right have typically argued that such matters are too important to be entrusted to civilians, and they point, with more than a touch of envy, to the fact that "in the Soviet Union, the strategy recommended to the Politburo is made by military professionals and not by a comparable cortege of economists, sociologists, psychiatrists, and comptrollers, the groups that have sought to monopolize strategic thinking in the United States." Attacks from the left often convey the image of a tightly knit, secret coterie of Dr. Strangeloves posing a threat both to world peace and to democratic institutions in America. Roy Licklider's systematic study of "the private nuclear strategists" sheds light on the personal and professional attributes of civilian, nongovernmental strategists, as well as on some of their beliefs and attitudes. His findings provide little if any support for the more extreme charges from either the right or the left. But this book is a sociology of one segment of the strategic community; it was not the author's intention to address all the troubling questions about the defense establishment.

Of 491 private civilian strategists—identified through authorship of at least one book or three articles on problems of nuclear strategy—to whom Licklider sent his long questionnaire, 191 responded. In an appendix the author carefully compares the respondents with those who failed to return the questionnaire. Political scientists and younger students of strategy were oversampled, but otherwise the 191 respondents are representative of the selected population. Their answers to 65 questions provide the data base for the book.

The central hypothesis informing Licklider's study was the suspicion that private strategists clustered into several homogeneous groups of like-minded persons. He expected to find professional communication within these groups but little between them. The data failed to support this image in any important respect. As a group the civilian strategists have many attributes of a pluralistic community.

The empirical core of the study consists of six chapters that explore differences between "influentials" and others, the effects of military service, motivations and frustrations, type of employment, academic discipline, and professionalism. Each chapter is liberally documented with tables—there are 50 in the book—most of which are characterized by an absence of statistically significant relationships. That is, in most respects one cannot predict the distribution of the strategists' attitudes, beliefs, or policy preferences from their other attributes.

In light of the controversies surrounding government-sponsored research, some of the most interesting findings concern the type of research the respondents would *refuse* to undertake for moral or political reasons. Examples range from research on techniques for staging a military coup in the United States (67 percent would refuse) and for establishing a Doomsday Machine (64 percent), to work on plans for unilateral disarmament by the United States (34 percent), and for establishment of world government (8 percent). Although those with experience on contract research were somewhat more willing to undertake what the author calls "right wing" projects of the Doomsday Machine genre, they were no less willing to do research on unilateral disarmament or world government.

In the concluding chapter Licklider suggests that strategic thinking has reached a plateau, partly as a result of widespread acceptance of some seminal ideas of the 1950's and 1960's, partly as a consequence of the Vietnam war. He predicts, however, that military technology—specifically the MIRV and the ABM—will lead to a revival of work on strategy. The book closes with a brief discussion, and perhaps overly optimistic dismissal, of the "garrison state" hypothesis that "specialists in violence" will come to dominate public policy.

Licklider has effectively achieved his goals, but his book is more likely to be of interest to sociologists than to political scientists or strategy buffs. We learn a good deal about the civilian strategy community, but relatively little about the linkages between the ideas and controversies that marked the development of strategic thinking since 1945, and their progenitors. We are told that these strategists—whether among the "influentials" (as identified by their peers) or not—feel highly efficacious, but we learn little about the complex political process by which their ideas may or may not have an impact on strategic doctrine, weapons procurement, and the like. Licklider's data support the contention that the community of private strategists is a pluralistic one, for example, but it does not necessarily follow that the "politics of defense" can be so characterized. In short, *The Private Nuclear Strategists* performs a useful service, but the real significance of Licklider's findings will be most apparent when they are systematically linked to the entire process by which strategic decisions are made.

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Questions about DNA

Evolution of Genetic Systems. A symposium, Upton, N.Y. H. H. SMITH, Ed. Gordon and Breach, New York, 1972. viii, 580 pp., illus. Cloth, $20; paper, $6.95.

One of the current central problems of biology is to arrive at a better understanding of the structure and function of the genetic material. We know that DNA is the basic source of information that is passed from generation to generation, but curiously it is present in hugely different quantities per cell as one proceeds from one kind of organism to the next. We expect viruses to have less nucleic acid than bacteria (which they do), because the free-living bacteria have more functions to perform than viruses. But it appears that in evolution from the primitive prokaryotic state to the eukaryotic the amounts of DNA per nucleus have increased tremendously (from 10- to 100,000-fold). This is certainly all out of proportion, since it is difficult to conceive that eukaryotes have literally thousands more different functions to carry out in their metabolism than do prokaryotes. Furthermore, related plant and animal groups show great differences in DNA content. For example, among the terrestrial vertebrates the Amphibia have the most DNA while the birds, on the average, have the least, and mammals are in the middle. These observations along with the apparent high degree of redundancy of DNA in the eukaryotes pose perplexing questions to be answered about the evolution of genetic systems and their functions.

