

Book Reviews

Information Processing

Coding Processes in Human Memory. Proceedings of a workshop, Woods Hole, Mass., Aug. 1971. ARTHUR W. MELTON and EDWIN MARTIN, Eds. Winston, Washington, D.C., 1972 (distributor, Wiley, New York). xvi, 448 pp., illus. \$12.95. Experimental Psychology Series.

Coding is a nebulous term that has been used to describe virtually every phenomenon of human memory, and a superficial perusal of the chapters in Melton and Martin's book leads to an impression of immense heterogeneity. In fact, however, the contributions to this volume have a surprising degree of coherence. To see that this is so, one needs to consider a number of recent tendencies in research on memory.

The two theoretical trends of relevance to coding processes are the examination of "control processes" and the gradual tracing of the large number of informational dimensions that the memorial system automatically abstracts from environmental input. When stimulation is first presented to the senses, it is automatically acted upon by the system in a series of stages. At each stage, features are abstracted and used for subsequent stages of abstraction. Thus a word presented visually may be encoded in features first representing areas of dark and light, then lines, angles, spaces, and so on, then letters, then letter groups, then words, then types of words coded linguistically and semantically, then synonyms and associates, then the overall context or situation in which the word appears. All or most of this process of abstraction occurs automatically in accord with the current structure of the processing system. The features that are abstracted are placed in the short-term memory store, where they may be used by the subject in accord with the task requirements. It is at this point that the subject exerts selective control over the coding process. He may selectively rehearse various aspects of the encoded information and retrieve additional information from long-term memory to add to the

features already abstracted. Eventually some portion of this information in short-term memory is transferred to, and stored in, long-term memory, and the coding process is complete.

As described in this outline, there are two relatively independent components to coding: the automatic sensory abstraction system, which provides features to short-term memory, and the control processes which the subject uses to embellish, select, and alter these features in short-term memory. The chapters in the present volume can be readily sorted into those dealing with one or the other of these views of "coding." For example, Posner and Warren emphasize the automatic coding in the early stages of processing; Bower discusses the effects of uncontrolled shifts in codes for context; Wickens emphasizes the numerous dimensions of sensory encoding; Liberman, Mattingly, and Turvey discuss the encoding and decoding of speech stimuli; and Garner and Attneave discuss dimensions and dimensionality of encoding. In these cases, the emphasis is on the early automatic phases of coding. These chapters help establish the automaticity of these stages, and to an even greater degree establish the wide range of dimensions along which stimulation is encoded. The traditional view in which a memory trace consists of an associative bond between two words, and nothing more, is clearly a relic of the past. Rather we are turning to a view of a memory trace as a whole context, or a scenario, or a complex organization. The implications of this view are just beginning to be explored.

Examples of chapters dealing with control of coding are Underwood's chapter, arguing (strangely) against multiple encoding dimensions, Richardson's and Martin's chapters emphasizing stimulus feature selection, Johnson's chapter on organization, Bjork's study of causes of directed forgetting, and Hunt and Love's discussion of a memory "expert." Although much evidence exists that coding control can have immense effects on learning (as seen for example in numerous paper-

backs giving techniques to "improve" your memory), and although we are beginning to learn what kinds of coding control are possible, we still have only very simplistic theories concerning the mechanisms by which these control processes produce their effects. Indeed many authors in this volume take pains to point out that their views are only first steps toward an eventual theory of coding.

A number of the chapters are summaries of previous work and representations of previous theories, but there are also some interesting new, creative views. Perhaps the most innovative and detailed view is offered by Estes, who suggests that order information forms the basis for retention in short-term memory, and that loss of item information is a causative effect of the loss of order information. There are also some theoretical disagreements, emphasized by the chapter arrangements. For example, Underwood's chapter minimizing the number of codes processed precedes Posner and Warren's chapter taking the opposite point of view; Martin's chapter emphasizing stimulus selection precedes Bower's chapter explaining the same effects by a theory of automatic context variability.

This book is clearly aimed toward researchers in the fields of memory, learning, and information processing. It cannot be recommended for casual reading for nonspecialists. The book contains much new and speculative material and so will be superseded in a few years as the research ideas are expanded and the theories elaborated. Nevertheless the contents represent an important period of transition in memory research. The contributions are generally of high quality, and the book is an important and necessary acquisition for workers in the field.

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Cyclicity in Man

Biological Rhythms and Human Performance. W. P. COLQUHOUN, Ed. Academic Press, New York, 1971. x, 284 pp., illus. \$14.50.

Perhaps the most obvious statement we can make about life is that it is cyclical. Being born, living, and dying are phases of an ultimate long-term life cycle that is broken up into shorter daily cycles of working, eating, and

sleeping. Throughout most of their lives women experience another well-known long-term periodicity, the menstrual cycle.

