

businessmen, bankers, actuaries, or government officials we can make quite good aggregate estimates of such things as 'future labor force, employment level, demographic distribution, birth rate, annual inflation rate, etc., etc.' But it would have been helpful to have both a time period and a comparison with something else to justify the use of the words "quite good." In general, demographic long-range forecasting has been particularly bad, and so have the forecasts of annual inflation rates. We all make them, but it is quite likely that value is more in the system than in the numbers the system produces.

The description of types of forecasts presented on page 34 might better have been presented at the beginning of the book. Furthermore, the concept of causative anticipation is scarcely discussed. There are many situations in which forecasting may be quite possible because the group doing the forecasting happens to control its environment. Hitler was probably in better shape to forecast the invasion of Poland than most other people were.

In two parts of the book (pp. 54 and 205) Project Hindsight is mentioned as having confirmed the growing suspicion that non-mission-oriented research has been ineffective in contributing to military programs (a result that is being used to block military sponsorship of fundamental research). Possibly I have a more cynical view of studies like Project Hindsight than does the author. In general all one needs to know about a review project is who is the sponsor, who is inventing the criteria for judgment, and who is running the project; at that point the odds are overwhelming that the conclusions can be guessed before the study has been done. It is my belief that Project Hindsight had many of the signs of a hatchet job and Ayres is being naive in his treatment of it.

Ayres notes that "the social impact of the new forms of communication has been explored most deeply by Marshall McLuhan" (p. 65). Even if that is so, Ayres should be aware at least of Harold Adam Innis, from whom McLuhan learned much of his approach to communication and who provided much of the basis for McLuhan's writings.

Probably where I am most skeptical of this book is in chapter 5, where Ayres discusses "morphological analysis." This phrase was coined by Fritz Zwicky, who used the method successfully to obtain a taxonomy of possible technical devices. On pages 85-87

Ayres talks about using morphological analysis for future worlds. Again on page 157 we are told that "with the help of electronic data processing it becomes possible to 'look' at hundreds of thousands of cases, whereas plodding human players might take several days to go through a single one." It is my considered opinion that, especially in areas where the problem is not particularly well defined, where the variables are hard to measure, and where the number of alternatives can be extremely high, human organizations at this time with all the computers in the world are fortunate if they have the time and the resources to explore meaningfully 10 or 20 alternative scenarios, let alone a hundred thousand. Exploration costs time. We are still at the stage where some human being has to interpret the outputs from a computer in most planning exercises. Tons of pages of computer output are in general a sign of a badly understood job. Most simulations have a value inversely related to the fourth power of the quantity of computer output. Corrective reading may be obtained by looking at Miller's classic essay "The Magic Number 7 Plus or Minus 2."

As someone who was intimately connected with the evaluation of a large-scale simulation and war game called TEMPER, I was fascinated to find out on page 158 that TEMPER "is actually a rather sophisticated man-machine system designed to relieve the participating human players of a great deal of tedious computation and data manipulation and thereby increase their ability to zero in on the real issue . . . explored." This human player found the real issues rather fascinating on discovering from TEMPER that, unless the United States actively supported Israel in a war in the Middle East, then were say Lebanon or Jordan to fight Israel alone Israel would lose that war. Possibly I do not appreciate the value of calculating all possible outcomes for all possible worlds.

A reasonably good discussion of the work of Olaf Helmer and company on the Delphi method is given on page 149. A balanced view is presented; however, the reader should also be aware of the work of Norman Dalkey in attempting to construct methods to validate the Delphi procedure.

If you want to get a reasonably good coverage of methodology and the developing methodology in some parts of long-range forecasting, this book is worth going over. It should, however, be read with a considerable dose of skepticism. The book is partly a product

of the Hudson Institute. However, unlike the works of Herman Kahn it does not bear the stamp of the outrageous which enables many of us to read those works with enjoyment and reinforced skepticism. Because Ayres's book is far more sober, one needs to be far more careful.

MARTIN SHUBIK

*Department of Administrative Science,
Yale University,
New Haven, Connecticut*

Rock Structure

Metamorphic Textures. ALAN SPRY. Pergamon, New York, 1969. viii + 352 pp. + plates. Cloth, \$10; paper, \$8. Commonwealth and International Library: Geology Division.

Metamorphic textures have been rather neglected in books on metamorphism since Harker's classic work. Although there are signs that the situation is improving, there is clearly a need for a full exposition of the modern approach to this subject. Spry, whose wide experience of metamorphic fabrics is fortified by a knowledge of the physics of crystal growth in the solid state, stresses that his approach is to regard metamorphism as "a series of structural transformations rather than as chemical reactions . . . [these transformations] affect real, not ideal crystals." No one can quarrel with the view that metamorphic rocks must be treated as kinetic systems; indeed one can only be perturbed if it requires underlining at this time. More than half the book is concerned with the principles of crystal growth. Geologists will be grateful for the comprehensive review of such difficult topics as grain boundaries, mineral transformations (both stress-activated—like gliding, kinking, and twinning—and thermally activated), nucleation, and the factors controlling the size and shape of crystals. I suspect that the research worker will find these sections (covering about 170 pp.) more valuable than the remainder of the book, which deals (at too great a length) with the textures of thermal, regional, and dynamic metamorphism.

