which requires a formal symbolic language, would thus be a uniquely human possession (or one shared by human beings and computers). Perceptual hypotheses, on the other hand, are essentially inductive. "We may say that deduction is non-biological—for there cannot have been deduction before there was formal language" (p. 161). Again, "it is the incredible invention of deductive thinking . . . which has given unique power to the human brain: allowing us to transcend our biological origin" (p. 162).

A number of issues arise in connection with this view. The author undoubtedly does not mean to say that formalized science is exclusively deductive, so comment here is unnecessary. But it needs to be shown, not merely asserted, what kinds of abstract thinking and communication involve deductions in what ways and to what extent. Nor is it clear why perceptual hypotheses are inductive if the problem to be solved is, "What is the object giving this projection?" (p. 36). Indeed, the author illustrates Helmholtz's doctrine of unconscious inference, of which his own theory of perception is said to be an extension, by way of a deduction (p. 30). Once more, it is difficult to see why a process that depends on language is "non-biological." Has not language a biological basis?

Many particular discussions in this book deserve mention. A single example of special interest is Gregory's treatment of the contrast between pictures and perceptual objects. Although, as he points out, most perceptual experiments have used pictures rather than objects, he shows important functional differences between the two. This discussion needs, of course, to be continued with a focus on similarities as well as differences between pictures and things. Metzger's work on three-dimensional illusions is relevant here, as well as the author's own ingenious "impossible object" constructed after the model of the "impossible triangle" of the Penroses.

The mixture of physiological and psychological terminologies in this book is particularly disturbing to the present reviewer. Such expressions as "pictures in the eye" (p. 15), "the brain never makes up its mind" (p. 38), "colour is transmitted to the brain" (p. 75) can only be confusing. The difficulty is not merely stylistic. To speak of "pictures in the eye" makes it easy to overlook the fact that the retinal image is a mosaic, and thus to bypass the problem of organization, as the author in fact does.

Gregory is obviously in command of the facts of perception, and his experimental contributions are excellent. His major thesis, that perception is intelligent, is an important and interesting one. It deserves better treatment.

MARY HENLE
Department of Psychology, Graduate Faculty, The New School, New York City

Heredity in Mental Disorders

Genetic Theory and Abnormal Behavior. DAVID ROSENTHAL. McGraw-Hill, New York, 1970. xviii, 318 pp., illus. $9.95. McGraw-Hill Series in Psychology.

Those who do not ignore the possibility of genetic influences on abnormal behavior are rightly cautious of unwarranted claims as to the nature and degree of such influences. A famous physician once reported a pair of identical twins so strikingly similar in their psychoses that both of them "often on the same day roused themselves from their habitual stupor and prostration"; such behavior would occur even when they were some miles apart. Of this report Francis Galton wrote in 1875: "Dr. Moreau (de Tours) ranked as a very considerable medical authority, but I cannot wholly accept this strange story without fuller information. Dr. Moreau writes it in too off-hand a way to carry the conviction that he had investigated the circumstances with the sceptic spirit and scrupulous exactness which so strange a phenomenon would have required."

A similar caution, together with a demand for high standards, pervades this book by David Rosenthal. This is one of its strongest points of recommendation in a climate of opinion in the social sciences where until recently it was widely considered outmoded to attach any weight at all to genetic factors. Rosenthal's conclusion, based on a detailed and thoughtful discussion of a wide range of evidence, that "it has been demonstrated beyond any reasonable doubt that heredity plays an important role indeed in the etiology of schizophrenia," will carry all the more weight, coming as it does from a trenchant but constructive critic of studies using schizophrenic twins and a pioneer of strategies employing adopted children.

The chapter on genetic studies of schizophrenia, over 100 pages long, forms the core of the book. There is a useful account of the methodology and results of recent adoption studies, and an instructive comparison of monogenic-biochemical, diathesis-stress, and life-experience models of the etiology. Much of the chapter is devoted to a discussion of the biological unity and specificity of the schizophrenic genotype, rather than just to whether genetic factors play a part or not.

If there were evidence that all functional behavioral disorders are genetically related, it would "support the popular claim that . . . there is only mental illness of more or less degree." Rosenthal's discussion of manic-depressive psychosis is more condensed, but it gives general support to its being a separate entity from schizophrenia, each illness having its own genetic spectrum. The fact that the author is a psychologist and not a psychiatrist wedded to the medical model will again add weight to his conclusions here. He warns that this basic foundation will crumble if it is not supported by blind diagnostic procedures. In fact, independent blind confirmation of results has already, in his own current work and elsewhere, strengthened conclusions concerning heredity.

In his book Rosenthal places human behavior in an evolutionary setting. The possible effects of both genetic and environmental variation are considered. But however important the genotype or constitutional diathesis may be for the major psychoses, its recognition, its mode of inheritance, and how it interacts with what environments to produce the psychosis are not matters that can be settled from the data at present available. The author wisely does not attempt to "tie all the material into a neat package with a cogent conclusion." Instead he organizes the evidence in such a way as to expose possible sources of error and to allow the reader to see what order can be brought to the data, what research they suggest, or what new theories they generate. He declares his own preference for a diathesis-stress theory of schizophrenia.

