sensitivity, and dimensional accuracy. The authors state that the indicators used are in agreement with existing ASTM standards or with revisions of these standards that are currently under review. The material discussed in this chapter provides the reader with a background in the technique for quantitative and qualitative assessment of neutron radiography test results.

Chapter 4 contains an abbreviated photographic atlas of defects revealed by neutron radiography in light water reactor fuel. Twenty radiographs of "typical" defects are supplied. References are provided for the reader who finds it necessary to review a more complete series. Following the fourth chapter, tabular data are provided to document neutron radiography installations in the European community. Techniques of exposure and modes of qualitative and quantitative analysis are outlined. These tables are followed by 26 diagrams of the neutron radiography facilities utilized by this group. Individuals outside the European community may find these data to be of reference use since it supplies data on those facilities with unique capabilities that are not duplicated outside the community.

In summary, this handbook will serve as a valuable reference for those individuals using or considering use of neutron radiography as a method of nondestructive testing. Symbols and terminology unique to this process are clearly defined. Numerous illustrations, tables, and figures enhance data presented in the text. There are only a limited number of typographical errors although the publisher has chosen to vary the size of type at what appear to be random locations throughout the text. This variation in type size is obvious, a minor irritant to the reader.

While on the staff of the University of Missouri Research Reactor Facility, Dr. Schlapper was involved in the design of experimental facilities dedicated to nondestructive evaluation of materials. With coworkers he has published several articles on the use of tailored energy neutron beams to produce tomographic images of biological and material specimens. Since January 1981, Dr. Schlapper has served as a faculty member of the Nuclear Engineering Department and Radiological and Health Engineering Program at Texas A&M University.

Hormesis with Ionizing Radiation

Author	T. D. Luckey
Publisher	CRC Press, Incorporated Boca Raton, Florida (1980)
Pages	225
Price	$66.00 domestic; $76.00 foreign
Reviewer	Gerald A. Schlapper

Is it possible that anything that is quite harmful in excess may be of no harm or indeed may even be of benefit at low doses? This is the question posed by Dr. T. D. Luckey in his book, *Hormesis with Ionizing Radiation*. This text examines data on effects of low doses of ionizing radiation and answers the question posed in the affirmative. Such a view will no doubt provoke controversy with acceptance from the "pronuke power" contingent while the "anti" coalition will probably reject the views expressed with only limited review of the data presented.

To read (and, to a greater extent, review) this publication does present a problem, for I admit that a claim of bias due to professional background could be made. A true attempt was made to limit bias, and hopefully I have been more successful than many of the anti group who claim to review data from the nuclear industry from an "independent" viewpoint. This publication cannot be

skimmed lightly. It must be read in depth in order to note statements that clarify and better define the applicability of the general theory of hormesis to ionizing radiation interactions.

Hormesis with ionizing radiation is the positive stimulation of an organism's response by use of appropriate, low-level doses of ionizing radiation. Acceptance of the thesis of radiation hormesis denies the validity of linear extrapolation from known harmful doses to zero levels. It implies that the argument that low doses produce harmful effects in proportion to dosage is invalid.

It supports the concept of a threshold below which no serious harm is found (and benefit may result) and clearly implies that radiation at low levels is considerably less dangerous than is usually accepted. Through a presentation of data from pharmacology, dietary antibiotics, and a number of experiments with low levels of ionizing radiation, Dr. Luckey indicates that a complete dose-response curve is required for all agents and that extrapolation of toxicity levels to zero, without supporting data, will usually be erroneous. He proposes that for any agent there exists a zero equivalent point below which the organism's response is stimulatory in nature. This point is proposed as an upper limit that should be used to set public health and safety standards and establish valid threshold doses.

The first chapter of the text introduces examples of studies showing beneficial effects of low-level radiation exposure. Evidence is submitted that indicates that ionizing radiation may be essential to life. A discussion of the reasons for lack of acceptance of these data from hundreds of experiments is noted. Careful review of this section is suggested.

