conclude that networks that have been designed using pinch technology have good controllability.

Kotjabasakis and Linnhoff present a case study in process flexibility (i.e., debottlenecking and catalyst fouling) and, in a somewhat related paper, Linnhoff et al. further extend this analysis to examine batch processing. In this latter paper, their analysis considers debottlenecking and energy integration as simultaneous goals. Here, they are trying to increase batch throughput rates and flexibility, as well as reduce energy usage.

Kemp and Macdonald also analyze batch processing. They describe methods that identify process changes by splitting the grand composite curve and they provide a more rigorous targeting method.

Rossiter and Ranade discuss the use of marginal costs for analyzing retrofit costs, while Ranade and Sullivan describe software allowing the integration of heat pumps. These two papers describe results from work sponsored by the Electric Power Research Institute and will be of interest to readers who are concerned with cogeneration. Glavic extends Linnhoff's methods to systems involving heat engines and chemical reactors. This paper is also relevant for cogeneration studies.

Other algorithmic approaches to solving heat integration problems are presented by Dhallu and Johns, Ciric and Floudas, and Chang and Yu. For example, Dhallu and Johns evaluate heat integration in distillation networks. They present a new algorithm for solving the nonlinear, nonconvex, modified transportation problem that results from their analysis. Ciric and Floudas apply a two-stage procedure for addressing heat exchanger network problems in retrofit situations. Their technique utilizes superstructure analysis with mixed integer linear programming and nonlinear programming. On the other hand, Chang and Yu provide a third approach. They describe an evolutionary stream-merging technique to reduce the number of heat exchanger units without energy penalty or violating the minimum approach temperature.

Four papers are concerned with flow sheet development more than with integration per se. Lott describes the use of simulators as an aid to process synthesis. This paper appears first in the book and provides a short overview of synthesis. Dhallu and Johns describe a procedure using dynamic programming to synthesize distillation trains with heat integration. They deal with state optimization by discretizing their continuous variables (e.g., pressure). On the other hand, Kaibel considers the use of exergy in arranging distillation columns with low energy consumption while Floudas applies mixed integer linear programming and superstructure analysis to solve a multiple-feed distillation tower synthesis problem.

This book is a useful reference for engineers who are already familiar with pinch technology and have some background in process synthesis. It addresses many relevant questions such as batch processing, retrofit analysis, flexibility, controllability, etc. It will be particularly interesting to chemical engineers since most of the examples are taken from the chemical processing industry.

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Radioactivity and Health, A History

Author	J. Newell Stannard
Publisher	Battelle Pacific Northwest Laboratories (1988)
Pages	~2000
Price	$67.50
Reviewer	Hugh F. Henry

This is a *big* book—all 7 lbs. and almost 2000 pages of it. Prepared for the U.S. Department of Energy, the basic purpose of this book is to summarize the wealth of radiobiological information developed by U.S. government-financed experimental work for internally deposited radioisotopes and associated phenomena in the period from World War II (1940) through 1980. Thus, these data were obtained not only before the records thereof disappeared into some "never-never land," but also while some of the principal experimenters were still available for interviews. Since the author was an important figure in this effort, it is particularly fortunate that he was willing to undertake such a tremendous project. One can only thank him for a difficult job well done.

The material is presented in 21 chapters, which the author suggests may be divided into the following major categories:

1. naturally occurring radioactive elements
2. manmade radioisotopes
3. inhalation toxicology
4. environment
5. instrumentation
6. therapy and nuclear medicine
7. concluding comments.

Categories 1 and 2 are obviously concerned with uranium, radium, radon (and daughters), thorium, polonium, and plutonium, along with various actinides and fission products. The data are presented element by element for the laboratories involved, and with rather detailed descriptions and analyses of the methods used and the results obtained. Included

in this section are excellent summaries of the earlier work involving radium-dial painters and uranium miners. For categories 3 and 4, the information is generally treated as recognition of a problem and the efforts at its solution. Dust and respirable gases are the general subjects for category 3, while category 4 provides information on a broad spectrum of topics from fallout and radioecology to the movement of radionuclides through the earth. In addition to general subjects, these four categories also include information on an amazing number of specialized topics such as tobacco smoke, Bikini Atoll, the Lucky Dragon, the Los Alamos UPPU group, Operation Plowshare, early "health spas" in Europe, and the "hot-spot" controversy raised by the National Resources Defense Council, an organization still causing unjustified concerns. Truly, it is difficult to think of a topic in the field delineated that has been missed. The considerations of categories 5 and 6 are perhaps obvious. All of the material is accompanied by adequate bibliographies and is extensively referenced, although some of the summaries are dated in the 1960s and after, frequently a number of years following completion of the work itself. Tables and illustrations (photographic and line) are well supplied.

Considering the author's stated purpose and scope of work, many areas of interest are necessarily omitted or given minimal treatment. Among these are external radiation, which is important in establishing "permissible limits" for some internal emitters; work done in non-government-financed projects here or in Europe, although some of the latter are mentioned; experimental work leading to radiation hormesis conclusions; and many of the recent epidemiological analyses. Furthermore, there is almost no mention of long-term data, including life spans, even where piggybacked on other experiments of more direct interest. In addition, a possible author bias in presentation must always be considered in an effort of this type.

This reviewer has never seen such a user-friendly book, despite its bulk. In addition to a final chapter giving overall conclusions, each chapter is accompanied by a concluding summary and commentary along with an introductory outline, overview, and brief chronology; each is also divided into major subheads as listed in the Table of Contents. There are three extensive indexes—one each for people, organizations, and subjects—and the interviewees are listed.

Overall, this book provides essentially all the fundamental data for the topics covered, and thus deserves wide distribution. The author's style of writing is very readable, the overall product is interestingly presented, and the information is provided in a readily retrievable format.

Hugh F. Henry is emeritus professor of physics at DePauw University.