mental body. They argued that they could combine both the pure science of the academic world and product development of the drug industry; that they could excel as both scientists and inspired entrepreneurs; that armed with these powerful tools and their own inspiration, they could, like some romantic hero, transcend the realities of corporate life.

If biotechnology entrepreneurs, with the help of the press, were being manipulative, then it was Wall Street and ultimately investors who were being manipulated. Wall Street is not absent of malice in this story. Teitelman suggests that Wall Street got caught up in and even fueled the mania because it was ignorant and perhaps too greedy to learn more about the limits of the technology. The later chapters of the book focus on how the "revolution" began to unravel in the mid-1980s as technical and commercial hurdles (which were not part of the mythos) became too compelling to ignore any longer.

The principal strength of *Gene Dreams* lies in its exploration of the process by which beliefs about technology and its commercial potential are formed and transformed. The book reminds us that these beliefs, whether or not they ultimately turn out to be sound, sway billions of investment dollars. Thus it is useful to think about where they come from and how specific groups and institutions shape them. Teitelman's detailed exploration of Genetic Systems and his gifts as a writer enable *Gene Dreams* to tell a graphic story about the interaction of entrepreneurs, the press, and Wall Street.

At the same time, the book's focus on the experience of Genetic Systems is also one of its principal weaknesses. While the story of Genetic Systems may be very accurately told, we do not know (from this book) how typical it is. Teitelman says that he chose Genetic Systems as the central case "because it seemed to illuminate more aspects of the industry than any other." However, one is left wondering whether the Genetic Systems case may not be somewhat extreme. The book places strong emphasis on the personalities of Genetic Systems' founders, David and Isaac Blech and Bob Nowinski. It does an outstanding job illustrating how founders' backgrounds, styles, and personalities shape a start-up firm's strategy and affect its fate. However, if founders' personalities play such an important role, then it is natural to wonder the extent to which Genetic Systems' founders were typical biotechnology entrepreneurs. This question is difficult to answer, and the book provides little relevant evidence. The fact that Genetic Systems has been one of the relatively few biotechnology firms to be fully acquired by a major pharmaceutical company suggests that its experience has not been typical. Skeptics will question whether the case of Genetic Systems fairly represents the biotechnology entrepreneur and the financial community.

Diversity is a fundamental and important characteristic of the biotechnology industry. There are several hundred firms around the world engaged in various aspects of biotechnology. These firms represent a highly heterogenous group in terms of founders' backgrounds, financial resources, R&D focus, manufacturing capabilities, and commercialization strategies. *Gene Dreams* filters out much of this diversity by compressing the story of the biotechnology industry into the case of Genetic Systems.

Gene Dreams is not for someone looking for a rigorous, scholarly, and comprehensive examination of the development of the biotechnology industry. However, if one is looking for a concrete, exciting, and eloquently written story about the rise of biotechnology mania and its fall back to reality *Gene Dreams* is a good choice.

GARY P. PISANO
Harvard Business School, Boston, MA 02163

Metrology Institutionalized

An Institute for an Empire. The Physikalisch-Technische Reichsanstalt, 1871–1918. DAVID CAHAN. Cambridge University Press, New York, 1989. xx, 315 pp., illus. $49.50.

In subtle ways measurement ties industry, research, government, and consumers together. It forms a basis for making work in laboratories usable elsewhere and, perhaps more obviously, it makes possible mass production, consumption, and regulation. The benefits of national and even international systems of measurement became increasingly evident in the latter part of the 19th century. As a result, several nations followed the lead of the newly unified Germany in creating new institutions to establish standards for measurement. In 1887 Germany founded the Imperial Physical-Technical Institute (PTR)—a translation of the subtitle given above. The British opened the National Physical Laboratory in 1899, and two years later the United States formed the Bureau of Standards.

