cal control systems, there has arisen in recent years another line of research with great (but as yet unfulfilled) promise, namely, the application of quantitative techniques generally borrowed from mathematics and engineering to biological systems. My chief criticism of this book is that it attempts to cover both viewpoints for all of biology and is therefore generally superficial.

The book consists of separate chapters by different authors, and is divided up into general sections on Principles and Methods, Cells and Individuals, Development and Genetics, and Groups and Populations. The editor has contributed several chapters, with most of the remainder written by his fellow faculty members at University College, London, and the rest by colleagues at other British institutions.

An introductory chapter of philosophical intent is followed by two rather elementary and superficial chapters on the mathematics of linear-control-system analysis, of the type more fully treated in every electrical engineering text on the same subject. Nonlinear systems are casually treated in a few pages, although it is an unfortunate fact of life that almost every biological system is nonlinear. Chapters follow on a wide variety of material covering the biological spectrum, beginning with molecular biology and concluding with population dynamics. Most of these efforts are descriptive rather than quantitative; with the exception of the chapters on physiological control systems and genetic variability, they contain no equations and few block diagrams or quantitative statements of any sort. Their quality varies; some are adequate or even superior reviews of their particular fields, others are quite brief and fragmentary. The book concludes with a general chapter on control hierarchies.

To whom might this book appeal? The biologist may be interested in the particular chapter in his specialty as a supplement to other reviews already in the biological literature. The reader with a quantitative background but little biological sophistication may wish to peruse the discussions of questions to which his analytical methods may some day be applied.

In summary, this book consists of a brief introduction to engineering control systems and a series of descriptive chapters on biological regulation, with no particular unity in viewpoint or consistent depth of coverage and sandwiched between layers of semiphilosophical veneer, but with some interesting individual expositions.

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Finding Optima

Foundations of Optimization. DOUGLASS J. WILDE and CHARLES S. BEIGHTLER. Prentice-Hall, Englewood Cliffs, N.J., 1967. xiv + 480 pp., illus. $12.50.

One of the earliest examples of optimization is provided by Queen Dido, who when founding Carthage enclosed the maximum amount of land by arranging the bull-hide rope in the form of a semicircle with the ends against the sea. Since that time there have been many other isolated examples, but it has apparently been only with the coming of large-scale digital computers that optimization has been recognized as a field in its own right. Indeed, there are those who contend that all of engineering is merely optimization in one form or another; which may merely reflect the fact that the pendulum of fashion has swung too far. The present book offers a unified approach to modern optimization theory.

The book begins with (indirect) methods that try to find the optimum by examining the nature of the optimum itself. Thus in the calculus the local extremes are given by the derivative being equal to zero, or else they occur at the ends of the interval. The case of several variables, with or without restraints, is also discussed, including Lagrange multipliers. The relatively new geometric programming method is also given.

The (direct) methods modeled on mountain climbing come next; the general case is treated first and is gradually specialized until linear programming is reached. Partial optimization (optimization of subpieces) is also covered.

The treatment is based on intuition, and at times the authors, rather than clutter up the book, refer the rigorist to other sources. They also include a good deal of opinion based on current experience rather than proven fact, and are not above making general recommendations that they realize are of necessity rather fuzzy.

R. W. HAMMING
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Books Received

Atlas of Electron Microscopy of Clay Minerals and Their Admixtures. A Picture Atlas. H. Beutelspacher and H. W. van der Marel. Text in German and English. Elsevier, New York, 1967. xii + 333 pp., illus. $40.

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(Continued on page 1394)

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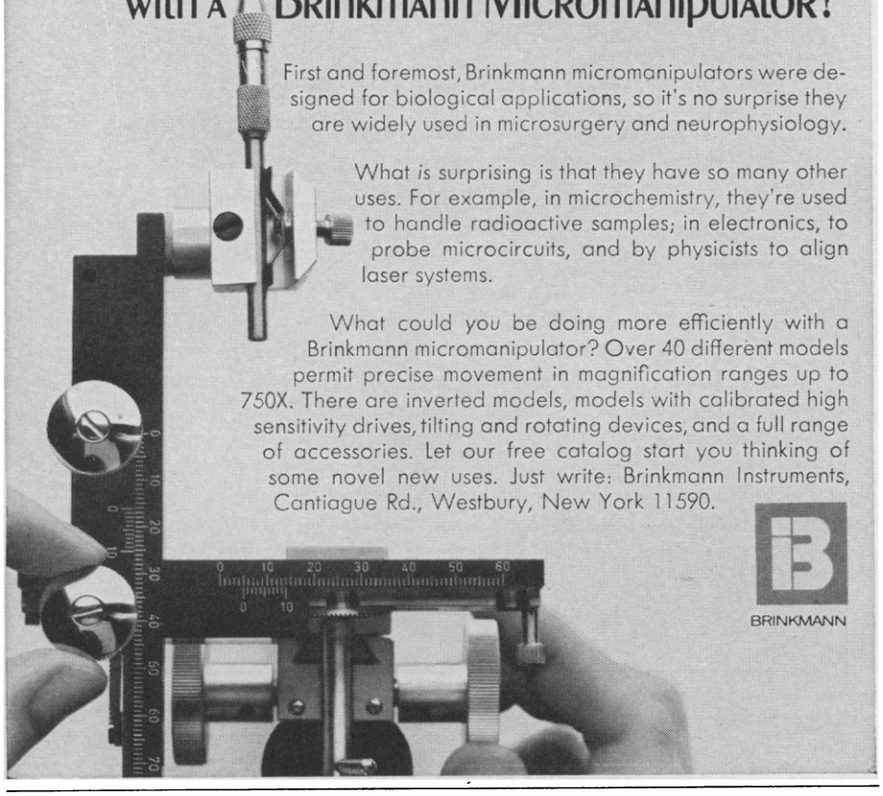

