perience with industrial research and equipment provided a basis for selection and screening of processing equipment. Concerted research and development permitted modification of machinery to suit the developed processes. The initial phase toward industrial production was to create a pilot plant with a unit operations approach to evaluate each step of the entire production process. Currently, after debugging and improvements by numerous colleagues, engineers, and vendors, the product is being manufactured on a large scale.

Structured development followed by structured implementation of innovations into the field for manufacture requires time before product can be inserted into the market. Constant changes in consumer demands over the last decade has created the requirement for rapid development and production of new materials. This rapid change can be achieved by adapting and retraining the knowledge base of those involved in the initial development and by short-circuiting development steps. Most start-up companies such as the one where I work utilize parallel development and production paths with an overlap of individuals. □

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## Impurities in Engineering Materials: Impact, Reliability and Control

*Clyde L. Briant, Editor*
*(Marcel Dekker, New York and Basel, 1999)*
*viii + 306 pages, $ 150.00*
*ISBN 0-8247-9965-8*

Clyde Briant, the editor of this book, has a long and distinguished record, first in industry and recently at Brown University, studying impurity segregation to grain boundaries in alloys and the effects thereof on plasticity and fracture, going on to study the processing of refractory metals, especially tungsten which has to be "doped" to be used successfully in making lighting filaments. He is thus well-qualified as a progenitor of the book under review.

The nine chapters in this book are devoted to metallic systems, either in the form of ultrapure ("clean") alloy systems or to less pure materials in which impurities cause problems. Briant has written the first chapter, on the Need for Clean Materials, which is supplemented by an essay about clean superalloys by a former industrial colleague of the editor's, Mark Benz, and another on superclean steels by Allan Cramb of Carnegie-Mellon University. Three chapters focus in different ways on grain-boundary segregation and resultant embrittlement; one is a long chapter by a German metallurgist, Grabke (with a wealth of relevant references) on grain-boundary segregation specifically in steels, the others are by the editor, and by Easo George (Oak Ridge National Laboratory) and Richard Kennedy (Allvac), this last particularly informative piece focused on creep in relation to impurities. Eileen Skelly Frame, late of General Electric and now elsewhere in industry, has a most illuminating long chapter on the many analytical methods used for assessing impurities and their sensitivities. The late Jack Nutting (Leeds, England) has a somewhat pedestrian account of the sources of trace impurities, in steels particularly.

The focus of the book is thus somewhat narrow (there is nothing about ceramics, for instance) but it makes up for this in depth, and some of what appears here is capable of giving good ideas to non-metallurgists too. The chapters on ultraclean alloys are particularly illuminating for someone who has not kept up well with this aspect of modern metallurgy.

The book is somewhat expensive for what it provides, but then it is not alone in that nowadays. For readers and libraries that can afford it, it will most certainly not disappoint them.

***Reviewer:** Robert W. Cahn is a metallurgist as well as a materials scientist, attached to Cambridge University, and is a member of the* MRS Bulletin *Book Review Board.*

## Electronic Genie: The Tangled History of Silicon

*Frederick Seitz and Norman G. Einspruch*
*(University of Illinois Press, Urbana and Chicago, 1998)*
*xvi + 281 pages, $34.95*
*ISBN 0-252-02383-8*

Here is a historical volume which starts much further back than other books on the events that gave rise to the transistor. It is almost justifiable to say that much of it covers the prehistory of silicon. It covers the precocious researches of pioneers like the German Braun and Hollmann, and the American Pickard; the birth of interest in silicon at the same time as wireless telegraphy began; and the early, tentative steps toward an understanding of how semiconductors as a class work. The roles of radar research in Germany, France, Russia, Japan, and Britain receive separate chapters, some very short. Several physicists loom large in these early stories, for instance, the Britons Denis Robertson (who later settled in America) and Herbert Skinner. Bell Labs do not raise their corporate head until chapter 13 (out of a total of 20), and the story of the "discrete transistor" occupies a lively chapter 14. The last chapters expertly review integrated circuits and possible futures. The book is very well provided with portrait photographs of the many actors in this tangled drama; this feature is always a special strength of books in which Seitz is involved.

The book has had a complex prehistory of its own and involved much archival research by the authors; the Acknowledgments occupy all of six pages, which indicates how complex the historical research was. The book's immediate precursor was a paper by Seitz in the *Proceedings of the American Philosophical Society* **140** (1996) 289.

For any reader who wants to know how the information age came about, this book is compulsory reading, as a necessary companion to Riordan and Hoddeson's book, *Crystal Fire* (1997).

***Reviewer:** Robert W. Cahn is a metallurgist as well as a materials scientist, attached to Cambridge University, and is a member of the* MRS Bulletin *Book Review Board.*





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