LIBRARY

Jack: Straight from the Gut

Jack Welch with John A. Byrne
(Warner Books, New York, 2001)
xvi + 479 pages, $29.95
ISBN 0-446-52838-2

Jack Welch, then a newly minted PhD graduate in chemical engineering from the University of Illinois, joined General Electric Co. in October of 1960. Twenty years later, he was named CEO, and in the ensuing 20 years he built the company from a $25 billion per year business with $1.5 billion in annual earnings to a $130 billion business with $12.7 billion in annual earnings in 2000. The book, cowritten with John A. Byrne of *Business Week* magazine, is part autobiographical, part an exposition of Welch's views on management, and part a history of the successes and failures during his tenure. The book encompasses 26 chapters arranged in five sections; a brief epilogue; four appendices; 16 pages of candid photographs of Welch, his family, business associates, and notable personages he encountered during his career; and a detailed index to people and events.

Only 88 pages of a total of 463 pages deal with Welch's life and activities before becoming CEO. Welch entered GE as a development engineer at its Pittsfield, Mass., plant, engaged in bringing a new plastic, polypropylene oxide (PPO, later named Noryl), from a laboratory curiosity to a commercial product. Despite an explosion of his equipment that blew off the roof of part of the Pittsfield plant, and the discovery of a serious flaw in PPO that although ultimately solved might have prevented its success in its largest intended market, Welch persevered and was soon named general manager of GE's $26 million plastics business—at age 32, the youngest GM in the company. Three years later, he was named vice president and GM of the Chemical and Metallurgical Division, a $400 million component involved in such diverse products as carbides, industrial diamonds, insulating materials, and electromaterials, as well as plastics. In later years, his responsibilities broadened still further as group executive to include medical systems, appliance components, and electronic components (e.g., semiconductors, TV tubes, and capacitors). Curiously, Welch was never enthusiastic about the semiconductor business, believing that despite high growth, it was too cyclical and capital-intensive to be a rewarding, steady earner.

As CEO, Welch introduced some new concepts in management to GE. He insisted that every component be No. 1 or 2 in its market; otherwise the component should be fixed, sold, or eliminated. Money realized from the sale of a business should not go to the bottom line but should be used to improve competitiveness elsewhere in the company. Just because a business had been a traditional one for GE and was profitable were not sufficient reasons to retain it. It must fall within the scope of three main areas: services (financial, information, nuclear, and construction engineering), high technology (medical, materials, industrial electronics, aerospace, and aircraft engines), and core (major appliances, lighting, turbines, transportation, motors, and contractor equipment); show strong growth potential; and not be threatened by low-cost non-U.S. competition. Another principle Welch strongly endorsed was that of *differentiation*, applicable to both people and businesses: reward the best and cut the worst. He also favored minimizing GE's bureaucracy, in particular, reducing the number of managerial layers in the organization.

Implementation of these ideas brought about a series of multi-billion-dollar divestitures and acquisitions. Some, like the sale of Utah International and the acquisition of RCA, were great successes. Others, such as the acquisition of Kidder-Peabody, an investment banking firm, were notable failures, as was Welch's last action before retirement, an attempt to get a proposed merger with Honeywell past the European Commission. Taken together, however, these actions both strengthened and grew the company enormously. Keywords that characterize Welch's managerial philosophy are "boundary-less," passion, and people. In his last 10 years as CEO, Welch introduced in the 1990s four major initiatives, to be implemented across the company, that he called "game changers." These were globalization, services, 6 Sigma (a statistical approach to quality control of both products and functions), and e-business (use of the Internet to interact with both customers and suppliers). Their substantial impact has eminently validated his vision. A final section of the book of particular interest is Welch's account of his process for the selection of his successor.

Overall, the book is a fascinating read and difficult to put down. The text is a seamless collaboration by Welch and Byrne. It is not so much a biography of Welch, or a history of GE, or a description of the many cutting-edge technologies that GE pioneered, but rather an extended essay on Welch's management philosophy, one that by any measure achieved enormous success for GE employees, investors, customers, and the world at large.

Reviewer: *Jack H. Westbrook is currently president and principal consultant for Brookline Technologies in Ballston Spa, N.Y., providing consulting services in the areas of materials and information systems. He was employed by General Electric from 1949 to 1985, first as a metallurgist in the R&D Center, then as manager of Materials Information Services, and finally as a consultant for Corporate Engineering and Manufacturing. In materials, he is particularly active in high-temperature materials, especially intermetallic compounds; he also has strong interests in the history of science and technology.*

Damage Tolerance and Durability of Material Systems

Kenneth L. Reifsnider and Scott W. Case
(John Wiley & Sons, New York, 2002)
435 pages, $99.95
ISBN 0-471-15299-4

The title of this volume curiously omits the word "composite." In fact, the content is exclusively devoted to the behavior of fiber composite materials, mainly continuous fiber polymer-matrix systems, with some discussion directed toward ceramic-matrix materials. The basic thesis, stated in the introduction, is that mechanistic models of damage tolerance and durability may be developed to predict the residual strength and service life of composite materials under a wide variety of loading and environmental conditions. The methodology, outlined in the introduction, is based on data gathered from the experimental determination of failure modes. Critical structural elements are identified, and the rates of all relevant degradation processes determined, so that a failure function may be defined and used to calculate remaining strength or life. The chapters follow a logical sequence, from "Physical Behavior" to "Engineering Concepts of Strength" and "Strength Evolution," followed by a discussion of micromechanics, stiffness and strength evolution, and the effects of damage accumulation. Then follows a chapter on "Nonuniform Stress States," which deals with edge stresses, notches, local effects of damage, and fracture mechanics. The final chapter consists of five case studies in which the methodology is demonstrated and predictions are compared with experimental data.