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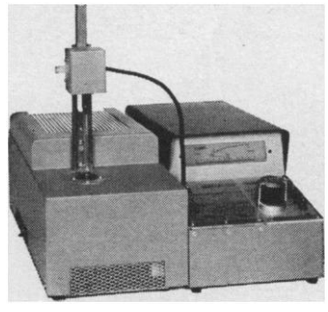

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Editor: ARNE ENGSTRÖM, Professor of Medical Physics, Karolinska Institutet, Stockholm

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New looks and outlooks on physical enzymology

J. D. BERNAL, F.R.S., Birkbeck College, University of London
Relation of microscopic structure to molecular structure

J. WYMAN, Rome University *Regulation in macromolecules*

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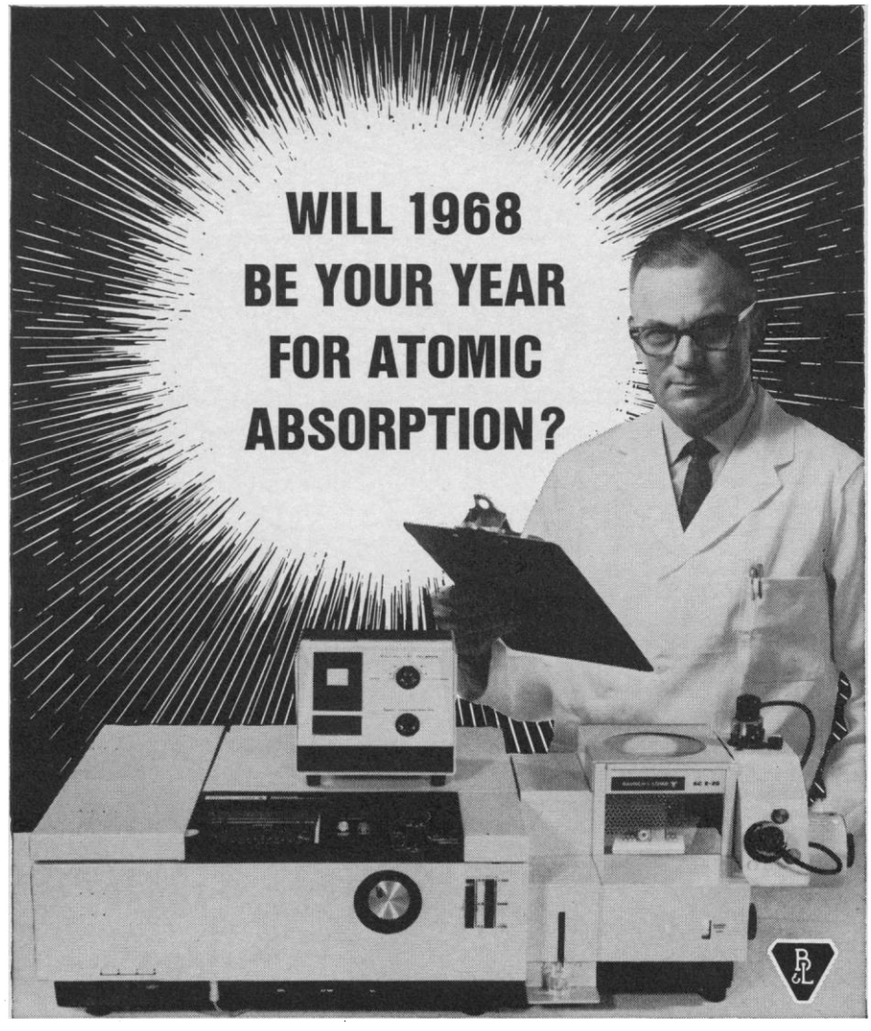

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