describes "An interdisciplinary program for law students in the environmental field" offered at the University of Colorado, in which law students were exposed to a variety of problems and programs of science-based state and federal governmental agencies, and Charles H. W. Foster outlines in "Counsel for the concerned" some of the specific possibilities and opportunities open to persons who wish to enter the field of environmental law.

This is a landmark volume and will be a much used contribution to the literature for some time to come. Because it has to do with novel and dynamic developments, the specific doctrines and propositions with which it deals are certain to be affected by social and legislative change, and users of the volume seeking information on the current state of environmental law will need to update its contents by reference to more recent sources, notably in the environmental law reporters and in the law journals. But the benchmark value of this volume will not be impaired, and it will be a long time before anyone seriously concerned with law and the environment can afford to be unacquainted with it.

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Mathematician

Carl Friedrich Gauss. A Biography. TORD HALL. Translated from the Swedish edition by Albert Froderberg. M.I.T. Press, Cambridge, Mass., 1970. xii, 176 pp., illus. $7.95.

Carl Friedrich Gauss is usually described in superlatives. He is "the prince of mathematicians," and is ranked with Archimedes and Newton as one of the greatest mathematicians of all time. His contributions to mathematics and physics range from number theory to telegraphy, from differential geometry to the calculation of planetary orbits. Yet though there are abundant materials—collected works, letters, notebooks containing unpublished discoveries, detailed scholarly studies of many aspects of his work—no mathematical biography of Gauss has ever been written.

Tord Hall's biography is a more modest undertaking. He answers two questions: "What sort of man was Gauss?" and "What sort of mathematics do we owe to Gauss?" The book can best be described as a modern popularization of some important topics in mathematics and physics that were greatly advanced by Gauss: prime numbers, congruences and quadratic reciprocity, construction of the regular 17-sided polygon, the method of least squares, the Gauss-Weber telegraph, triangulation, differential geometry and curvature, non-Euclidean geometry, complex numbers, and elliptic functions. The account is interwoven with biographical data, and the topics are presented in the order in which Gauss took them up. In the brief last chapter, "Personal facts about Gauss," Hall has given us a nice picture of Gauss the man, including his aversion to teaching, his conservatism in politics, his views on religion, his attitude toward his children, his loneliness, and above all his love for the beauty of mathematics. There is no ground-breaking historical research here, but Hall makes some interesting nontechnical generalizations about Gauss's work.

The popularization of the mathematics is generally good, especially on the geometrical topics. But sometimes, though the mathematical problem is easily stated, no quick popular explanation of the solution is possible. Hall may leave the nonmathematical reader wondering, among other things, Where does the logarithm come from in the number of primes less than a given number n? How could one possibly prove the fundamental theorem of algebra?

Though Hall spends much time explaining the mathematics, he has chosen not to explain in any detail how Gauss himself approached the problems. In particular, no Gaussian proofs are reproduced. For a detailed account of Gauss's mathematics, its influence on his contemporaries and successors, and its relationship to the mathematics of earlier periods, the reader must turn elsewhere: to histories of mathematics, to detailed studies of particular works, or to Gauss's works themselves. But Gauss's works are notoriously difficult; the *Disquisitiones Arithmeticae* has been called "that book with the seven seals."

There are some errors in the historical remarks Hall does make. For instance, he implies that "There is one and only one parallel to a given line through a given outside point" is the famous Fifth Postulate of Euclid's *Elements*; it is a later equivalent. He believes that Newton and Gauss mean Euclid, rather than Archimedes, when they speak of the "rigor of antiquity." Finally, there are no footnotes, and the bibliography is brief and unselective.

For a nonmathematician, whether student or scientist, who wants a modernized, elementary account of some major topics in classical mathematics, Hall's book is not a bad source. The reader will at the same time get a feeling for Gauss as a human being. But we still await a major mathematical biography of the prince of mathematicians.

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Population Genetics

An Introduction to Population Genetics Theory. JAMES F. CROW and MOTOO KIMURA. Harper and Row, New York, 1970. xvi, 592 pp., illus. $13.95.

The genetic state of a population is determined by the genotypes of its members, their relative frequencies, and their values. Accordingly, the central concerns of population genetics are with the forces responsible for change (or stability) of genotype frequencies, expected rates of change, and the concurrent effects on the average genotypic values and genetic variances of populations. These, and many relevant ramifications, are the things about which Crow and Kimura have written. Their book is, as its title indicates, devoted to theory, primarily theory tailored to diploid organisms and populations subject only to natural selection. It is modestly labeled an introduction. Far less would have qualified as an introduction; it is not exhaustive, but it is a very thorough introduction, and on several subjects (among them inbreeding, Fisher's fundamental theorem of natural selection, and gene frequency drift in finite populations) the treatment is far better described as sophisticated than as introductory.

