are major determinants of the population densities of breeding birds. Moreover, Fretwell presents some evidence that individual field sparrows, *Spizella pusilla*, with breeding territories on their wintering grounds (broom sedge habitats) have higher winter survivorship than individuals nesting in habitats different from the wintering habitats; however, the latter are better breeding territories in that reproductive success per breeding season is higher in them. Because the longer-lived birds produce fewer progeny during any given reproductive season, the total production of offspring over the lifetimes of individuals with each type of breeding territory may be comparable.

Fretwell envisions a balanced system in which the average fitnesses of individuals breeding in different habitats are equalized by these means and by both intraspecific and interspecific density adjustments within each habitat type. This concept of a population is very appealing, and certainly Fretwell's thesis that winter is a critical season for many temperate-zone birds is amply documented and indisputable.

The preface contains a curious, yet lucid, explanation of Levins's fitness sets and adaptive functions couched in the anthropomorphism of "the strategy of being an ecologist," which could be useful to students to whom these concepts are new. Unfortunately, however, this exercise is entirely irrelevant in the context of the present book, since fitness sets are not used elsewhere. Instead, Fretwell develops a number of highly specific, largely graphical, models and theories to account for population densities under a variety of different assumptions and conditions. No truly general statement about population densities in seasonal environments seems to emerge except that seasons are important and that winter survival may constitute a "bottleneck."

The book is rather difficult reading, often unnecessarily so; some of the figures (for example 18, 24, and 46) are pretty cluttered and require considerable effort to fathom. The title is somewhat misleading as the book "concentrates too much on birds" (p. 205), although muskrats, thrips, the codling moth, and side-blotched lizards are briefly considered.

This book, the fifth in a series of monographs on population biology, seems much less likely to become a minor classic than some of its predecessors. Nevertheless, its purpose will presumably be served if avian ecologists consider the biology of their subjects in the winter as well as during the breeding season.

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The Motor Control System

Mechanisms Regulating the Discharge of Motoneurons. RAGNAR GRANIT. Thomas, Springfield, Ill., 1972. x, 78 pp., illus. $8.25. Sherrington Lectures, University of Liverpool, 11.

This monograph is a comprehensive account of a Sherrington lecture given by the author at Liverpool. The author has focused on the difference in behavior between phasic and tonic alpha motoneurons with special attention to their functional significance. It was about 16 years ago that the author and his collaborators first noticed that mammalian spinal motoneurons may be classified into phasic and tonic types by reflex discharge in response to sustained muscle stretch. Subsequent tests with several criteria, however, have shown a continuous gradation between the two types of motoneurons and failed to separate them qualitatively into two distinct categories. This was not disturbing to Granit, and he rather felt that it would be even more interesting to find out how the merely quantitative differences between these motoneurons are exploited by the organism to develop functionally distinct motor control systems. This book shows that relevance or irrelevance of the experimental results depends simply on what the investigator is looking for.

Any movement of the body is produced by contractions of skeletal muscle, and muscle contraction is brought about solely by the discharge of motoneurons. This is the principle on which the author's idea is based, and he defines the motor control system as the neural mechanisms which regulate the discharge of impulses from motoneurons. The author proceeds with the problem of phasic and tonic motoneurons step by step at the mechanistic level; yet, the outcome of each of the analyses is interpreted in terms of the overall function of motor control. The author warns that the basic neural mechanisms analyzed at the cellular level under laboratory conditions should not be generalized too freely. The results obtained from the observations on freely moving animals or on human subjects, no matter how crude the analyses, do not always fit with those predicted from the mechanisms analyzed under simplified conditions. The author intuitively speculates that phasic and tonic motoneurons act as partners and that the proportion of their contributions in each movement is determined by the program formed in the central nervous system. Thus, the properties of phasic and tonic motoneurons once adequately clarified by the author at the mechanistic level seem to be unfortunately merged into an ambiguous functional concept. Those who are mechanism-oriented may criticize this book because of some untestable speculations posed by the author, whereas others who are function-oriented would admire it because of the author's ingenious and imaginative synthetic approach. The judgment depends on how the reader is oriented or how he is biased. Whatever the reader's judgment, no one can deny the author's distinguished contributions to the neurosciences.

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Immunology

The Cells and Tissues of the Immune System. Structure, Functions, Interactions. LEON WEISS. Prentice-Hall, Englewood Cliffs, N.J., 1972. xvi, 252 pp., illus. Cloth, $9.95; paper, $6.95. Prentice-Hall Foundations of Immunology Series.

Contact with a foreign antigen, in the form of a macromolecule or tissue graft, results in the formation of a specific antibody or leads to graft rejection. The cells responsible for this type of immunological reaction are located in the lymph nodes, spleen, thymus, and bone marrow, and are part of the lymphoid system. During the last decade it has become clear that there are at least two types of lymphocytes—the T (thymus-derived) and the B (bone-marrow-derived).