This book is a written report of the proceedings of the Brookhaven Symposium in Biology held in the summer of 1971. The preface states that "the purpose . . . is to bring together recent

research on genetic mechanisms, from the molecular to chromosomal level, and from lower to higher forms, in order to present a picture of current activities and ideas in this field of biology." The contents of the book are indeed described by this statement, and the use of the word "evolution" in the title is warranted because in nearly every case the authors emphasize the evolutionary implications of their data and ideas.

The 21 papers published in these proceedings treat a rather wide range of topics, from recombination (H. L. K. Whitehouse) to chromosome structure (E. J. Dupraw) to the metaphysics of evolution at the molecular level (C. R. Woese). However, a central theme is evident, which is the nature of repetitious versus unique DNA in the eukaryotes and the question why there is so much redundancy in the higher eukaryotes. Papers by B. J. McCarthy and M. N. Farquhar and by N. R. Rice deal with this question directly. McCarthy issues a warning about interpretation of data by pointing out that redundant and unique DNA are to a great extent defined by the experimental conditions and are not two distinct classes. Rice points out that there are at least several classes of repeated sequences of DNA. She has found that 10 to 20 percent of rodent species studied (some as closely related as rat and mouse) have genomes with repeated elements that are unique to the species. Thus it would appear that 20 percent of the total mouse DNA, which shows high thermal stability, has no measurable counterpart in rat DNA. This is indeed an important, though puzzling, observation.

The currently popular subject of "neutral" mutations is discussed in two papers, one by W. M. Fitch and the other by R. Milkman. As expected they leave the answer in the air, but their discussions and the remarks from the floor are of great interest for an understanding of this important question.

Probably the part of the volume which will have the longest half-life is a series of four papers giving quantitative data about DNA per genome in organisms ranging from prokaryotes to higher plants and vertebrates. All four of these papers contain detailed data, and will serve as a ready source of reference. In particular the papers by Sparrow *et al.* and H. Rees have valuable charts which will be of considerable usefulness in teaching.

The last paper in the volume, by A. Campbell, is a speculative one about the role of episomes in bacterial evolution. It has a considerable number of thought-provoking ideas in it; but so do the other papers, for the participants are all experts in their areas.

Evolutionists of all varieties will do well to consult this volume.

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The History of Mapping

Maps and Man. An Examination of Cartography in Relation to Culture and Civilization. NORMAN J. W. THROWER. Prentice-Hall, Englewood Cliffs, N.J., 1972. viii, 184 pp., illus. Cloth, $5.95; paper, $2.95.

This book is a concise and summary account of the development of cartography from earliest times to the present day. More precisely, it seeks to trace the interplay of cartography with cultural and scientific history, to identify a development process not so much in its own right as in relation to the changing total environments in which it was set. For example, in a chapter entitled "Cartography in the scientific revolution and the enlightenment," the author is concerned to select from across the spectrum of scientific advancement those aspects which related to progress in contemporary cartography. Thus he draws attention to improvements in survey instruments and techniques as well as astronomical discovery. But it was not just a matter of new methods of making maps giving rise to cartographic progress. Scientific discovery was in some instances of a nature which required cartographic portrayal, and thus an unprecedented amount of new subject matter was available for cartography. The rapid advance in thematic mapping was necessary to portray such diverse and newfound information as the patterns of prevailing winds across the earth's surface or the nature of the earth's magnetic field, and new techniques (for example isopleths) were developed to handle such subject matter. Moreover, not only was improvement in cartographic technique stimulated by scientific discovery; the dissemination of knowledge by cartographic means was in turn a stimulus to scientific discovery.

In dealing with the period prior to the 17th century, the author is covering well-trodden ground. He takes full account of recent work, however, and thus his treatment of early developments is a useful summary despite overlap with the work of previous writers. Among other things, he gives more credit to both Roman and Oriental cartographers than has been customary in much previous writing. But it is the last three centuries which provide a field for greater originality in textbook writing, and over half of the book is usefully devoted to this period. In particular the succinct treatment of the complex innovations in 19th-century cartography is welcome. For example, considerable sophistication came about in the field of cadastral mapping, in part as a consequence of the development of precision techniques, but once again not to be seen out of the larger historical context. It was a wide range of factors which gave the impetus to substantial improvements in both technique and the volume of work achieved, factors such as contemporary exploration, the political and administrative necessity of locating boundaries, the military need for precise survey work, the legal necessity of accurate measurement and allocation of newly settled agricultural land, and, conversely, rapid urban growth.

The book concludes with a review of modern cartography, in which a range of topics are dealt with, such as the state of the International Map of the World, the extent of large-scale topographic mapping of the earth's surface (which is very much more restricted than is generally appreciated), the concept of the national or regional atlas, lunar mapping, and publicity or propaganda maps. Inevitably, this last section is highly abbreviated, but in the context of a slim and summary volume which encompasses the entire time span of cartography, such abbreviation is appropriate. This is a book not for those who seek detailed information about modern maps, but rather for those who look for an introduction to a prolonged evolutionary process in which our modern map is just one more phase.

It is unfortunate that in a few instances the black-and-white reproductions are so reduced in size to fit the modest format that they verge on the illegible.

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