where, and thus this review serves a useful purpose. The recent studies reported avail themselves of new technology and the knowledge gained from the 1960 cascade, thus creating an important link between the cellular and the humoral concepts of how the thymus influences the body.

The bibliography is extensive and valuable. This book should prove stimulating and useful, especially to those persons engaged in studying the role of the thymus from a cellular rather than a humoral point of view.

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The Biston Affair

The Evolution of Melanism. The Study of a Recurring Necessity. With Special Reference to Industrial Melanism in the Lepidoptera. BERNARD KETTLEWELL. Clarendon (Oxford University Press), New York, 1973. xxiv, 424 pp., illus. + plates. $33.

This is the masterwork of an extraordinary biologist. Twenty-five years ago, H. B. D. Kettlewell abandoned 15 years of medical practice to return permanently to the study of the Lepidoptera. As Nuffield Foundation Research Fellow at the University of Oxford, the amateur was converted to professional. Thus we have been treated to yet another spectacle of highly successful unorthodoxy in British science. Where else in the world do such things happen?

The short title is somewhat misleading. On first reading it I thought perhaps Kettlewell was going to deal broadly with blackness in nature. But, as the second subtitle suggests, the book centers on the author's principal research interest, the evolution of industrial melanism in moths. Perhaps this is for the best. The reader is led through 50 pages of an introductory nature, following a complex outline which deals with concepts, attributes, examples, functions, and classifications of melanism. The approach is pedantic and the style turgid, but coverage of individual topics is fortunately brief. I have the impression that the author felt obliged to introduce the subject in this broad way but his heart was not in it.

The tone of the book improves noticeably when we come to a 50-page review of "The phenomenon of industrial melanism." But all this is still only prologue and stage setting. Finally, the classical case of melanism in the peppered moth *Biston betularia* is adduced and dealt with in all its fascinating details. What has made the *Biston* affair an evolutionary classic is the wealth of data that have been brought to bear on it. Thus there is the history of the blackening of the environment of the English midlands, the knowledge of bird predators and their habits, and the genetic bases for the melanistic forms of the species. The climax is reached when Kettlewell recounts the actual details of his own ingenious experiments on the action of natural selection. All these things have made this the best-known and most dramatic case of adaptive evolution in action. This same need for documentation in breadth and depth deprives most of the other cases that Kettlewell reviews of the intense interest that centers around *Biston betularia*. They seem of secondary importance and beset with many of the same uncertainties that once surrounded *Biston*. Nevertheless, the author succeeds in demonstrating that manifold genetic melanisms exist quite apart from those that have evolved as a genetic response to industrial pollution. These provide valuable comparative insight into the *Biston* case. Especially useful in this regard are the data on two other moths, *Amanthes glareosa* in the Shetland Islands ("Northern melanism") and *Lasiocampa quercus* ("Recessive melanic polymorphisms") from northern Scotland.

The book concludes with a miscellany of melanisms including a brief excursion into polymorphism in butterflies. The chapter labeled "The synthesis" is only six pages, and one is left with the feeling that integration of these cases into modern evolutionary population genetics has yet to be satisfactorily done.

Although there are several useful appendices, very little previously unpublished material has been included, and the mode of presentation follows very closely that of Kettlewell's scientific papers. In some instances verbatim quotes are used, and many tables and figures are slightly altered versions of the original ones. What emerges, then, is a compilation rather than a synthesis. The usefulness of having all this material between two covers is slightly impaired by the fact that some reproductions of black-and-white photographs are not up to the quality of the original figures in the journals. There are, however, a number of fine colored plates.

Kettlewell's rugged individualism permeates the book. Here are his work, his impressions, his view of biology. His name dominates the bibliography and the index. I raise this point not in criticism but as a reminder, in these days of the "team effort" and the "crash program," of the importance of individual dedication in intellectual endeavor. Science has its social aspects; collaboration and communication are necessary, and indeed every new fact must be interpreted with regard to the foundation laid by others. Throughout Kettlewell's book he is at pains to make us aware of how much he has depended on the heritage of predecessors. For example, mating behavior in *Biston betularia* was first observed and studied by John Ray on 29 May 1673! Although 85 percent of the author's cited publications are without coauthors, he has nevertheless carefully paid tribute to those who have assisted and influenced him. They range from amateur collectors and observers to active field associates and many of the major figures in evolutionary genetics and ecology. Despite all this, however, it is the individual enthusiasm, the personal drive, and the fired curiosity that are of the essence of Kettlewell's work.

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Hard Tissue

Mechanical Properties of Bone. F. GAYNOR EVANS. Thomas, Springfield, Ill., 1973. xiv, 322 pp., illus. $25.75. American Lecture Series, No. 881.