Leon Weiss in *The Cells and Tissues of the Immune System* looks at immunological reactions through the eyes of a morphologist and electron microscopist. The first part of the book consists of a clear and concise discussion

of the origin, location, and gross and fine anatomy of the various lymphoid organs. Weiss considers the lymphoid tissues as vascular filters, consisting of a three-dimensional network of reticular cells and reticular fibers. Each lymphoid organ has its characteristic arrangement of reticular meshwork, attached to the internal surface of the organ. The bone marrow, which is the chief source of immunologically active cells, consists of cells which migrate away. If the cells migrate to the thymus they can proliferate there and acquire thymic-specific tissue antigens (T-cells). If, on the other hand, the cells migrate to the spleen, lymph node, or other peripheral lymphoid tissues, they can become potential antibody-forming (B-) cells. In many instances, the B-cells need the help of the T-cells before they can synthesize humoral antibody. The interaction between T- and B-cells, most likely, takes place in the peripheral lymphoid tissues, such as spleen and lymph nodes.

The exact role of the B- and T-cells during graft rejection and delayed hypersensitivity is less clear, but there is strong evidence that the T-cells may be the actual "killer" cells during cell-mediated immunity. The function of the B-cell in cell-mediated immunity is unknown.

In the second part of the book Weiss deals with the cell types which comprise the tissues described in part 1. First there is the macrophage, a wandering, phagocytic cell which, in many instances, makes the initial contact with the antigen. The antigen is "processed" by the macrophage and the processed antigen is capable of turning on the T- and B-lymphocytes, leading to antibody synthesis. The macrophage is also believed to be involved in cell-mediated immunity, but its precise role in this process is unclear. Weiss also describes the structure of the stem cells, thymus cells, and antibody-forming cells. The latter, because of their increased synthetic activity, possess an elaborate endoplasmic reticulum—a common feature for cells engaged in active protein synthesis. Schematic diagrams and electron micrographs or immunofluorescent pictures of the different cell types are shown side by side so that the reader, without effort, learns to understand cell structure.

Part 3 of the book deals with the nature of the immune response. A typical response to an antigen results in the initial production of an antibody (IgM) of large molecular size (19*S*), followed by a second class of antibody (IgG) of smaller molecular size (7*S*). Other classes of antibodies include IgA, a secretory immunoglobulin; IgE, an immunoglobulin involved in hypersensitivity reactions; and IgD, of as yet unknown function. The production of antibody decreases the level of antigen and eventually results in the cessation of antibody synthesis. When an organism is confronted with the same antigen for the second time, a secondary immune response occurs. This is manifested as a more severe immune reaction. The nature of the memory cell responsible for a secondary reaction is not clearly understood.

The book is well illustrated, with plenty of schematic diagrams to explain the light and electron micrographs. At the end of each chapter, the author lists a group of suggested references, with an explanation why the particular reference is considered pertinent. As a bonus, the book has a comfortable format with non-glossy paper and easy-to-read print.

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Health Hazard

Pulmonary Reactions to Coal Dust. A Review of U.S. Experience. MARCUS M. KEY, LORIN E. KERR, and MERLE BUNDY, Eds. Academic Press, New York, 1971. xvi, 216 pp., illus. $14. Environmental Sciences.

This book is welcome at a time when concern about coal workers' pneumoconiosis (CWP) is widespread. The editors' stated purpose is to give the current American view of the condition, to provide a reference point for legislation and control purposes, and to promote discussion among workers in the medical, scientific, and administrative fields. These objectives have been achieved by contributors whose distinction in many different disciplines indicates the extent of the work being carried out to control the hazards to health caused by the inhalation of airborne coal dust.

The book has three parts. The first deals with the historical background and emphasizes the development of the legislation affecting coal mines. There follows an authoritative account of the present state of knowledge concerning the dust concentrations currently prevailing in the working environment of American mines and the instruments used to monitor these. Clinical characteristics are considered in part 2. In this there are seven chapters, each concerned with a particular aspect of the problem. The account of the epidemiological investigations which have already been carried out and the chapter dealing with the development and use of the International Union against Cancer (U/C) classification of the radiological appearances of the pneumoconioses are particularly helpful. Part 3 deals with treatment and prevention and presents an outline of a number of studies in which the U.S. Public Health Service is currently involved.

Although the editors comment in their preface that "it would be premature to seek a greater consensus at this time," it is disturbing to find such large differences of opinion on what constitutes CWP. Thus we find on page 111 that the condition is defined anatomically, whereas on page 189 the definition in etiological terms is very much broader and appears to include cases of nonspecific airways obstruction with negative roentgenological findings. This latter definition is surely too sweeping, at least until such time as the contribution made by the inhalation of coal dust to the development of airways obstruction has been finally established. This very real difficulty, which contributes so much to the misunderstandings between groups concerned with the clinical and administrative aspects of the condition, might be overcome by the adoption of the definition presented at the fourth International Conference on Pneumoconiosis organized by the International Labor Organization in Bucharest in September–October 1971. This is similar in its essentials to the one given by Prendergrass and his colleagues on page 111. These authors stress the dominant role the radiologist should play in the diagnosis and elucidation of the natural history of the disease, but they do not perhaps lay sufficient emphasis on the difficulty of using the recommended radiological classification. The possible errors arising from observer variation in the interpretation of the radiographs are now well recognized and can be reduced, but a major and continuing effort to do so must be made.

The elucidation of the biological significance of the changes demonstrated in the radiograph is a task related to but distinct from the problem