Spry believes that metamorphic petrology is at present undergoing a change of emphasis, marked by the considerable number of papers dealing with metamorphic textures that have been published in recent years. Certainly there have been notable successes—

for example the clarification of such topics as force of crystallization and the nature of progressive metamorphism—and Spry is correct to point to chronological analysis as a vital tool for the metamorphic petrologist. But from reading this book I would judge the significance of textural studies to be that of a valuable corrective rather than a pointer to new directions in research, unless they emphasize the need for more experimental work on crystal growth in the solid state.

The reader will find ambiguities in some definitions and classifications adopted in the book. For example, it seems a disservice to define polymetamorphism as repeated metamorphism "of the same kind" and then proceed to discuss the case of thermal metamorphism followed by regional metamorphism. What is meant by "kind" here? Also, the definition makes no distinction between metamorphic complexes that have undergone episodic crystallization during a single metamorphic event and those that have received the imprint of two quite distinct metamorphisms.

However, this is a very useful book and it will be welcomed by research workers. In addition it is hoped that it will be used to broaden the scope of undergraduate teaching of metamorphism.

M. R. W. JOHNSON

Grant Institute of Geology, University of Edinburgh, Edinburgh, Scotland

Microbial Genetics

Episomes. ALLAN M. CAMPBELL. Harper and Row, New York, 1969. xiv + 194 pp., illus. \$5.95. Modern Perspectives in Biology.

Following infection of a sensitive cell by a temperate bacteriophage, the phage DNA may be duplicated in either of two mutually exclusive states. Should the infection proceed in the "lytic" direction, the DNA is duplicated about once per minute, the structural proteins of the mature virus particles are produced, particles are assembled, and the host cell lyses. If the infection proceeds in the "lysogenic" direction, such "autonomous" DNA duplication is repressed, as is the expression of most of the phage genes. One (usually) copy of the phage genome attaches to the host cell genome, and any remaining, unattached copies are diluted out of the culture as the infected bacterium resumes its own dupli-

cation. The attached phage genome is now duplicated exactly once per cell generation, as are the other, "normal" parts of the host DNA. In 1958, François Jacob and Ellie Wollman pointed out that these features of temperate phages (acquisition by infection, duplication in two mutually exclusive states, attachment to the host genome) are shared by agents which confer fertility or the ability to produce bacteriocins upon their bacterial hosts. The occurrence of the features simultaneously in apparently unrelated biologic entities suggested a fundamental relationship among the features. In order to underscore this relationship, Jacob and Wollman proposed to call by the same name all entities which manifested this constellation—thus, "episomes."

Campbell has recounted, in a personal though modest way, progress to date in the studies of temperate phage, fertility agents, bacteriocinogeny agents, and the medically important and evolutionarily fascinating agents which transfer antibiotic resistance. In so doing he has utilized the Jacob-Wollman definition in a not completely successful attempt to impose coherence upon his review. The book will be bought with high hopes by embryologists, evolutionists, epidemiologists, maize geneticists, and others who feel, rightly, that bacterial episomes may be pertinent models for phenomena of their immediate interest. Many of them will be disappointed. Campbell, though explicitly aware of his potential audience, has forgotten that many people who want to know about episomes do not already know about "marker rescue," "early mutants," "late genes," "anneal" meaning the reassociation of DNA chains by slow cooling of a heated solution of duplex molecules, "hybrid" meaning a duplex composed of annealed chains from genetically distinct individuals, "hybrid" meaning intertypic recombinant, "transfer induction," and "zygotic induction." All these terms and more are used without prior definition. Furthermore, help will not be found in the index—none of the terms listed above are there. For active workers in microbial genetics, *Episomes* will be useful, although, like any primarily technical review, it will not retain a high degree of usefulness for very long. The lasting contribution which could have been made to biology at large lies buried in laboratory slang.

FRANKLIN W. STAHL

Institute of Molecular Biology, University of Oregon, Eugene

Cell Infection

Enzyme Induction by Viruses. SAUL KIT and DEL ROSE DUBBS. Karger, Basel, 1969 (U.S. distributor, Phiebig, White Plains, N.Y.). x + 114 pp., illus. \$6.50. Monographs in Virology, vol 2.

This book collates in a straightforward manner a great deal of information on enzyme synthesis in virus-infected cells. As might be expected, a large percentage of the information is concerned with phage-infected bacteria, and much of this information has been reviewed before. The new enzymes found in infected cells are described and evidence concerning their induction and synthesis is presented and discussed. In spite of the brevity the uses of host mutants, virus mutants, and inhibitors are clearly described.

The information on virus-infected animal cells is handled in a similar manner, but, because the subject has not been as frequently reviewed, this section seems fresher. It suffers, however, from extensive use of unfamiliar terminology such as letters, which are not listed in a convenient table, to designate particular cell lines. A list of abbreviations used for common biochemical terms is given, but not for less well known terminology.

I believe the book would be a useful reference for classes in virology or biochemistry or for an individual because it provides a ready means of locating a complete list of original references on metabolic changes in virus-infected cells. In addition, a brief insight is provided about relevance of the papers.

RAYMOND L. ERIKSON

Department of Pathology, University of Colorado School of Medicine, Denver

Cardiovascular Prostheses

Engineering in the Heart and Blood Vessels. GEORGE H. MYERS and VICTOR PARSONNET. Wiley-Interscience, New York, 1969. xvi + 208 pp., illus. \$14.95. Wiley Interscience Series on Biomedical Engineering.

In order to expand the possibilities of cardiac surgery, several artificial devices have been developed in the last decade. These include artificial hearts, assisting heart devices, artificial heart valves, cardiac pacemakers, artificial blood vessels, and other implantable devices. Some of these devices are the result of highly sophisticated electronics and mechanical