Evans is well situated to write this book. In 1957 he wrote the seminal *Stress and Strain in Bones;* he works in Ann Arbor, one of the world centers of bone research; finally, most importantly, researchers on bone must continually quote his work because he has started so many fruitful investigations into this maddening tissue.

He does not try to update the earlier book. He deals with bone as a tissue rather than with whole bones, which were the subject of *Stress and Strain in Bones*. He adopts the tactic of considering, in turn, the effects of factors such as drying, age, sex, and strain rate on the measured mechanical properties.

Anyone reading this book will get a clear idea of the state of knowledge of tne mechanical properties of bone as it was in about 1969. There are few later references. The experiments are set out in detail, usually far too great detail. For instance, in 1965 the reviewer published a paper concerning anelasticity in bone. It was 13 pages long, with six illustrations. Evans paraphrases it in 5½ pages using all six illustrations magnified 40 percent (this magnification being a general feature of the book). There is no possible reason for devoting 1½ percent of the book to this possibly pioneering, but certainly naive, paper.

What the reader will not get is any feeling for what are important problems to be solved now. This is for two reasons. First, there are effectively no comments on the worth or significance of different pieces of research. Work done by Rauber in 1876 is treated in exactly the same way, and at the same length, as the highly sophisticated work of, for instance, McElheney or Evans himself. Second, almost no consideration is given to why bone behaves as it does. Sometimes, if the authors he cites themselves discuss the matter, Evans will quote them, but the result is less than satisfactory. For instance, the discussion by Roth *et al.* of the causes of plasticity in bone was interesting in 1961; nowadays it reads like something from another age.

All this is particularly bitter because no one is better placed than Evans to sit back and comment on where the evidence so far accumulated is leading. This is a book that all research workers on bone must own, with regret that it is not a different book.

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Plant Physiology

Phloem Translocation. M. J. CANNY. Cambridge University Press, New York, 1973. xii, 302 pp., illus. + plates. $22.50.

The intriguing question of the mechanism involved in transporting carbon compounds over long distances in plants has evoked much research, and recently several reviews and books on the topic have been published. Canny emphasizes the kinetics of carbon transport and deliberately works "towards a mechanism." In these respects he extends the available literature on the anatomy, physiology, and biophysics of the process.

The early chapters of *Phloem Translocation* cover aspects of the anatomy of the phloem, the chemical composition of the moving solution, the energy supply, and bidirectional transport. Detailed information on these aspects of the process can be obtained from other texts, but in this volume it is oriented toward aspects relevant to the kinetics of carbon transport. Furthermore, it is background information that will allow readers new to the topic to appreciate the biology of the process.

The book collects and interprets almost all the data that have ever been obtained from radiocarbon tracer profiles; this material constitutes a useful résumé and illustrates the accomplishment of existing techniques. The treatment of the theoretical profiles is limited, though the inclusion of the work of Taylor will be appreciated. In contrast experimental data on tracer profiles, that is, the distribution of tracer in a plant as a function of time and distance from the point of application, are exhaustively examined. These cover many species, times, and treatments and generally illustrate that they fit error curves.

Three characteristics must be taken into account to describe mass transfer: the concentration of the solution, speed, and the cross-sectional area involved in transport. The relationships among these components will be important in understanding translocation, and, as Canny comments, whether speed is related to the amount of sugar moving or independent of the mass moved is a "crucial question that awaits experimental attack." Clearly definitive techniques to describe these components are required.

The objective of the book becomes most apparent in part 2—this is, to present the author's theory of the mechanism. This is achieved by a step-by-step explanation of fitting error functions, its application to 28 tracer profiles, extensive discussion showing that the results support the accelerated-diffusion model, and relative neglect of other models. The reader becomes well acquainted with Canny's point of view and may be tempted by the detailed description of the method to apply it without understanding the model. The validity of Canny's interpretation of the profiles has been questioned by MacRobbie and Passioura. I think there are many experimental data showing that the shape of the carbon profile is determined primarily in the source region and that there is little alteration along the leaf or stem, although this conclusion may depend on species and environmental conditions.

This volume emphasizes the need for reliable techniques to obtain quantitative kinetic data about the transport of carbon in plants. Some data already available conflict with Canny's interpretation, but many more are required to elucidate the mechanism of this process that is important in plant production. The chapter entitled "Towards a mechanism" describes the discussion in this book. The goal has yet to be attained.

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Books Received

Aging and Behavior. A Comprehensive Integration of Research Findings. Jack Botwinick. Springer, New York, 1973. x, 326 pp., illus. $10.50.

Alfred Binet. Theta H. Wolf. University of Chicago Press, Chicago, 1973. xiv, 376 pp. $13.75.

Ancient Views on the Origins of Life. Ernest L. Abel. Fairleigh Dickinson University Press, Rutherford, N.J., 1973. 94 pp. $6.75.

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Chemotherapy of Malaria and Re-

(Continued on page 120)