The second chapter introduces the layman to ionizing radiation and its harmful effects. Also noted is the fact that exposures showing radiation as a harmful agent are 10 to 10^4 times greater than any of those used in studies of radiation stimulation. This very basic discussion of the physical characteristics and interactions of various forms of ionizing radiation is worth reading as it also provides guidance for nuclear professionals who have problems relating this information to the nontechnical community. Also noted in this chapter are methods of radiation measurement to include some of the problems inherent in measuring low levels of exposure. The next section of this chapter discusses background ionizing radiation sources, both exogenous and endogenous, in great detail. Contribution to radiation exposure due to choice of residence is noted as is the content of radionuclides in food and liquids consumed. Medical exposures are also discussed.

The next section of the second chapter outlines the biochemical reactions that occur when a body is exposed to ionizing radiation. The presentation is directed to the individual who possesses only a limited background in radiation interaction with biological systems. Direct and indirect modes of interaction are discussed. Worthwhile information is presented for members of the nuclear profession who lack formal coursework in radiation biology. Protective and sensitizing agents are discussed as are the macroscopic biological effects of ionizing radiation.

The final section of the second chapter will provide for much discussion and hopefully spark future research as it asks whether exposure to low levels of ionizing radiation is essential and also includes an expansion of this concept to the proposal that ionizing radiation levels somewhat above ambient could be beneficial for many physiological functions. Note that there may be physiological functions that are affected in a negative fashion. Blind acceptance of the thesis of this section without further research is questionable. This fact is also noted by Dr. Luckey.

The third chapter digresses from discussion of ionizing radiation effects to further detail the general thesis of hormesis. This chapter introduces additional nomenclature, presents the author's past experience with this general phenomenon, and summarizes an extensive data base supporting the thesis of "positive stimulation by subharmful quantities of any agent to any system." Several examples are presented of unexpected results that were considered anomalous because they were not predicted by extrapolation of data from a dose-response curve. Dr. Luckey states that a common response of workers who have noted stimulation by low doses of agents that are harmful at high levels is to assume a false result and ignore the data. Common, everyday examples that support the thesis of hormesis are presented. The concept of the zero equivalent point is introduced and elaborated on in this chapter.

The fourth chapter begins with a historical survey of limited work in the field of use of low-level ionizing radiation for stimulation. The author notes the wealth of experimental work that has been performed to determine the amount of radiation that will cause harmful effects. He points out that the common extrapolation of these dose-response curves to zero levels gives no hint of possible hormetic effects. Numerous studies supporting the beneficial effects of exposure to low levels of various forms of ionizing radiation are presented in a clear, tabular format. While the majority of the studies cited are based on experience with plants, studies with invertebrate and vertebrate animals are also included in the listings. Dr. Luckey includes arguments posed to negate the thesis of ionizing radiation hormesis and supplies his response to these claims.

In the fifth chapter of the book, several mechanisms of hormesis are examined. Examples of possible mechanisms are taken from the fields of biochemistry, hormone interaction, and toxin production. A hypothetical sequence of events in ionizing radiation hormesis is proposed. This chapter is followed by a summary chapter that places the wealth of data presented in previous chapters in perspective. A claim that low doses of ionizing radiation conform to the general concept of hormesis is repeated, and justifications to support validity of this claim are summarized.

The book contains a detailed index to allow the reader to readily find specific studies. This is necessary since the experiments cited span more than eight decades from studies conducted shortly after Roentgen's discovery of x rays to those currently in progress. There are only a limited number of typographical errors. The average reader, to include the reviewer, will not really be able to totally evaluate the wealth of data supplied.

Most readers will have problems with portions of this publication: for example, the lack of experiments on higher animal forms (that results from limited funding), the lack of references to "the other side of the fence" studies, and the lack of a discussion of statistical problems that exist in many of these studies. However, it is basically a scientific publication where opinions and judgments expressed do have basis in clearly referenced scientific evidence.

This text provides a counterpoint view to the intentionally alarmist, uninformed journalism employed by some of the "anti" lobby where personal opinions are frequently equated with fact. Review of this publication will show that critical questions, such as how much radiation is really harmful, remain unanswered. In spite of the extensive studies of the effects of ionizing radiation, there is still more to learn, and further research in the effects of low-level ionizing radiation exposures is dictated.