Attention is directed first to genotype frequencies as functions of gene frequencies, mating system (random, assortative, and consanguineous), and interlocus correlations in gametic allele content (amount of linkage disequilibrium). This done, the focus is shifted to the joint effects of selection, mutation, drift, and migration on gene frequencies. Changes in genotype frequencies arising from changes in mating system or gene frequency are trans-

lated throughout into terms of consequent changes in genetic means and variances. In all of this the trait receiving prime attention is, appropriately, Darwinian fitness. Numerous special topics are covered; examples are the components of genetic variance, effective population number, correlations between relatives, the cost of natural selection, genetic loads, probability of fixation of mutant alleles, and the number of neutral alleles maintained in finite populations.

There are some important things that might have been, but are not, found in this book. Available theory is presented, but not much in the way of perspective concerning its adequacy is provided. In general the authors have not offered judgments concerning the sufficiency of present theory or the areas in which further theoretical developments are most needed. Similarly, there is little discussion of how theory presented can be employed for inference concerning the genetic state of real populations or the actual shape of the genetic details (such as dominance, epistasis, selective values) that modify theoretical expectations. In a slightly different vein, it is worth noting that this book concentrates on the problems of single populations as opposed to those that arise from the interplay between species. For example, the fact that, while Darwinian fitness can only be increased by natural selection (that is what Fisher's fundamental theorem is about), species may, and often have, become numerically smaller (or extinct) is recognized by the authors but is not examined with the same quantitative rigor that they bring to the subject of gene frequency changes.

Lucid presentation of mathematical deductive theory with emphasis on derivations and underlying assumptions was the obvious objective of the authors. They have given us an effectively organized and integrated presentation of a substantial portion of the significant, currently available theory concerning single populations (to which, incidentally, they have both made their own substantial contributions). The book is written for students and in a manner designed to facilitate their understanding of both the derivations presented and the procedures by which theory is developed. The bibliography is extensive and will certainly be appreciated by many readers. In my opinion this book will be very useful to many of us and should be kept within easy reach by all serious students of population genetics, population biology, and biomathematics.

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Neuroscience

Short-Term Changes in Neural Activity and Behaviour. A conference, Cambridge, England, July 1969. GABRIEL HORN and ROBERT A. HINDE, Eds. Cambridge University Press, New York, 1970. viii, 606 pp., illus. $28.50.

The major topic of the conference represented by this volume was the neural basis of habituation, the term "habituation" referring to behavioral response decrement occurring as a result of repeated or continuous stimulation. The selection of habituation as the focal point of the conference stemmed from the hope that it might be "a relatively simple type of behavioural change in which units are phenomenologically similar at lower levels of analysis." The papers on behavioral and physiological aspects of habituation effectively dispose of this hope. It seems likely that the processes underlying habituation are no more similar than are, for example, the processes underlying behavioral "inhibition" or "extinction of conditioned reflexes." The wide diversity of mechanisms mediating behavioral habituation does not lessen the value of this volume, however, for its papers are thorrough and scholarly and have the mark of being written expressly for this publication rather than pieced together from previous works. Indeed, the organizers of the conference have been extraordinarily successful in enlisting the cooperation of participants so as to achieve complete coverage of the general problem areas under consideration.

The volume is divided into three sections: Neural Basis of Habituation, Neural Basis of Plastic Changes Other than Habituation, and a section on Behavioural Considerations relevant to the first two topics. Given the 600 rather large pages of which this book consists, the 19 separate chapters, and the 27 eminent participants, it is obviously impossible to review the contents of the volume in detail. But there are a few generalities that emerge. First, the authors have written thorough and highly readable reviews, as well as covered their own research efforts. These papers extend well beyond the topic of habituation per se, covering subjects classified in the volume as "neural basis of plastic changes other than habituation." These reviews deal with a wide range of topics, from the insect central nervous system to neurochemical correlates of learning in the mammalian brain.

In essence, though the conference may have failed to come up with support for the hope that habituation might be a key to unlock the secret of a neural basis for behavioral plasticity, the individual contributors have prepared a series of papers of remarkably high quality.

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Predation

Searching Image in Carrion Crows. Hunting Strategy in a Predator and Some Anti-Predator Devices in Camouflaged Prey. HARVEY CROZE. Parey, Berlin, 1970. 88 pp., illus. $12.10.

We are accustomed to a high quality in the reports from N. Tinbergen's laboratory. The questions he asks are significant, and the answers reflect both a high degree of ingenuity and diligence. Whether studying "pecking responses" or "predation," Tinbergen and his group provide grist for the mills of both those who are interested in behavioral mechanisms and those who attend to the ecological and evolutionary aspects of behavior. Croze, in *Searching Image in Carrion Crows,* continues in this laudable tradition. His booklet is especially useful at this time because the concept of searching image has become overused (and abused) of late, this reflecting the embarrassing fact that it has rarely been the subject of careful study, despite its age. The concept of "searching image" was introduced by Lukas Tinbergen (brother of Niko) to explain certain discrepancies between the abundance of a prey organism and the numbers actually taken by its avian predators. At low densities, a new species of insect prey may be altogether overlooked at first, only to suddenly become especially esteemed. This was assumed to result from the fact that birds