an additive polygenic model, and Erlenmeyer-Kimling a heterogeneous model in which multiple, independent genetic defects yield a distribution approximating one expected under polygenic theory. A polygenic explanation appears most plausible, since it seems to fit many of the known behavioral and genetic data better than other models do. Nevertheless, it is questionable whether this model will have much heuristic value for the biochemist, the psychologist, or the geneticist until the contributions of single genes to the polygenic system are isolated. The estimates of heritability (the proportion of the total phenotypic variance due to additive genetic variation) that have been made on the basis of a threshold polygenic model have been high, too high in fact, suggesting that a simple additive system is unlikely. Furthermore, one must question where, at the present stage of our knowledge, the strategy of heritability calculations is leading and what possible difference it would make for the clinician.

In contrast to the contributions of data in the genetics section, the papers dealing with experiential factors concentrate largely on conceptual and theoretical issues. The differential impact on family function depending on whether the husband or wife is affected is discussed by Lloyd Rogler. H. B. M. Murphy reviews the evidence regarding cultural factors in schizophrenogenesis, and Melvin Kohn summarizes the effects of social class. Kohn points out that the higher rates of schizophrenia associated with low socioeconomic status appear to hold in large metropolises but disappear in cities with smaller populations. The question of whether lower socioeconomic status is conducive to schizophrenia or individuals from higher classes "drift" downward in social status en route to becoming schizophrenic is largely unresolved, but Kohn thinks the evidence to support the drift hypothesis is not sufficient to explain the high concentration of schizophrenia in the lowest socioeconomic strata. His brilliant discussion of the inadequacies of the indices used in the social class studies and of various alternative hypotheses is one of the highlights of the volume. The families of schizophrenics are discussed by Theodore Lidz in respect to linguistic and cognitive disturbances, by Lyman Wynne in respect to shared foci of attention, by Yrjo Alanen in the context of psychoanalytic theory, and by David Reiss in respect to family problem solving.

Research design and methodology have been major stumbling blocks in establishing the etiological significance of both genotypic and family-interaction variables in schizophrenia. The third portion of the volume is largely devoted to methodological issues focusing on studies of groups particularly vulnerable to the development of schizophrenia.

The keystone of the volume is a series of papers by the editors, in collaboration with Paul Wender and others. The studies focus on individuals adopted in infancy. Since these children are not reared by their biological parents, the agents of hereditary transmission are separated from those of experiential transmission. In one study, two groups of suitably matched individuals reared in unrelated adoptive homes were compared, one a group whose members each had a schizophrenic biological parent (index cases) and one whose members had nonschizophrenic biological parents; the prevalence of schizophrenia among the index adoptees was considerably higher than among the control group—a finding in accord with earlier data by Leonard Heston. In a second study, the frequency and severity of psychopathology among parents who reared their own schizophrenic offspring were found to be significantly greater than among adoptive parents of a group of schizophrenic patients, adoptive parents of nonschizophrenics showing the least psychopathology. In a third study, schizophrenia and related disorders were found to be randomly distributed in the adoptive families of a group of adoptees with diagnoses of schizophrenia (index cases) and of a group of control adoptees, whereas the biological families of the index cases showed a significantly higher prevalence of schizophrenia and related disorders than the biological families of the controls. In comparison with appropriate control groups, the higher prevalence of psychopathology among the adoptees with an affected biological parent and among the biological parents and relatives of affected adoptees argues for a mechanism of hereditary transmission. In sum, these studies provide the most straightforward, unambiguous evidence to date of genotypic influences in the development of schizophrenia.

The questions often posed in the past regarding schizophrenia (Is it inherited or learned? What are the relative contributions of heredity and environment?) have not been productive. It has become obvious that the *nature* of the genotype-environment interaction is the central issue in the understanding of schizophrenia. I agree with Rosenthal when he singles out the question posed by Erlenmeyer-Kimling, "What kinds of environmental input trigger manifestations of the disorder in genotypically vulnerable persons, and why are these important, in a psychophysiological sense?," as the one most likely to lead to productive research in the future.

Elliot Mishler and others point out the difficulties of differentiating between the etiological antecedents and the consequences of psychopathology through retrospective studies. The Rosenthal-Kety volume reflects an almost total unanimity among its contributors regarding the need for long-range, methodical, prospective studies, along the lines pioneered by Sarnoff Mednick and his co-workers, on groups genotypically at high risk for the development of schizophrenia.

The opening of communication channels, the reduction of conceptual polarization, and the consensus on future research needs are the major achievements of the conference represented in this book. It is to be hoped that the publication of these proceedings will stimulate further discussion and promote the collaborative research efforts that are needed on a problem that has immense individual and social costs.

SEYMOUR KESSLER
*Department of Psychiatry, Stanford University School of Medicine, Stanford, California*

## Examples of Ingenuity

**Simple Working Models of Historic Machines.** (Easily Made by the Reader.) AUBREY F. BURSTALL. M.I.T. Press, Cambridge, Mass., 1969. 80 pp., illus. $3.95.