While on the staff of the University of Missouri Research Reactor, Dr. Schlapper was involved with the Operational Health Physics Program. He also served as a research fellow in the Nuclear Medicine Department of the Harry S Truman Veterans Administration Hospital. In January of 1981, Dr. Schlapper joined the faculty of the Radiological Health Engineering Program of the Nuclear Engineering Department at Texas A&M University. He also serves on the consulting faculty of the Nuclear, Biological and Chemical Protection Branch of the U.S. Army Academy of Health Sciences.

The Dynamics of Explosion and Its Use

Author	Josef Henrych
Publisher	Elsevier/North-Holland, Inc., New York (1979)
Pages	558
Price	$107.25
Reviewer	Jerzy R. Moszynski

This is a very unusual book. It attempts to present in nine chapters a wealth of information on the origin and development of explosion-caused stress waves, the damage due to them, design for protection, engineering use of explosions and, finally, calculation methods for deformations in various types of materials and structures.

The coverage is very uneven. At one extreme are very detailed calculation procedures in Chaps. 7 and 8 of elastic and elastoplastic deformations of elements and structures under a wide variety of impulsive loadings. At the other is the very terse presentation of fundamental aspects of stress wave theory and explosion effects in a medium in Chaps. 1 and 2, and the discussion of explosions in air and water and their effects in Chaps. 3 and 4, respectively. Here, difficult concepts are presented without discussion, equations and their solutions are written down, often with reference to publications not easily accessible. Perhaps the most extreme example is Sec. 2.9 on nuclear explosions, which contains some elements of kinetic theory, quantum mechanics, and radiation that are never used again and are simply written down. In between are Chaps. 5 and 6, which contain a great deal of empirical data and calculation procedures dealing with the use of explosions in excavation, earthwork, metal forming, etc., and in demolition, respectively. An excellent chapter on the seismic effects of explosions concludes the text.

The compilation of empirical data and calculation procedures is one of the best features of the book and will appeal to the designer and practicing engineer. The theoretical treatments are a little more disappointing and may not even serve as a useful starting point for someone embarking on the solution of a specific problem. This is due to the references being mostly Russian books, many not easily accessible. There are practically no references to Western technical journals; some books are listed, however. Even references to Soviet or Eastern European journals are scarce, and almost 15% are to the author's own work. Very few of the references are more recent than 1970.

The text, while terse in places, is understandable with a few exceptions. The translation is competent with very few linguistic lapses. The notation used, largely unfamiliar to an American reader, is very complex. The list of symbols occupies 14 pages. This hardly contributes to ease of reading.

In summary, the book will probably be a useful reference for practicing engineers and may provide a source of information on Soviet and East European work (albeit not too recent) in the field.

Dr. Jerzy R. Moszynski has been professor of mechanical engineering at the University of Delaware since 1966, having previously taught at Case Institute of Technology, Brown University, and the University of London. His primary interests are in thermodynamics and heat transfer with recent research centered in the areas of two-phase flow and reactor safety problems. He has translated or edited four books and authored or coauthored over 30 papers. He was awarded a Humboldt Foundation (Federal Republic of Germany) senior fellowship and a research prize of the secretary of the Polish Academy of Sciences. He is a consultant to government agencies and laboratories and to private industry. Active in professional societies, he is a fellow of the Institution of Mechanical Engineers (Great Britain).

Gas Turbine Combustor Design Problems

Editor	Arthur H. Lefebvre
Publisher	Hemisphere Publishing Corporation, New York (1980)
Pages	431
Price	$45.00
Reviewer	M. R. Bottaccini

A book dedicated to combustion chamber design is an unlikely source of information for nuclear engineers, especially a book such as this one, the heterogeneous proceedings of a meeting held at Purdue University in 1978. Such "workshops" are full of bombast and intellectual noise with nearly vanishing information content. And yet there are compensations even for the nuclear engineer whose work, we are told on p. 87, is being diminished by "the well-publicized opposition to nuclear power," which