David Cahan describes the origins and development of the PTR from 1871, when Germany was unified, until the end of World War I. He notes the crucial collaboration between the electrical manufacturer Werner von Siemens and Germany's leading physicist, Hermann von Helmholtz, in establishing an institution to control standards and to provide a research site superior to those then found in German universities and free of teaching duties. Both Siemens and Helmholtz argued that "pure" scientific research benefited technological development in unpredictable ways and thus had to be supported. By the 1880s Siemens had marshaled enough interest to persuade the state to establish the PTR and make Helmholtz its first president. Helmholtz built facilities for the Scientific Section before starting work on the Technical Section. After 1895, his successor, Friedrich Kohlrausch, a physicist known for his work in measurement, built the PTR into a leading research institute. The third president, Emil Warburg, sought to reorganize the PTR when he took over in 1905, but World War I interfered with his reforms.

Helmholtz, Kohlrausch, and Warburg hoped to do research. But Cahan's survey of activities in the Scientific and Technical Sections in the years 1892, 1903, and 1913 demonstrates that testing equipment for the electrical and precision instrument industries, a major rationale for the PTR, left little time for research. Electrical companies needed a variety of properly calibrated meters and viable mechanisms for measuring luminosity. In developing instruments necessary to carry out routine testing, physicists at the PTR sometimes worked at the cutting edge of physical research. In their work on luminosity, for instance, they contributed significantly to research on black-body radiation. Success meant, however, that physicists at the PTR were offered positions in universities that were increasingly supporting research. After 1900 the PTR faced personnel problems resulting from inadequacies in state financing.

Cahan does not analyze Helmholtz's ideology of "pure" science so much as use it in his analysis. Whether a hierarchical relationship exists in which technology merely derives from science is an important issue with policy ramifications. Some scholars argue that technology, a body of knowledge in its own right, sets the agenda for science through, for instance, instrumentation or by solving engineering problems prior to the development of a science that could explain or even predict the solutions. Cahan himself notes the contributions that work on a technological problem, luminosity, contributed to research on black-body radiation. The claim that "pure" science should be supported because it might in the future produce economic benefits is now widely recognized as a rhetorical device used to generate funding and legitimize research agendas. The relationships between science and technology are more complex, but Cahan sets up two categories—"pure" scien-

tists and "technologists," which he reduces to research and testing.

These categories fail to capture the complex historical process that he describes. Cahan shows that Siemens and Helmholtz tied together technical, scientific, financial, and political resources in building an institute to carry out research and testing in electrical technology and fine mechanics. They had opponents. Industrial and engineering groups represented in the German Engineering Association wanted an institute to carry out research in "engineering sciences," but Cahan dismisses them as technologists. These competing programs would have connected German science, technology, and society in different ways, hence the heated debate. Cahan recognizes the key role that mensuration played in tying together the new Reich, but the ideology of "pure" science was meant to insulate science, and it does not allow Cahan fully to analyze one program for binding the nation together. Nor, as Cahan shows, did the ideology allow the PTR's first three directors adequately to accommodate science and testing in one institute. Despite its conceptual problems, Cahan's study is a valuable introduction to the institutionalization of measurement.

EDMUND N. TODD
Department of History, University of New Haven, West Haven, CT 06516

Books Received

Animal Re-Introductions. The Arabian Oryx in Oman. Mark R. Stanley Price. Cambridge University Press, New York, 1989. xii, 291 pp., illus., + plates. $34.50. Cambridge Studies in Applied Ecology and Resource Management.

As We Forgive Our Debtors. Bankruptcy and Consumer Credit in America. Teresa A. Sullivan, Elizabeth Warren, and Jay Lawrence Westbrook. Oxford University Press, New York, 1989. xii, 370 pp. $29.95.

The Assembly of the Nervous System. Lynn T. Landmesser, Ed. Liss (Wiley), New York, 1989. xvi, 313 pp., illus. $96. From a symposium, Storrs, CT, June 1988.

Assessment of Crop Loss from Air Pollutants. Walter W. Heck, O. Clifton Taylor, and David T. Ingey, Eds. Elsevier Applied Science, New York, 1989. xiv, 552 pp., illus. $144. From a conference, Raleigh, NC, Oct. 1987.

