management," the "communal security," the "extra-national," and the "entrepreneurial" arenas. The nature of each of these is relatively evident from its name. A self-regulative arena is one in which government allows a sector of society (such as the oil industry) to develop and administer its own rules of conduct; the entrepreneurial arena is one in which the government actively involves itself in producing or consuming a product (such as basic science or space exploration).

Schooler finds that scientists' influence is low for policies classified as self-regulative, redistributive, extra-national, or narrowly distributive; moderate for policies classified as regulative; and high for policies in the economic management, communal security, and entrepreneurial arenas. These last three arenas, Schooler points out, are distributive in the particular sense that they produce benefits—economic security, security from eternal attack, and new knowledge—that are perceived as being in the interest of almost every segment of society.

Schooler also attempts to relate differences in the level of scientists' influence to 22 other independent variables, for example the field of science involved, the presence of scientific or political conflict among scientists, and the stage at which scientists participate in the policy process. He is unable to carry off this attempt in any systematic manner, and the relative importance of these 22 variables in different policy situations is never very clear. By the time he reaches his summary chapter, separate treatment of them has been abandoned.

To me the most interesting of Schooler's findings is that scientists' influence is greatest in just those areas of government activity—science policy, deterrence and weapons policy, space policy, and fiscal and monetary policy —in which there is a newly developed (since World War II) and intimate relationship between the top levels of the executive hierarchy, especially the presidency, and other elite segments of our society—universities, high-technology aerospace and defense industries, and large financial institutions. The integrated nature of these relationships has recently come under scrutiny by such diverse analysts as John Kenneth Galbraith, Murray Weidenbaum, and Charles Reich. These are the areas in which conflict over the goals and especially over the means of policy is least widespread and the decision-making process most centralized. On the other hand, scientists' influence over government policy in areas of high social conflict or deeply vested interests such as education, welfare, and agriculture has historically been low, according to Schooler. In these areas, pluralist politics and incremental decision-making still determine policy choices. Yet it is just this conflict-ridden, pluralist set of issues to which the federal government is now asking scientists and engineers to address their attention, apparently more or less with the expectation that if technology can get us to the moon it can solve—for example—urban blight. Schooler's analysis suggests that there are formidable obstacles, primarily political in character, in the path of effectively making science and scientists "relevant" to many of our social problems. As long as the impact of a public policy is viewed by important groups in society as "redistributive"—as taking from some to benefit others—politics rather than science is likely to have the primary role in shaping it.

There are serious deficiencies in Schooler's work, most of them related to the way in which he attempts to provide evidence to support his arguments. As noted earlier, Schooler's goal was theory-building, but he is candid in characterizing his work as "more exploratory than hypothesis testing" and as "a hypothetical sketch working sometimes impressionistically from a minimum of data." Schooler's data are drawn exclusively from secondary sources such as newspaper accounts of policy decisions, case studies, and the like, and are often merged, says Schooler, with his "own perceptions and observations." The crucial variable which the study seeks to explain is the level of scientists' influence, yet Schooler admits that "describing scientists' influence is a matter of judgment. No . . . visible evidence exists." He states no criteria by which he arrived at his judgment of influence level. The empirical core of the book is a series of 20 essentially separate essays on each of the policy types studied, and these essays seldom evidence any feeling for the details or realities of the forces influencing decisions within the executive branch. In the area which I know best, space policy, Schooler's interpretation of the decision process misses most of what really went on. Because he has spread himself thin in attempting to analyze, on the basis of questionable data, 20 types of policy, some of them over a 20-year period, he often lapses into generalizations unsupported by evidence. Some of these seem plausible—for example, "scientists concerned with the structure and performance of governmental organizations have no driving desire to influence policy making." Some appear far less credible—for example, "Americans would prefer to substitute hardware for 'humanware' in any war, even if it means the use of nuclear weapons." The book is also verbose and terribly repetitious.

Despite its limitations, however, Schooler's work is an important contribution to the literature of science and public policy, most particularly because it contains a potentially fruitful conceptual scheme for the analysis of an important question. What is needed now is refinement of that scheme and its use in studies based on first-hand evidence of the scientist-government relationship.

JOHN M. LOGSDON
School of Public and International Affairs, George Washington University, Washington, D.C.

Heredity in Man

Human Cytogenetics. JOHN L. HAMERTON. 2 vols. Vol. 1, General Cytogenetics. xvi, 412 pp., illus. $18.50. Vol. 2, Clinical Cytogenetics. xviii, 546 pp., illus. $27. Academic Press, New York, 1971.

Innumerable books on medical cytogenetics have appeared in recent years, but few, if any, have combined the biological depth and clinical usefulness of the volumes by Hamerton. The serious student of human cytogenetics will welcome these scholarly, eminently readable discussions of basic and clinical cytogenetics.

The indebtedness of the human cytogeneticist to plant and animal cytologists is duly acknowledged in volume 1. Hamerton properly describes the beginnings of modern human cytogenetics in terms of techniques adapted from work on the chromosomes of simpler organisms. His historical perspective is aptly chosen, and his account serves to remind the human cytogeneticist that cytogenetics did not begin as a scientific discipline with the discovery in 1956 by Tjio and Levan that the human chromosome number is 46. Volume 1 reviews, from this perspective, meiotic and mitotic cell division and the evidence for (and against) the idea of inactivation of the X chromosome. The

final chapters set the stage for the volume that follows by elucidating the mechanisms of mutational events as they affect chromosome number and structure. The appendixes to volume 1 are valuable in that they include detailed techniques of cell culture and chromosome preparation, as well as the reports of the Denver (1960), London (1963), and Chicago (1966) conferences on standardization of the nomenclature in human cytogenetics.

