tion occurs, and many statements cry out for further explanation. The statement about the Renaissance cited above is an illustration. Though some of the technical operations of the 16th century may have been known in China centuries before, or in the Middle Ages, their development and utilization were an outgrowth of the intellectual ferment of the Renaissance. For example, the improvement in English methods of building and handling ships increased that nation's potential as a sea power and helped to change the course of world history.

Wars have had an enormous impact upon technological development, especially during the past century and a half. In a chapter on Military Technology, Thomas A. Palmer, after enumerating developments during the Civil War, comments: "The Civil War proved to be the first occasion when the achievements of the Industrial and Scientific Revolutions were put to large scale military use—a war in which the artisan, the farmer, and the mechanic as well as the soldier played essential roles in determining the final outcome of the conflict." Presumably volume 2 will devote much of its space to describing the complete utilization of a nation's technological potential in time of war and the byproducts for peaceful use that have resulted.

Although specialists will find many statements throughout this volume with which they may not agree, few will fail to profit from reading it from beginning to end. For those who wish to pursue special subjects further, the authors have provided 28 pages of bibliographical references.

LOUIS B. WRIGHT
Folger Library, Washington, D.C.

The Sense of Location

Human Spatial Orientation. I. P. HOWARD and W. B. TEMPLETON. Wiley, New York, 1966. 541 pp., illus. $13.50.

Pilots of high-speed aircraft and space vehicles become disoriented during flight maneuvers. They may misjudge the location of a visible target, misreach for an object, or report seeing motion where objectively there is none. These consequences of man's exposure to the unusual circumstances created by technological advance dramatically emphasize that orientation in space is dependent upon a large variety of environmental factors, some obvious, others unexpected. Howard and Templeton have done a considerable service by bringing together, from very diverse sources, many of the experimental results that bear on the human capacity to orient with respect to objects and events. In addition, they have examined the manner in which the orientation of the body in space affects the perception of objects.

The text begins logically by considering the first step in any act of orientation, the reception of sensory stimulation which provides the basic information concerning the location and spatial properties of either objects or events. Accordingly, the early chapters of the book are devoted to a discussion of the stimulation available to, and processed by, the visual and auditory systems. Kinesthesis, the sense understood to be responsible for discrimination of movement and position of bodily parts, is considered in a separate chapter, as is the closely related vestibular system. Three chapters deal with oriented responses in which gravity can be assumed to play a role by defining a unique reference direction.

Having considered the sensory basis for orientation, the authors go on to discuss the available data on the conditions which influence the accuracy and precision of oriented responses. In addition to this material, references are made throughout the book to studies of alterations in orienting behavior produced by atypical experiences. These changes may be provoked by prolonged exposure to particular constellations of stimuli. Sensory inputs rearranged so as to produce altered feedback initially cause inaccuracies in localizing behavior, but as exposure continues these effects are cancelled by adaptation. The authors indicate that since the sensory feedback in a stable environment is patterned, this information may be used for adaptive modification as well as for maintenance of orienting behavior. Consequently, the technique of rearranging stimuli provides a tool for analyzing normal spatial behavior. Howard and Templeton's review of this topic is the most balanced account in the literature of a field which has become the subject of much controversy in recent years. Several chapters deal with the effects on perception of the locus and orientation of shapes relative to the observer. A final chapter discusses what is publicly known of orientation in the weightless state.

This book is largely a compendium of relevant literature, and its 78 pages of bibliography attest to its thoroughness. The authors make their contribution in several ways. First of all, they have interspersed clear-cut analyses of particular issues among the reviews of various topics. Occasionally they present their own very reasonable interpretations of controversial issues. However, in their efforts to cover a diversity of topics, they have been unable to show very much overall coherence in the material. The reader might have hoped for an organization of contents based on a more general theoretical analysis. This lack of continuity probably reflects more about the state of the field than about the efforts of the authors. They are to be commended for their industry and the resultant benefit to a field which is attracting increasing interest.

RICHARD HELD
Department of Psychology, Massachusetts Institute of Technology, Cambridge

Cytogenetics

Sex Chromosomes. URSULA MITTWOCH. Academic Press, New York, 1967. 316 pp., illus. $14.

A little over a decade ago, dramatically improved techniques began to give superlative results with the previously obstinate chromosomes of the higher vertebrates, including man. New discoveries have been appearing at a remarkable rate, but often from workers whose primary interest has been not in genetics or cytogenetics but in the clinical implications or in the organisms themselves. The reports are very widely scattered through biological and medical publications. Thus any attempt at summary and assessment against a background of general genetics, cytogenetics, and biology is welcome.

The most intriguing variations in genetic mechanisms among the vertebrates and by far the widest range of known chromosomal abnormalities in man involve the sex chromosomes. The longest chapters of the present volume are devoted to these chromosomes in man and other mammals, and to the related problems of "sex chromatin," a phenomenon evidently confined to mammals. There are shorter chapters on the sex chromosomes of the other classes of vertebrates, the sex chromosomes of *Drosophila*, sex determination in the Lepidoptera, and such mech-