An Atlas of Antigens. Fluorescence Microscope Localisation Patterns in Cells and Tissues. C. D. Ockleford. Stockton, New York, 1990. x, 323 pp. $125.

Atomic Collisions. Electron and Photon Projectiles. Earl W. McDaniel. Wiley-Interscience, New York, 1989. xxx, 699 pp., illus. $74.95.

The Avian Egg. Chemistry and Biology. R. W. Burley and D. V. Vadehra. Wiley-Interscience, New York, 1989. vi, 472 pp., illus. $85.

Basics of Cosmic Structures. Ludwik M. Celnikier. Editions Frontières, Gif sur Yvette, France, 1989. viii, 409 pp. $43; paper, $30.

Brain Opioid Systems in Reproduction. R. G. Dyer and R. J. Bicknell, Eds. Oxford University Press, New York, 1989. xiv, 365 pp., illus. $89.

Calcium Protein Signaling. H. Hidaka, Ed. Plenum, New York, 1989. xii, 532 pp., illus. $95. Advances in Experimental Medicine and Biology, vol. 255. From a symposium, Nagoya, Japan, July 1988.

Cell Activation and Signal Initiation. Receptor and Phospholipase Control of Inositol Phosphate, PAF, and Eicosanoid Production. Edward A. Dennis, Tony Hunter, and Michael Berridge, Eds. Liss (Wiley), New York, 1989. xx, 387 pp., illus. $150. UCLA Symposia on Molecular and Cellular Biology, vol. 106. From a symposium, Keystone, CO, April 1988.

Cell Structure and Function by Microspectrofluorometry. Elli Kohen and Joseph G. Hirschberg, Eds. Academic Press, San Diego, CA, 1989. xxiv, 465 pp., illus. $165. Analytical Cytology Series.

Cellular Proteases and Control Mechanisms. Tony E. Hugli, Ed. Liss (Wiley), New York, 1989. xvi, 173 pp., illus. $80. UCLA Symposia on Molecular and Cellular Biology, vol. 104. From a colloquium, Lake Tahoe, CA, Feb. 1988.

The Chances of Explanation. Causal Explanation in the Social, Medical, and Physical Sciences. Paul Humphreys. Princeton University Press, Princeton, NJ, 1989. x, 170 pp. $29.50.

Cochlear Implants. Models of the Electrically Stimulated Ear. Josef M. Miller and Francis A. Spelman, Eds. Springer-Verlag, New York, 1989. xvi, 422 pp., illus. $89.

Cold Fusion. The Making of a Scientific Controversy. F. David Peat. Contemporary Books, Chicago, 1989. iv, 188 pp., illus. $16.95.

Colon Cancer Cells. Mary Pat Moyer and George H. Poste, Eds. Academic Press, San Diego, CA, 1989. xviii, 554 pp., illus. $175. Cell Biology.

Common Mechanisms of Transformation by Small DNA Tumor Viruses. Luis P. Villarreal, Ed. American Society for Microbiology, Washington, DC, 1989. xii, 259 pp., illus. $54; to ASM members, $39. ICN-UCI Conference in Virology. From a conference, Newport Beach, CA, 1989.

Cosmogenesis. The Growth of Order in the Universe. David Layzer. Oxford University Press, New York, 1990. xii, 322 pp., illus. $24.95.

Cosmopolis. The Hidden Agenda of Modernity. Stephen Toulmin. Free Press (Macmillan), New York, 1990. xii, 228 pp. $22.95.

Crown Ethers and Analogs. Saul Patai and Zvi Rappoport, Eds. Wiley, New York, 1989. x, 558 pp., illus. $195. Updates from the Chemistry of Functional Groups.

Data Presentation/Interpretation. H. Keller and Ch. Trendelenburg, Eds. DeGruyter, Hawthorne, NY, 1989. xxii, 479 pp., illus. $158. Clinical Biochemistry, vol. 2.