The authors have taken on the task of attempting to describe all of the observed failure processes, including fiber fracture, matrix cracking, delamination, and kink-band formation under compression, and the associated growth processes under quasi-static, fatigue, creep, and thermal loading, in quantitative mathematical terms so that a failure function may be defined. This is a mammoth undertaking, as many of the fundamental parameters,

such as interface strength, are difficult to measure or quantify. Inevitably, this leads to some computational complexity, which is the "meat" of several of the chapters. The derived failure functions inevitably contain disposable constants to achieve the necessary curve-fitting. In some cases, this calls into question the physical significance of the approach. There are instances of arguments being supported by doubtful comparisons, for instance, the strain at failure for fatigue loading where a glass/epoxy composite is compared with "CrMoV" (presumably a steel!). The materials chosen for the tables of properties in the appendices are somewhat dated. The fiber properties in Table 1-1, which have been taken from another source, are compared with a "Steel (1% hot rolled)." There are many other cases of carelessness in proofreading, in graphs with no units stated on the axes, in the lack of definition of mathematical parameters, and with figures where legends have been omitted or do not correspond with the text or captions. The writing style is terse, and some of the terminology is unique to these authors. This does not make for ease of reading for those not already acquainted with the authors' research publications. The work is well supported by references, but the authors have chosen to ignore much of the work conducted outside of the United States. Notwithstanding its defects, this book offers very thorough coverage of the measurement and prediction of the residual strength and life of composite materials and will appeal to the advanced researcher and academic.

Reviewer: *Michael G. Bader, Professor Emeritus of Composite Materials in the School of Engineering at the University of Surrey, Guildford, United Kingdom, has researched composite materials, mainly strength and failure, for more than 30 years and has published ~100 papers.*

Polymer Analysis

Barbara Stuart
(John Wiley & Sons, Chichester, England, 2002)
xxi + 279 pages
ISBN 0-471-89926-7 (hard cover, $135.00)
ISBN 0-471-81363-X (soft cover, $50.00)

The purpose of this book is to provide introductory treatments of the analytical techniques used to characterize polymers, with a particular emphasis on practical aspects. It is part of a series of such books addressing the most important areas of the physical, life, and materials sciences, and is designed both for use in a classroom setting and for self-study. Learning aids provided include clear statements of objectives, summaries, suggestions for discussions, and self-assessment questions and numerical problems (with responses and worked solutions). There are also bibliographies; a list of acronyms, abbreviations and symbols; tables of SI units and physical constants; a glossary of terms; literature references; and a subject index.

The number of topics covered precludes the book from treating any of the methods in much depth. For example, the treatment of light-scattering for solution characterization is given fewer than three pages and includes a schematic of a Zimm plot, but essentially no discussion. This inherent problem in such a survey, however, is more than offset by the utility of the book in giving a very broad, brief overview of a remarkably wide range of well-chosen topics. It is amazing that anyone would attempt to do this, and the author is to be commended for carrying it off as successfully as she has.

Thus, this book will serve the purpose of giving the reader a quick glimpse of what a certain method involves with regard to measurements and interpretations of data, with enough illustrative problems to provide a feeling for the results and their utility. Those wanting more than a passing acquaintance with a method will have to dig more deeply into the relevant detailed literature using, for example, some of the references provided in each of the chapters.

Reviewer: *James Mark is a professor in the Chemistry Department of the University of Cincinnati. His research focuses on the physical chemistry of polymers, particularly the mechanical properties of elastomers.*

Fundamental Aspects of Electrometallurgy

Konstantin I. Popov, Stojan S. Djokic, and Branimir N. Grgur
(Kluwer Academic/Plenum Publishers, New York, 2002)
305 pages, $135.00
ISBN 0-306-47269-4

This is a very interesting book that covers most of the areas of electrometallurgy. However, the coverage is not entirely uniform, and the degree of detail varies throughout the book. For example, the first five chapters go into considerable depth on the theoretical side of electrometallurgy and expound on the classical fundamental studies, performed at the University of Belgrade, on the basic equations relating to electrometallurgy; surface morphology of metallic electrodeposits, which are of fundamental importance in all aspects of electrometallurgy except where the product is a liquid; current distribution in electrochemical cells; and electrodeposition when alternating and pulsating currents are applied. This is a very useful contribution, as it brings the whole of this excellent work into one easily accessible volume. It also gives a very useful explanation of the science behind many electrometallurgical processes rather than the simple recipes for electroplating that appear in many texts. A few of the equations are not adequately explained in the text, but reference is given to original publications so that the reader can pursue any questions.

The remaining seven chapters, electrowinning, electrorefining, electroplating, electroless plating, electrodeposition of metals from molten salts, and environmental issues, are far less detailed and unfortunately make little use of the fundamental science presented earlier in the book. In fact, the coverage of certain areas such as the extraction of metals from molten salts is somewhat cursory, and much better sources of this information are available elsewhere. One disappointment is that the latter half of the book does not make much reference to the detailed and thorough analysis presented in the earlier chapters.

The book would have benefited from being proofread and edited by someone with a scientific background, as there are innumerable spelling mistakes (the table on page 1 has four spelling errors), and there are odd statements such as "if the metal ions in the solution are the same as in the electrode metal."

Despite these minor criticisms, the first part of this book is a very important contribution to the understanding of electrometallurgical processes, which up to now was only available by trawling through the literature. For anyone interested in electrometallurgy, especially researchers, this is an essential book for any personal library.

Reviewer: *Derek Fray is a professor of materials chemistry in the Department of Materials Science and Metallurgy, University of Cambridge, and has worked extensively in electrometallurgy.*

https://doi.org/10.1557/mrs2003.107 Published online by Cambridge University Press