

# **Medical Aspects of Radiation Accidents**

**A HANDBOOK FOR  
PHYSICIANS, HEALTH PHYSICISTS  
AND  
INDUSTRIAL HYGIENISTS**

**Eugene L. Saenger, M.D., *Editor***

**UNITED STATES ATOMIC ENERGY COMMISSION**

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## PREFACE

Before 1945 the probability of a radiation accident was judged to be so remote that such an occurrence was of no interest. In the intervening years this attitude has undergone a drastic change. Largely because of the important work of pioneers in medicine and physics, the entire atomic energy field with its great ramifications and implications for industry and science has had a safety record which is unmatched when compared to developments of similar magnitude. The injuries to persons and contamination of the environment from peaceful uses of nuclear power has fortunately failed to increase in proportion to the growth of the industry; in fact the reverse is true.

Because of the enormous power created and because of the great quantities of radioactive waste products produced, the possibility of serious accidents is always of concern. Many such events have been recorded. The number of fatalities has been remarkably small.

Having been involved in a rather small accident in 1951, I was appalled by the confusion and indecision of a rather experienced group of scientists and engineers in coping with the situation. In the intervening years I have been fascinated by the many approaches to similar problems by others. Most accidents have been handled with great skill and dispatch; an occasional touch of fantasy may be found if one probes deeply enough.

The care of people injured by radiation requires considerable thought and experience. There is no specific antidote for radiation. Many treatments which have been proposed in the past are either ineffective or even hazardous. Thus it seemed practical to assemble all of the pertinent, tested, and useful information for several reasons. Such a compendium would be useful to the physician and health physicist faced with an emergency. It is hoped that this material will serve as a basis for further investigation of the many problems of diagnosis and therapy which is badly needed in this nuclear age.

In preparing this handbook, considerations of the problems of nuclear warfare were excluded by mutual agreement. The peacetime radiation accident is not different from that which might be encountered in nuclear warfare except in degree. To this extent the information presented here is applicable to the far more serious situation, although the relatively elegant civilian facilities might be lacking.

The design of the handbook is such that the simplest instructions are presented on the frontispiece. A group of rules then elaborates

## PREFACE

on these instructions in section 1. The remaining sections elaborate on the various possible accidents and technique for coping with them. There is some repetition, which has been intentional, so that each section is relatively complete in itself.

There may be some concern on the part of the reader in relation to the use of the several units of radiation dose—rem, rad and roentgen. In general we have tried to restrict our uses to the term rad since the RBE for different types of radiation in respect to human injury is not determined. Occasionally the rem is used particularly when material has been taken from pertinent Federal codes. The roentgen is used only as the unit of exposure dose. Appropriate conversion factors can be found in the appendix.

A number of Atomic Energy Commission installations were visited by me in preparing this manuscript, and I have tried to express faithfully the many fine concepts about accidents which the physicians and health physicists of the Commission so patiently spelled out.

The help of the following individuals is gratefully acknowledged: G. Andrews, G. V. Beard, V. P. Bond, A. Brodsky, W. D. Claus, M. J. Cook, E. P. Cronkite, T. Ely, A. J. Finkel, J. Healy, G. S. Hurst, D. Moeller, K. Z. Morgan, D. Norwood, A. Spitzer, N. Telles, and H. Wellman. The editorial assistance of Patricia K. Novak and Ruth V. Lindsey is appreciated. Particular thanks are extended to the Department of Medical Art of the University of Cincinnati College of Medicine.

If future accidents can be handled in a well-organized manner, the damage, both to humans and the environment, can be minimized greatly. It is our hope that this handbook will help to achieve this aim.

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NOTE: A recent book has been published after this manuscript had been submitted. It is "Diagnosis and Treatment of Acute Radiation Injury" International Documents Service, Columbia University Press, New York, 1961. In addition to reviews of most of the more serious accidents referred to in this text, there is an important discussion of the Lockport incident where several individuals received large partial body exposures of X-irradiation. The book is highly recommended as an additional valuable source of information.

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## SECTION 1

### 1 SUMMARY—A COOKBOOK APPROACH

- 1.1 General Principles
- 1.2 The Accident
  - 1.21 Rules for Health Physicists
  - 1.22 Rules for Physicians
- 1.3 Guidelines for the Protection of Workers Aiding in a Radiation Accident
- 1.4 Determination of the Existence of Radiation Injury
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### 1 COOKBOOK APPROACH

In this section a cookbook approach to a radiation accident is described. Each step of the procedures outlined here is described in greater detail in subsequent sections.

#### 1.1 GENERAL PRINCIPLES

A radiation accident may be defined as an unforeseen occurrence, either actual or suspected, involving exposure of or contamination on or within humans and the environment by ionizing radiation. The accident will be considered as occurring over a short time period of seconds up to several days. Chronic occupational or other long-term exposure will not be considered.

A survey of the literature shows little purpose in trying to distinguish between the words accident and incident to define the extent or degree of severity of an unforeseen event involving radiation. The participant tends to use the word "incident" as possessing less ominous implications; the observer being less personally involved has no particular reluctance to employ the word "accident." Hence in this handbook there has been no attempt to distinguish between the two. Both the Webster dictionary and Roget's Thesaurus leave one with a sense of ambiguity, at least for the individual who might crave for firm distinctions between these synonyms.

Radiation accidents or incidents may, however, be classified to some extent by degree. One can realize that a small spill of a radionuclide in the laboratory is considerably less hazardous than a fire or explosion in a reactor with dissemination of radioactivity over a portion of the countryside.