Dawn of a Millennium. Beyond Evolution and Culture. Erich Harth. Little, Brown, Boston, 1990. x, 190 pp. $17.95.

Depth Perception in Frogs and Toads. A Study in Neural Computing. Donald House. Springer-Verlag, New York, 1989. viii, 135 pp., illus. Paper, $16.20. Lecture Notes in Biomathematics, vol. 80.

Dictionary of Light Microscopy. S. Bradbury *et al.* Royal Microscopy Society and Oxford University Press, New York, 1989. x, 139 pp., illus. $32; paper, $14.95. Microscopy Handbooks, vol. 15.

Discourse Ability and Brain Damage. Theoretical and Empirical Perspectives. Yves Joanette and Hiram H. Brownell, Eds. Springer-Verlag, New York, 1989. xvi, 258 pp., illus. $50. Springer Series in Neuropsychology.

Drinking Water and Health. Vol. 9, Selected Issues in Risk Assessment. National Research Council. National Academy Press, Washington, DC, 1989. xvi, 268 pp., illus. Paper, $29.95.

Dynamics of Soil Organic Matter in Tropical Ecosystems. David C. Coleman, J. Malcolm Oades, and Goro Uehara, Eds. Department of Agronomy and Soil Science, University of Hawaii, Honolulu, 1989 (distributor, University of Hawaii Press, Honolulu). xxx, 249 pp., illus. $30. From a conference, Maui, HI, Oct. 1988.

The Eastern Pacific Ocean and Hawaii. E. L. Winter, Donald M. Hussong, and Robert W. Decker, Eds. Geological Society of America, Boulder, CO, 1989. xiv, 563 pp., illus., + charts in slipcase. $54.50. The Geology of North America, vol. N.

Ecological Revolutions. Nature, Gender, and Science in New England. Carolyn Merchant. University of North Carolina Press, Chapel Hill, 1989. xviii, 379 pp., illus. $34.95; paper, $13.95.

Electrochemistry IV. E. Steckan, Ed. Springer-Verlag, New York, 1990. xiv, 151 pp., illus. $69.50. Topics in Current Chemistry, vol. 152.

Electromagnetic Man. Health and Hazard in the Electrical Environment. Cyril W. Smith and Simon Best. St. Martin's, New York, 1989. viii, 344 pp. $29.95.

Electronic Materials. Science and Technology. Shyam P. Murarka and Martin C. Peckerar. Academic Press, San Diego, CA, 1989. xiv, 622 pp., illus. $59.95.

Elementary Particle Physics. Concepts and Phenomena. Otto Nachtmann. Springer-Verlag, New York, 1989. xx, 559 pp., illus. $98; paper, $54. Texts and Monographs in Physics. Translated from the German edition by A. Lahee and W. Wetzel.

Endogenous Regulatory Peptides. Chemistry, Biology and Medical Significance. J. Menyhárt, Ed. Akadémial Kiadó, Budapest, 1989. x, 924 pp. $76.

The Enzyme Catalysis Process. Energetics, Mechanism, and Dynamics. Alan Cooper, Julien L. Houben, and Lisa C. Chien, Eds. Plenum, New York, 1989. x, 493 pp., illus. $110. NATO Advanced Science Institutes Series A, vol. 178. From an institute, Barga, Italy, July 1988.

Enzyme Systems for Lignocellulose Degradation. M. P. Coughlan, Ed. Elsevier Applied Science, New York, 1989. x, 408 pp., illus. $101. From a workshop, Galway, Ireland, April 1989.

Evolutionary Biology of Transient Unstable Populations. Antonio Fontdevila, Ed. Springer-Verlag, New York, 1989. xii, 293 pp., illus. $49.50. Based on a conference, Banyoles, Spain, July 1988.

The Excitement and Fascination of Science. Reflections by Eminent Scientists. Joshua Lederberg, compiler. Annual Reviews, Palo Alto, CA, 1990. Vol. 3, part 1. xxvi pp. + pp. 1–1298, illus., + index. Vol. 3, part 2, xii, pp. + pp. 1299–2338, illus. $90. Reprinted papers from volumes in the *Annual Reviews* series, 1977–1987.