The idea of a collection of plans for models of important mechanisms has been discussed by educators since the British *Report on the Classics* of 1921. Such a collection has seemed an excellent way to do four things: to interest vocational high school students in the history of science and society, to introduce the principles of mechanics into shop work in an effective way (instead of centering merely on tactics with the

latest industrial gear, which is certain to go out of date quickly), to give college preparatory students a new sense of concreteness in their study of history (building, mining, blacksmithing, time measurement, and so on), and to create the area of common activity needed to get some collaboration between students whose work centers in the shop and those whose work centers in the library. The present book is an attractive first step toward implementation of this notion. Its appeal, however, is not limited to educators and secondary school students: any scientist with an interest in history or in ingenuity will be fascinated by the drawings and brief accounts of the wide range of machines collected: the classical steam engine and classical slot machine, the oliver (a medieval blacksmith's aid), the Cornish man-engine (a weird anticipation of modern mine elevators), the Chinese south-pointing chariot, and 30-odd more. The format—a page of text facing a full-page drawing of each device—is as attractive as any such layout can possibly be. One defect of the book so far as its ostensible purpose is concerned, but a virtue for a wider audience than potential model-builders, is its preference for the mechanically unorthodox or amusing to more routine, simpler items.

As reading for a humanist or scientist, and as a step toward a new set of programs in education, the book is excellent. As an actual guide to building the attractive models it presents, it is not as good. The author keeps forgetting at crucial points that the potential model-builder can't telephone the machine shop of the school of engineering to send him a pair of balanced fine-jet nozzles of equal weight or a 30-tooth wheel for the verge-and-foliot model (the suggestion that this can be made by the student with saw and file seems to me to make sense only if the student is in prison, with nothing else to do with his time), and so on. Advice ranges from the insultingly trivial (a pulley can be whittled out of wood) to the impossible (correct adjustment of the planetary shaft of the differential box of the south-pointing chariot is essential). The compression of the text precludes more than brief allusions to historically interesting material, and every so often leads to omission of essential details. (The text and drawing of the verge-and-foliot model really give no clue to the way the pallets work; the screw-cutting machine comes out a model of obscurity; and so on.) The author talks about using standard materials, but never mentions Tinker Toy, Erector, or Meccano parts where these would be exactly what is needed.

Maybe this book is just the right first step: an exotic, if somewhat arbitrarily selected, set of plans that will interest a wide audience in its central idea. But it needs as a second step a complete redesign—perhaps four pages rather than two for each machine—in collaboration with someone who actually teaches or works in a modestly equipped shop, but who is able to get needed parts from local toy, grocery, and hardware stores. A bibliography would also help—the credits for photographs and plans are totally inadequate for this purpose. Any young model-builder should be told about Heron's *Pneumatica*, Britten's *Old Clocks and Watches*, Vitruvius' *On Architecture*, and a dozen or so more works.

ROBERT S. BRUMBAUGH
*Department of Philosophy,*
*Yale University,*
*New Haven, Connecticut*

## Working Oceanographers

**The New World of the Oceans.** Men and Oceanography. DANIEL BEHRMAN. Little, Brown, Boston, 1969. xii + 436 pp., illus. $8.95.

This book is a pleasant surprise. Reading it on board a hot, cramped vessel in the Atlantic, I was prepared for another wide-eyed, slack-jawed account of oceanography in the manner of the glossy magazines, and prepared to dislike it.

Behrman's book is definitely journalistic, but in a respectable tradition. He writes in a Sunday supplement style, with a sense of humor and some degree of irreverence. Behrman is able to communicate what oceanographers do, how they do it, and, to some extent, why they do it. Everyone working in or at the sea likes to call himself an "oceanographer"; this book is a good guide to the most important scientific areas covered by that now almost meaningless term.

The book is built around the large American oceanographic institutions and the men who work in them. Behrman is able to capture the personalities and conversational styles of the people he interviews. In a way, the book is like a gossip column; working oceanographers will enjoy reading between the lines, and seeing how an outsider reacts to some of the strong personalities that abound. The book is vaguely reminiscent of a recent volume by Rex Reed entitled *Do You Sleep in the Nude?*, which does for movie stars what Behrman has tried to do for oceanography.

There is solid science in the book, generally well explained. Some of the more technical matters are accompanied by accounts that are a bit muddled and don't explain. But these are small slips and detract little from the value of the book.

The point where I do take issue with it is in the lack of distinction between good science and bad or even pseudo science. *The New World of the Oceans* is a potpourri of the profound with a sprinkling of the humbug and silly. Perhaps it takes a working scientist to appreciate the difference, or to appreciate that not all scientists are particularly bright. The author is not enough of a skeptic.

On the whole, however, this book makes good reading, either on a long oceanographic cruise or as a general source on what people try to do on oceanographic cruises.

CARL WUNSCH
*Department of Earth and*
*Planetary Sciences, Massachusetts*
*Institute of Technology, Cambridge*

## Processes in Plants

**Perspectives in Phytochemistry.** Proceedings of the Phytochemical Society Symposium, Cambridge, England, April 1968. J. B. HARBORNE and T. SWAIN, Eds. Academic Press, New York, 1969. xii + 236 pp., illus. $9.

Emphasis in this symposium is on secondary metabolism, with particular reference to biosynthesis and chemotaxonomy. T. J. Mabry has contributed an interesting discussion on the establishment of structures of flavonoids by ultraviolet and nuclear magnetic resonance spectroscopy. The occurrence of secondary metabolites in relation to classification of plant taxa is discussed generally by R. Hegnauer and by H. Erdtman. V. Herout and F. Sorm consider sesquiterpenoids in relation to classification of the Compositae. E. C. Bate-Smith has written a thought-provoking paper on the occurrence of flavonoids in relation to