whereas others think that a mask interrupts the processing of a target by means of inhibition.

As researchers have attempted to resolve these and other issues, masking has become one of visual science's most widely studied subjects. At the same time, it has been one of perceptual psychology's standard tools for investigating visual phenomena ranging from rod-cone interactions to subliminal perception. In view of the extensive research on masking, the time was ripe for the appearance of a book on the subject. It is gratifying that such a book has now been authored by Bruno Breitmeyer. During the last decade Breitmeyer has made many experimental contributions on this subject, and his 1976 theoretical paper with Leo Ganz is the most ambitious attempt to date at a comprehensive model of visual masking.

In his opening chapter Breitmeyer does a marvelous job of placing the study of visual masking in a historical context. He has unearthed quotations from published papers that show that most of the salient features of masking were recognized by the latter half of the 19th century. We discover, for instance, that Sherrington appreciated the distinction between forward and backward masking, and we also learn that the seeds for the two major categories of contemporary masking theories (integration and interruption theories) were planted by Stigler around the turn of the century. The next several chapters review the voluminous literature on masking, with particular emphasis on metacontrast masking (backward masking in which a target and a mask do not overlap spatially). In these chapters Breitmeyer introduces two major themes that run throughout the rest of the book: that temporal transients play a crucial role in masking and that masking results from interactions at multiple levels of stimulus processing. Next comes a chapter that critically reviews contemporary theories of masking. The chapter is intended to set the stage for Breitmeyer's own theory, and as a result some other theories are covered perfunctorily or not at all.

Breitmeyer's theory of visual masking, which is the focus of the rest of the book, is an unabashedly neuropsychological one. Expanding on the model presented in his 1976 paper, Breitmeyer voring some form of it. Breitmeyer, however, endorses a rather extreme, and therefore controversial, version of the distinction. For one thing, he equates sustained and transient channels with X and Y cells. This is a mistake, for both cell types can exhibit either sustained or transient responses, depending on stimulus factors. The mistake is compounded when Breitmeyer overemphasizes the differences between the receptive-field properties of X and Y cells. He erroneously concludes, for instance, that transient (Y) cells behave like low-pass spatial filters whereas sustained (X) cells resemble band-pass spatial filters. In fact, both cell types typically exhibit band-pass selectivity. Breitmeyer also concludes that transient cells respond faster than do sustained cells, when in fact there is solid evidence to the contrary.

Breitmeyer could avoid these difficulties by abandoning the physiological underpinnings of sustained and transient channels and relying entirely on psychophysics. Even neurophysiologists acknowledge that the story of the X and Y cells remains too muddled to be useful dation, Breitmeyer's theory would bother those who demand logically tight, neuroreductionistic reasoning. From the outset Breitmeyer candidly admits that his theory is built on "fuzzy" categories, as he calls them, and he argues that the fuzziness is a necessary consequence of his integrative approach. Breitmeyer's approach *is* bold; it offers an account of perceptual and neural findings in which coherence is provided by functional parallels between these two classes of phenomena. Moreover, in the last few chapters Breitmeyer tackles the issue of ecological significance by arguing that visual masking plays important roles in normal visual behavior, including the elimination of "double-exposures" from different, successively fixated scenes.

Whether Breitmeyer's integrative approach is successful remains debatable, but it is surely interesting and significant. Breitmeyer has given us a well-written, provocative book that is the definitive source on visual masking.

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Issues of Gene Regulation

DNA Methylation. Biochemistry and Biological Significance. AHARON RAZIN, HOWARD CEDAR, and ARTHUR D. RIGGS, Eds. Springer-Verlag, New York, 1984. xiv, 392 pp., illus. $59.50. Springer Series in Molecular Biology.

The level of interest and research activity focused on the biochemical mechanisms and biological functions of DNA methylation has grown exponentially in recent years, as is evidenced by a cursory review of the number of scientific journal articles addressing this subject. Despite the intense study there remain many unanswered questions, and any discussion of DNA methylation is likely to evoke strong opinions from serious followers of the subject. Given this state of affairs it seems a propitious time to summarize the existing experimental data about DNA methylation in a manner more comprehensive than would be possible in a single journal review article. To provide such a summary is the expressed intention of the editors of *DNA Methylation*. They have set out to provide an in-depth introduction for students, as well as a reference guide for investigators working in the field. The book contains 16 chapters, beginning with a general introduction and continuing with a series of mini-reviews, each of which is focused on a particular aspect of DNA methylation. The result shows that a well-written and well-organized collection of contributions by different authors can provide an authoritative, readable,

and balanced treatment of a complex topic.

The six chapters that follow the introductory chapter deal largely with the occurrence and function of DNA methylation in prokaryotic organisms. This is an appropriate point of departure, for it is in prokaryotes, specifically in the bacterial restriction-modification enzyme systems, that the evidence for an important biological regulatory role for postsynthetic methylation of DNA is unequivocal. The authors of these chapters do an excellent job of succinctly summarizing the current ideas concerning the mechanisms and interactions of bacterial methylases and restriction enzymes. At the same time, enough selected experimental design is discussed to stimulate students to adopt a critical approach to the existing data. Chapters on the possible role of methylation in DNA replication and repair and on the establishment and maintenance of methylation patterns form a natural transition between chapters describing the established function of methylation in prokaryotic restriction-modification systems and those describing less clear-cut functions in both prokaryotes and eukaryotes.