Experimental High-Resolution Electron Microscopy. John C. H. Spence. 2nd ed. Oxford University Press, New York, 1988. xvi, 427 pp., illus. $75.

The Fate and Effects of Oil in Freshwater. J. Green and M. W. Trett, Eds. Elsevier Applied Science, New York, 1989. xii, 338 pp., illus. $75.75.

Feminism, Marriage, and the Law in Victorian England, 1850–1895. Mary Lyndon Shanley. Princeton University Press, Princeton, NJ, 1989. x, 213 pp. $25.

Fidia Research Foundation Neuroscience Award Lectures. Vol. 3, 1987–1988. Eric M. Shooter *et al.* Raven, New York, 1989. x, 227 pp., illus. $56.50.

Field Testing Genetically Modified Organisms. Framework for Decisions. National Research Council. National Academy Press, Washington, DC, 1989. xiv, 170 pp., illus. Paper, $19.95.

Fluoride Glasses. Alan E. Comyns, Ed. Published for the Society of Chemical Industry by Wiley, New York, 1989. x, 219 pp., illus. $89.95. Critical Reports on Applied Chemistry, vol. 27.

Food Additives. A Larry Branen, P. Michael Davidson, and Seppo Salminen, Eds. Dekker, New York, 1990. xii, 736 pp., illus. $150. Food Science and Technology, vol. 35.

Foundations of Measurement. Vol. 2, Geometrical, Threshold, and Probabilistic Representations. Patrick Suppes *et al.* Academic Press, San Diego, CA, 1989. xvi 493 pp. $79.50.

Fractals. Selected Reprints. Alan J. Hurd, Ed. American Association of Physics Teachers, College Park, MD, 1989. iv, 139 pp., illus. Paper, $16.

The Frozen Earth. Fundamentals of Geocryology. Peter J. Williams and Michael W. Smith. Cambridge University Press, New York, 1989. xvi, 306 pp., illus. $65. Studies in Polar Research.

Genetics. Peter J. Russell. 2nd ed. Scott, Foresman, Glenview, IL, 1989. xiv, 913 pp., illus. $33.

A Guide to the Birds of Panama, with Costa Rica, Nicaragua, and Honduras. Robert S. Ridgely and John A. Gwynne, Jr. 2nd ed. Princeton University Press, Princeton, NJ, 1989. xvi, 534 pp., illus., + plates. $49.50.

A Guide to the Birds of Puerto Rico and the Virgin Islands. Herbert A. Raffaele. 2nd ed. Princeton University Press, Princeton, NJ, 1989. x, 254 pp., illus., + plates. $39.50; paper, $15.95.

Handbook of the Hemopoietic Environment. Mehdi Tavassoli, Ed. Humana, Clifton, NJ, 1989. xxii, 453 pp., illus. $79.50. Contemporary Biomedicine.

Harmony. A Psychoacoustical Approach. Richard Parncutt. Springer-Verlag, New York, 1989. xii, 206 pp., illus. $59. Springer Series in Information Sciences, vol. 19.

Hazards of Biotechnology. Real or Imaginary? Anthony D. Dayan, Peter N. Campbell, and Thomas H. Jukes, Eds. Elsevier Applied Science, New York, 1989. viii, 138 pp., illus. $45. Reprinted from *Journal of Chemical Technology and Biotechnology*, vol. 43, no. 4 (1988). From a symposium, London, U.K., Dec. 1987.

The Human Career. Human Biological and Cultural Origins. Richard G. Klein. University of Chicago Press, Chicago, 1989. xxii, 524 pp., illus. $39.95.

Huntington's Disease. A Disorder of Families. Susan E. Folstein. Johns Hopkins University Press, Baltimore, 1989. xii, 251 pp., illus. $40. Johns Hopkins Series in Contemporary Medicine and Public Health.