It does not require much scientific acumen to discover that our feelings and our performance vary throughout a normal day, and most of us have ideas and hypotheses about such changes, characterizing ourselves and others by such statements as "I'm an early riser" or "He works best late at night." Aside from such obvious rhythms, our lives are characterized by lesser-known ones, for example, alpha rhythms with a frequency of about 10 hertz and daily variations in body temperature, heart rate, and mental alertness.

This book is concerned with many of these tides of life, a subject that should appeal to a wide spectrum of scientists.

Colquhoun has tried to get a small group of experts to describe what is currently known about specific classes of biological rhythms and human performance. One particular emphasis in the book is on measures of actual performance rather than on feelings and moods, not because variations in the latter are any less apparent or impressive, but rather because they are more difficult to quantify and to measure. Another major emphasis of the book is on *human* performance, an emphasis that has both good and bad points.

The book contains seven chapters. The first, by Keith Oatley and B. C. Goodwin, is on "The explanation and investigation of biological rhythms." The other chapters are "Circadian variations in mental efficiency" by W. P. Colquhoun, "Temperament and time of day" by M. J. F. Blake, "Sleep behavior as a biorhythm" by Wilse B. Webb, "A periodic basis for perception and action" by A. J. Sanford, "Menstrual cycles" by June A. Redgrove, and "Industrial work rhythms" by K. F. H. Murrell. Each chapter has an extensive bibliography with, unfortunately, titles of journal articles not given.

As so often happens with collections of articles, there is in this one an unfortunate lack of continuity between the articles, and together they do not entirely cover the field. The lack of continuity is especially noticeable with regard to the first chapter, which describes several very sophisticated statistical techniques for measuring and quantifying biorhythms. None of these

techniques is used anywhere in the rest of the book. For all that, each chapter is a thorough, up-to-date review of its particular subject. The overall impression left by the book, however, is that despite a voluminous literature we can still say very little with much assurance about biological rhythms and human performance.

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Tumor Cytogenetics

The Role of Chromosomes in Cancer Biology. PEO C. KOLLER. Springer-Verlag, New York, 1972. xii, 124 pp., illus. \$15.30. Recent Results in Cancer Research, 38.

In this rather compact book the author traces succinctly the history of research pertaining to the role of chromosomes in cancer biology and presents cogent recent findings from karyotypic studies, of both induced and spontaneous tumors in animals and cancers in the human, as they bear on the development of tumors and, particularly, on the behavior of cancer cells once a tumor becomes established. The remarkable variability of the cytogenetic findings in cancers, particularly human, both primary and metastatic, is comprehensively covered and illustrated.

The general theme of these discussions is the author's belief (shared by the reviewer) that the visibly recognizable chromosomal changes in human cancer (and leukemia) are secondary phenomena to the neoplastic state and are not the direct cause of the cancer (or leukemia). This theme is developed logically and substantiated with an ample number of studies from the literature and the author's laboratory as well. The role of congenital or hereditary cytogenetic aberrations in cancer causation, Boveri's theory of the role of chromosomes in cancer, the stemline concept of cancer genesis and the clonal evolution of chromosomal aberrations, and the karyotypic findings in so-called precancerous lesions receive special emphasis.

In each chapter appropriate and informative tables and figures are included; the lack of a picture of a metaphase with the Ph¹-chromosome (Philadelphia chromosome) is regrettable, since this chromosomal anomaly is the only consistent and characteristic one established to date for any mam-

malian malignancy, in this case chronic myelocytic leukemia in human subjects. The chapter dealing with chromosomes and the treatment of cancer is not quite on a par with the others. Not much space is devoted in the book to human acute leukemia, a condition of especial interest because it tends to be as often aneuploid as diploid. A short chapter on cytogenetic methodologies in cancer and leukemia and on recently described techniques for fluorescent staining and banding patterns of chromosomes would have been welcome. These last few statements should not be taken to indicate, however, that the book, though consisting only of 124 pages, is not packed with important information on chromosomes and cancer. It includes an impressive list of selected references, by an author who has devoted much of his scientific work to the unraveling of the riddle of chromosomes and cancer.

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Epidemiological Problems

Geochemical Environment in Relation to Health and Disease. Papers from a conference, Oct. 1971. HOWARD C. HOPPS and HELEN L. CANNON, Eds. New York Academy of Sciences, New York, 1972. 352 pp., illus. Paper, \$25. *Annals of the New York Academy of Sciences*, vol. 199.

This book covers the analysis and distribution of trace elements in the geochemical environment, known relationships of health to the geochemical environment, and the methodology and problems of determining causal relations between disease and the geochemical environment.

The first half of the book is devoted to an overview of the analysis and distribution of trace elements in the natural environment and presents trace element data for rocks, soils, waters, and plants. Various factors that influence the availability of trace elements to the successive members of the rock-soil-water-plant-animal cycle, such as solubility, adsorption phenomena, soil-plant interaction, competition among mineral elements relating to adsorption by animals, and aspects of diet are discussed. Diseases or conditions associated with regional or local trace element anomalies are brought in at various points. Problems encountered in the sampling of rocks, soils, waters, and