reviewer does not even find them mutually consistent. (1) and (4) constitute one comprehensive classification; (2) and (3) are tools that might be used in either category of forecasts, mechanical or causal.

The six cases were contributed by JOSEPH B. HUBBARD, of Union Service Corporation; MYRON S. SILBERT, Federated Department Stores; WILLIAM W. TONGUE, Jewel Tea Company; KENNETH D. ROSS, Stein Roe and Farnham; DONALD J. WATSON, General Electric Company; and WILSON WRIGHT, Procter and Gamble Company. Each describes competently how he handled the short-range forecasting of some of the phases of post World War II period. They all followed an outline provided by the editors. In describing the uses of the forecasts—the payoff—all but one of the contributors is specific enough to give other forecasters the courage to go on. The contributors' work is interesting and on the whole well presented. Joseph Hubbard's is the most mechanistic. What they miss, collectively, is a cohesive explanation and adequate guidance for the onlooker in terms of what to watch.

It is not desired to belabor these points. The editors of *Business Forecasting in Practice* attempted a formidable task. Perhaps part of the difficulty lies in their selection of an audience. It is not entirely clear whom they are addressing, but it would appear that the expected audience is wide, ranging from technicians in the business of forecasting to executives who perhaps should be more interested than they are in buying and utilizing forecasts. But the technician will not find the things he needs in his work. Particularly, he will miss fuller discussion of the newer techniques of forecasting. (Why, for example, are such new developments as diffusion indexes and mathematical programming techniques so lightly dismissed?) As for the potential employer of working forecasters and their forecasts—he is apt to be scared off for good (perhaps "for better or for worse" would be a more objective phrase).

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OPERATIONAL RESEARCH QUARTERLY

THE MARCH 1957 issue of the *Operational Research Quarterly* (vol. 8, No. 1) has the following table of contents:

W. ROSS ASHBY, *An Introduction to Cybernetics,*
John Wiley & Sons, Inc., New York, 1956, 295 pp., $6.50

HERE we have the first attempt at an elementary, but still technical, exposition of the central notions of cybernetics. Professor Ashby's (more or less) implicit thesis is that cybernetics is a collection of mathematical, not empirical,

concepts which are appropriate for describing the behavior of systems. His explicit thesis is that these concepts are fundamentally simple, though not obvious, and that they can be explained without assuming much mathematical background. Although this is not a mathematics text—the attitude, exposition, and material are still too closely tied to applications for that—it goes a long way in supporting this thesis. Nonetheless, as I shall try to indicate, the book cannot be judged wholly successful.

The volume is divided into three parts plus an introductory chapter. The first part, MECHANISM, is composed of five chapters devoted to an abstract description of the behavior of a 'machine with input.' By interleafing numerous examples from many fields with the formal concepts, the author explores the ideas of transients, the coupling of machines (a function from the states of one to the inputs of another), feedback, equilibria (fixed points of the function characterizing state transitions), stability of equilibria, isomorphism and homomorphism of machines, and the black-box problem. The impact of the modern tendency toward abstract simplicity and generality is evident. The main restriction on generality is to discrete sets— indeed, for the most part, finite sets—of states and inputs on the grounds that the main ideas are then more definite and, therefore, easier to grasp and that, after all, continuous systems can always be approximated by discrete ones.

Ashby fails, however, to stress with sufficient force the importance in applications of utilizing whatever mathematical structure may exist on the set of states and that, in particular, the mathematics of continuous systems, which he barely touches, is vastly richer and more thoroughly explored than the mathematics of most discrete systems which might be used to approximate the continuous. In the same vein, the problem of abstracting a set of states from an empirical context is handled much too casually. The naive reader cannot but feel that such decisions are fairly obvious, which they rarely are except in routine problems, and he will be only the more confused on this score by the unfortunate phrase 'the determinate machine,' referring to an analysis of a system into states such that the behavior can be described by a single-valued function. Although the author briefly cautions that this term refers to *a* description of the behavior of a physical or biological system, a more apt term would have been desirable.

Part two, VARIETY, is basically concerned with information transmission (in the technical sense). The first two of the three chapters continue in much the same spirit as the first part: no probability is involved, the notions are simple and amply discussed and illustrated. The central ideas are 'variety' (the number of distinct elements in a set or the logarithm to the base 2 of that number, whichever is more convenient), 'constraint' (any limitation of variety), coding, and selection. The first two tie closely into the preceding part because, in general, the behavior of a machine reduces the variety of its states and so can be viewed as a constraint. The elucidation of a wide range of familiar examples in terms of these few notions and their ramifications is impressive. Unfortunately, however, the exposition begins to grow uneven in this part of the book and it remains so to the end. To cite only one example, the definition of 'degrees of freedom' in Chapter 7 is meaningless as stated, but not so far removed from meaning that confusion is impossible. The final chapter of part two effects an abrupt change: the reader is now supposed to be

familiar with Shannon's book, the chapter being but "... a series of notes, intended to supplement Shannon's masterly work. ..." The reader had better be, for entropy is poorly motivated, channel capacity is flirted with but never defined, and equivocation will be equivocal to the beginner.