In volume 2, Hamerton brings his own experience, and that of Polani's group at Guy's Hospital in London, to discussions of autosomal and sex chromosomal abnormalities. This volume is most informative in its treatment of the latter group of disorders, though the author might well have spared us the at times excessive enumeration of the clinical manifestations and cytogenetic findings in too many cases of sex chromosomal and autosomal disorders. Nonetheless, this cataloging is useful from a reference point of view. Despite the occasional weight of detail, the syntheses come through clearly, and the author's discussion of the chromosomal determination of sex, in man and other mammals, is particularly valuable.

Unfortunately, the last chapters of this volume, the cytogenetics of pregnancy wastage and of neoplasia, seem somewhat artificial. The author might have done better to incorporate the discussion of abortuses into his discussions of sex chromosomal and autosomal abnormalities. The excellent studies now published on fetal wastage seem so relevant to our understanding of the trisomy and X-monosomy conditions, in particular, that it is a pity he elected to review these studies separately. The chapter on chromosomes and cancer is an adequate review of the subject, but it is more or less unintegrated into the basic structure of the volume, and seems to this reviewer to have been an unnecessary addition.

The figures of meiotic and mitotic chromosomes are generally excellent, adding a sense of the esthetics inherent in this discipline when it is properly pursued. The bibliography is extensive and valuable as a source of original and review papers.

One is tempted to regret that the newer techniques of fluorescence and heterochromatin staining (to produce specific banding patterns of human chromosomes) were not available until after publication of Hamerton's volumes. These techniques will greatly increase our knowledge of the extent and meaning of chromosomal variation in human populations. However, it will likely be several years before the biological basis of these staining techniques is understood, and perhaps even longer before their widespread use clarifies fully their value and limitations. Hamerton's two-volume work will stand, then, for quite some time as the definitive text in the field.

ARTHUR D. BLOOM
Department of Human Genetics, University of Michigan Medical School, Ann Arbor

Transplants and Hosts

The Immunobiology of Transplantation. RUPERT BILLINGHAM and WILLYS SILVERS. Prentice-Hall, Englewood Cliffs, N.J., 1971. xiv, 210 pp., illus. Cloth, $9.75; paper, $4.95. Prentice-Hall Foundations of Immunology Series.

A survey of problems in transplantation, meant for reading by biologists, is a welcome addition to existing books in the field. Billingham and Silvers have produced the best general account of transplantation that I know, and have let the account range from genetics to surgery without losing its form as a work about biology. Their experience in most of the areas covered in the book means that a reader is favored by a single view of transplantation, and this single view eases his way into the subject.

Throughout, clinical and experimental materials are woven together most skillfully. The chapters on the genetics of histocompatibility begin with the history of transplantation and move through a description of animal systems, especially the mouse, to a chapter on human histocompatibility genetics. Progress in this field is succinctly but clearly described, together with the usefulness of typing in organ transplantation. Again, in the chapter discussing immunologically privileged sites for transplantation and the special properties of some tissue and organ grafts, a happy mixture is found of animal experiments and clinical results. Succeeding chapters on tolerance and the reaction of graft versus host deal with some classic aspects of experimental transplantation, neither of which, fortunately in the latter instance, has been much applied in clinical practice. Chapters on pregnancy as a problem in homografting and on immunosuppression in man-made graft systems conclude the book. Throughout, as many problems are raised as solid strong statements of fact are made. The statement "we don't know" recurs, emphasizing the complexity that has been brought to order in this book and the continuing advances in the field.

A short but useful list of older references, stressing reviews, is given for each chapter. Read with the book, the reviews should readily allow students to get a solid grounding in transplantation. To then extend their knowledge to the very recent literature might be somewhat more difficult. Many recent experiments are cited, but only the authors' names are given rather than complete references, and tracing the articles might take a few minutes with an index or two. Still, this device allows access to the literature without encumbering the book by enormous reference lists.

The use of the book as an introduction has been experimentally tested in my own laboratory. It has been impossible to lay hands on the review copy for the past few months, as several new students, coming into immunology from biochemistry, have given themselves quick and useful introductions to the field by means of it. This book is an auspicious start to its series: monographs on basic topics in immunology for a diverse audience.

MICHAEL EDIDIN
Department of Biology, Johns Hopkins University, Baltimore, Maryland

Geological System

Cambrian of the New World. C. H. HOLLAND, Ed. Wiley-Interscience, New York, 1971. viii, 454 pp. + plates. $29. Lower Palaeozoic Rocks of the World, vol. 1.

Rocks of the Cambrian System represent a time span of perhaps as much as 100 million years. The physical limits of the system are not defined in the present volume, biostratigraphic and philosophical argument being deferred to a later book in the series. Despite the lack of precise definition, the continents of the New World display a great array of acknowledgedly Cambrian rocks at and below the surface of a vast area. Effective treatment and analysis in this single volume result from a combination of skillful authorship and the nature of the preserved Cambrian record. A. S. Palmer, in cov-