The remaining chapters, which constitute the bulk of the volume, examine the major recent experimental evidence linking DNA methylation in eukaryotes to regulation of gene expression via effects on transcription, X-chromosome inactivation, cellular differentiation programs, and chromatin structure. Emphasis on these issues is quite appropriate since they are arguably the most exciting aspects of the subject and are currently the most intensively studied aspects of DNA methylation. The studies described involve three major lines of investigation: those concerned with the temporal and tissue-specific inverse relationship between methylation at specific 5′-methylated CpG sites in DNA and the expression of a wide variety of genes in vivo; those concerned with the effect of in-vitro methylation or the lack of methylation of cloned gene sequences upon the expression of those genes in cultured cells and organisms; and those concerned with the positive effects that agents that perturb DNA methylation (chiefly 5-azacytidine) have upon specific gene expression, X-chromosome activation, and overall cell differentiation. Each of these lines of investigation is presented by a leading experimentalist who has made major contributions concerning a particular aspect of the subject. Though the use of such authors predictably results in a strong bias in favor of the biological importance of DNA methylation, it also insures a thorough and historically correct discussion of the specific experiments that have contributed to our current understanding of the subject.

In fact, most of the authors present both positive and negative data concerning the regulatory role of DNA methylation in eukaryotes. For example, in a chapter entitled "DNA methylation and gene expression," Cedar concludes in effect that the balance of experimental evidence suggests that DNA methylation alone is probably neither the primary force in controlling gene regulation and differentiation nor a mere passive feature of most inactive genes or inactive X-chromosomes. It seems more likely that methylation constitutes one of perhaps several signals involved in such regulatory processes. Furthermore, it is pointed out elsewhere in the book that the absence of detectable cytosine methylation in arthropods argues strongly against a universal regulatory role for DNA methylation in eukaryotes. The viewpoint that higher eukaryotic gene regulation may involve multiple, perhaps even independent, factors may be offensive to the reductionist. However, the rapidly rising number of *cis*-acting DNA sequence elements and *trans*-acting (presumably nuclear protein) factors that have been associated with tissue-specific eukaryotic gene regulation and chromatin structure certainly lend support to this increasingly accepted view.

In a volume that is intended to summarize and organize a large quantity of experimental data in a rapidly progressing area of investigation the subject should not be presented dogmatically or in a way that leaves the reader stranded in a sea of disjointed data. In addition the data presented should be as current as is feasible in a bound volume. By these measures, this treatise is a definite success. It reflects the overriding evidence that DNA methylation is neither a trivial epiphenomenon nor a completely understood regulatory signal in higher eukaryotes. The only possible criticism of the book might be that the chapters dealing with methylation as it relates to gene expression overlap. However, this is not a serious flaw since each chapter can be used alone as a resource for investigators and the overlap should highlight the most important concepts for beginning students.

In summary, the book provides solid background on and a thought-provoking stimulus for future experiments aimed at defining the precise biological role (or roles) of DNA methylation. It fills an important need in every molecular biology resource library, and it would be a valuable addition to the personal libraries of investigators in this or related fields.

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Phosphoproteins

Protein Phosphorylation in the Nervous System. ERIC J. NESTLER and PAUL GREENGARD. Wiley, New York, 1984. xiv, 398 pp., illus. $59.50. Neurosciences Institute Publications Series.

Since the pioneering work of Sutherland and of Krebs in the 1950's and 1960's, the role of protein phosphorylation as a key regulatory process in biological systems has become increasingly evident. It is now clear that many hormones and neurotransmitters produce some of their effects on their target tissues through systems that reversibly phosphorylate effector proteins in the target.

In *Protein Phosphorylation in the Nervous System*, Eric Nestler and Paul Greengard redevelop the ideas that Greengard's laboratory has advanced both conceptually and experimentally for over ten years. The book aims to substantiate the view that protein phosphorylation is one of the major mechanisms underlying signaling in the nervous system and that the study of neural phosphoproteins, in addition to providing insights into cellular regulation, can also provide insights into a wide variety of neuronal processes.

The authors begin with a clear statement of goals and then launch into a discussion of various components of major protein kinase systems. Their review is not limited to the nervous system, since a great deal of what is known about protein kinases and protein phosphatases was learned from work on nonnervous tissues. The largest section of the book deals with phosphorylated substrate proteins specific to the nervous system. One chapter catalogues many of the substrates that have been studied biochemically and another examines electrophysiological support for the idea that ion channels are regulated by phosphorylation. The discussion not only illustrates how the study of protein phosphorylation can encompass a wealth of approaches but also highlights the gaps in our understanding: overall, very little is known about the functions of sub-