Mental retardation, aging, normal personality variation, and the behavioral consequences of disorders such as epilepsy fall outside the scope of the book, but there are excellent chapters on genetic studies of psychopathy, criminality, psychoneurosis, homosexuality, and alcoholism. "In all likelihood,

many, if not most, crimes are committed by individuals in whom the role of heredity is minor, nonspecific, or perhaps irrelevant." Criminality is clearly genetically heterogeneous. Strangely enough, we are here sometimes better able to form an idea of what is inherited and how it interacts with the environment than we are in the functional psychoses. Electroencephalographic and chromosomal abnormalities, low IQ, and psychopathy, some of it under genetic influence, play their part in predisposing to crime.

The author is to be commended for the number of studies he has presented and discussed, reasoning about them step by step, rather than to be criticized for omitting others in his attempt to cover a very wide field. The book was originally intended for students of abnormal psychology, but it will be of equal value to their teachers and to professional workers in the field. It deserves to be widely read, and one hopes it will achieve the author's primary goal, "to get students to see the great, untapped potential in this immature field, and to stimulate a few to take an active interest in advancing it further."

JAMES SHIELDS
Institute of Psychiatry, London

Reproductive Entomology

The Physiology of Insect Reproduction. FRANZ ENGLEMANN. Pergamon, New York, 1970. x, 308 pp., illus. $18.75. International Series of Monographs in Pure and Applied Biology, vol. 44.

It has been becoming more and more apparent in recent years that the variety of reproductive patterns and underlying physiological control mechanisms found in the class Insecta rivals and may well exceed that found in the vertebrates. This book is one of the first attempts to treat insect reproduction in a comprehensive manner. Engelmann has performed an important service in bringing together the diverse and widely scattered literature of this field. Topics covered in his review include sex determination and sex differentiation, gonadal development (spermatogenesis, oogenesis, and vitellogenesis), mating behavior and the control mechanisms involved therein, insemination, factors affecting fecundity, hormonal control of egg maturation, neuroendocrine integration of reproductive processes, parthenogenesis, oviposition, viviparity, hermaphroditism, heterogony, endocrine influences on reproduction in males, and caste determination and control of social structure in social insects. The chapters on gonadal development, mating, fecundity-affecting factors, and hormonal control of egg maturation, which make up the bulk of the book (148 of 243 pages of text), are of the greatest interest not only because these topics have captured a major share of the attention of investigators in recent years, but also because of the substantial contributions to these areas arising from Engelmann's own research.

This reviewer found the chapter on mating to be the least satisfactory one in the book. It is, as the author points out, "a formidable task to extract the essentials" from the vast literature on this subject, and the material presented on this topic seems somewhat less well digested than that presented in other chapters. The minor errors and omissions that occasionally frustrate the reader seem more numerous here than elsewhere in the book. Engelmann cautions repeatedly and wisely against generalizing on the basis of evidence from a few species, yet on occasion he fails to heed his own warnings. For example, experiments on certain laboratory strains of the cockroach *Leucophaea maderae* indicate that the corpus allatum hormone is important in enhancing the sexual receptivity of females, and the author concludes that in cockroaches "the corpus allatum hormone affects the central nervous system, thus changing the female's behavior." Yet other data exist (not all of which are cited) indicating that in other strains of *Leucophaea* as well as in two other cockroach species, hormones from the corpora allata have a negligible effect on female sexual receptivity. A tendency on the part of the author to give top billing to his own interpretations of the processes regulating insect reproduction, and in so doing to ignore data suggestive of other interpretations, appears in the chapter on hormonal control of egg maturation as well as in the one on mating; I did not note it elsewhere. The only other criticism to be made of this book concerns the inordinate amount of time between the completion of the literature survey (1968) and the publication of the book. As a result the book is out of date on a number of points; indeed, some of the issues raised by Engelmann have been substantially resolved in the interim.

The book is quite well illustrated, the illustrations generally serving to enhance the text. There is an adequate index listing both species and subjects, an extensive bibliography, and a brief but useful glossary.

If the foregoing criticisms are borne in mind, this book is an extremely useful survey of the literature of insect reproduction. A careful reading of it should be of particular benefit to students interested in doing research in insect reproduction, for Engelmann takes care to point out subjects in need of further investigation, not only among topics of current interest but also among those that are currently rather neglected, such as sex differentiation (thought to be under strict genetic control until the recent demonstration of the importance of epigenetic factors in certain beetles), endocrine influences on reproduction in male insects, the physiology of oviposition, and caste determination in social insects (a topic that formerly commanded considerable attention). It is to be hoped that the book will serve as a stimulus to research in these and other areas of insect reproductive physiology.

ROBERT H. BARTH, JR.
Department of Zoology,
University of Texas, Austin

Germ Cells

Ovarian Development in Drosophila melanogaster. ROBERT C. KING. Academic Press, New York, 1970. x, 228 pp., illus. $16.50.

This volume is based on the work of King and his collaborators on germ cell proliferation and development in *adult* female *Drosophila.* As an organized presentation of this work, it will be of value to geneticists and developmental biologists who use this species. The author's aim, "to summarize information on how reproduction is accomplished and regulated in this species," emphasizing the analysis of the developmental failure of female-sterile mutants, has been accomplished in part. However, he has failed to produce a comprehensive treatise on the germ cells of female *Drosophila.*

Good account is given of the structure and functioning of the adult ovariole. A detailed, tabular description of the morphologically defined stages of oogenesis is made, and later stages are well illustrated by semidiagrammatic drawings. Rates of growth of egg chambers, nurse cells, and oocyte are given, along with the temporal relations for actively laying, mated females.