Part three, REGULATION AND CONTROL, is broken into five chapters. The idea that regulation is a blockage in "the flow of variety from [external] disturbances to essential variables" is exploited in numerous ways to study, among others, the subjects of error control, regulation of Markovian machines, and the intriguing 'amplification of regulation.' As very many topics are covered very briefly and the common thread of the earlier chapters is often nearly out of sight, I fear that these sections may have a somewhat Markovian quality to many students.

Has cybernetics been 'introduced'? One's answer is, in some measure, a matter of taste—both as to what is in and out of cybernetics and as to what belongs in an introduction. As indicated above, I feel that a far deeper examination is needed, both of the effects of structure on the set of states and of the basic scientific problem of defining the states. That Ashby really underestimates the latter problem is suggested by his account of design (Chapter 13), which he passes off as a simple problem of selection, whereas one can easily argue that much original design entails new formulations of the underlying abstractions. This too may be selection, but not in any very naive sense. Also, even in an introduction, I would have been strongly tempted to indicate something of the relationship between information transmission and statistical inference, which now seems to be one of the more important research trends.

But let us accept Ashby's delimitation of the area, then to what extent does the book succeed and fail? Its merits, to my mind, are these: A reasonably successful attempt to keep simple ideas simple and to use a small number of them in effectively illuminating many properties of systems that most students will be certain are empirical in nature. The frequent use of familiar examples from many sources, which should convince the student that the ideas of cybernetics are appropriate for describing certain aspects of behavior whether it be physical, biological, or social and whether it be continuous or discrete. And, not least, the numerous, mainly easy, exercises with full answers.

Nonetheless, the book fails in some serious ways: As an introduction—Ashby's own criterion—the second half is not very successful. He who knows enough information theory to follow Chapter 9 or enough game theory to make much sense of, or at least not to be misled, by section 12.22 hardly requires the somewhat pedantic detail of the earlier chapters. And shouldn't an introduction to a growing subject also be one to its literature and, possibly, to its history? Only 26 references are given, and the origins of cybernetics are hardly mentioned. The second and third parts contain too many sections which will at best confuse, and at worst mislead, the beginner. Finally, although illustrations and toy examples are ubiquitous and areas of plausible application are alluded to frequently, the newcomer is not treated to a really serious example examined in adequate detail so that he can be fully persuaded of the actual power of the methods.

In sum, the weaknesses of the book are sufficiently serious to limit severely its usefulness. Apparently, Ashby intends that it be employed largely for self-study,

but I would hesitate to recommend it for that purpose. Its most effective role should be in the classroom where, by careful selection and supplementation, its merits can be made to dominate its shortcomings.

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BOOKS RECEIVED

EDWARD H. BOWMAN AND ROBERT B. FETTER, *Analysis for Production Management*, Richard D. Irwin, Inc., Homewood, Illinois, 1957, 503 pp., $7.80.

Conferencias de Investigacion Operativa, Escuela de Estadistica, Universidad Central de Madrid, Madrid, Spain, 1956, 269 pp.

JOHN DIEBOLD & ASSOCIATES, INC., *An Introduction to the Business Use of Automatic Data Processing Systems*, John Diebold & Associates, Inc., New York, 1956, 72 pp.

EUGENE M. GRABBE (ed.), *Automation in Business and Industry*, John Wiley & Sons, Inc., New York, 1957, 611 pp., $10.00.

MAURICE G. KENDALL AND WILLIAM R. BUCKLAND, *A Dictionary of Statistical Terms*, Hafner Publishing Company, New York, 1957, 493 pp., $4.50.

WILLIAM N. LOCKE, *Scientific French—A Concise Description of the Structural Elements of Scientific and Technical French*, John Wiley & Sons, Inc., New York, 1957, 112 pp., $2.25.

SHERMAN J. MAISEL, *Fluctuations, Growth, and Forecasting*, John Wiley & Sons, Inc., New York, 1957, 552 pp., $7.50.

WILLIAM T. MORRIS, *The Rationalization of Industrial Decision Processes*, Engineering Experiment Station, College of Engineering, The Ohio State University, Columbus, Ohio, 117 pp., $2.00.

GEORGE J. RESNIKOFF AND GERALD J. LIEBERMAN, *Tables of the Non-Central t-Distribution: Density Function, Cumulative Distribution Function and Percentage Points*, Stanford University Press, Stanford, California, 1957, 389 pp., $12.50.

HERMAN WOLD, *Analisis de la Demanda—Un Estudio de Econometria*, Instituto de Investigaciones Estadisticas, Madrid, Spain, 1956, 431 pp.