and it is a valuable collection of information for the microbial physiologist.

The next chapter presents material on the isolation and recognition of bacterial mutants and discusses the types of lesions in DNA that occur in mutants. Finally, it presents the mechanisms of genetic exchange in *E. coli*. This chapter does not cover these topics to exhaustion but does provide sufficient background for the student to appreciate chapter 7, which discusses the lactose, arabinose, and tryptophan operons, as well as the molecular genetics of control of gene expression for ribosomal proteins.

Two chapters are concerned with growth rate. The first considers primarily the kinetics of bacterial growth. In general, it is a very good discussion of the important concepts in this subject. However, the authors may have added confusion to a point that is already befuddling to students. Two growth rate parameters, μ and k, are used by microbial physiologists. They differ in the base of the logarithm used to define them mathematically. The authors define these parameters using a convention opposite to that used by most other microbiology textbooks, although they consistently and correctly use the appropriate parameter given their definitions.

The last chaper, "Regulation at the whole cell level," discusses results from experiments employing shifts between growth conditions and the role of guanosine tetraphosphate in regulation. Much of this material concerns the research of Maaløe and Neidhardt. Perhaps as a result the treatment is of the sort I would expect to see in a monograph rather than in a textbook. There are four informative and useful appendixes, which include a genetic catalog of *E. coli* and a short discussion of methods used for genetic mapping.

Several features make the book useful to students. Each chapter has a summary of important concepts. Each chapter also has a short list of references, including primary sources as well as reviews. The references include some of the most significant papers on the physiology of *E. coli* from the previous two decades. Finally, some chapters have problems for students to solve.

This book is no replacement for a textbook on microbial biochemistry or genetics and does not pretend to be. However, it does an exceptional job in covering a specific topic, the physiology of growth. In addition to its use as a textbook, it should be read by all microbial physiologists, because it provides marvelous insight into the way a microorganism must coordinate its metabolism. It is also a valuable reference volume that documents the energetic costs that *E. coli* must pay to procreate.

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Neural Circuitry

Chemical Neuroanatomy. P. C. EMSON, Ed. Raven, New York, 1983. xiv, 560 pp., illus. $75.

It has been known for many years that the integrative functions of the nervous system are subserved by circuits that rely on the transmission of electrical impulses along axons and on the release of neurotransmitters at synapses. The work of pioneers like Ramón y Cajal at the turn of the century outlined the basic architecture of this circuitry and demonstrated that it is made up of literally thousands of distinct cell types that are connected in a very precise way. The identification of neurotransmitters in specific cell types progressed much more slowly, so that by 1960 it was only known with certainty that acetylcholine and norepinephrine were utilized by neurons in certain parts of the peripheral nervous system.

The situation changed dramatically in 1962 with the introduction by Carlsson, Falck, and Hillarp of a histofluorescence method for the cellular localization of norepinephrine, dopamine, and serotonin in the brain. This method indicated which cells and fibers in the brain may contain these biogenic amines, and, particularly in the hands of Foxe and Dahlstrom, it also revealed the existence of three major previously unknown neural systems. These systems revolutionized thinking in neuroanatomy because they were unlike any others known since the time of Cajal: small groups of neurons in the brainstem appeared to innervate most parts of the central nervous system in what seemed at least initially to be a rather nonspecific way.

The power of the method was that it provided a bridge between anatomy, biochemistry, and pharmacology, and its most visible success was the identification of dopamine cell death in Parkinson's disease, which resulted in treatment of the disease with L-dopa. About ten years later, in the early 1970's, the scope of this approach was greatly expanded when Hartman and Barry applied immunohistochemical methods to the cellular localization of a wide range of antigens associated with neurotransmitters. In the last few years literally dozens of possible neurotransmitters have been identified chemically. In addition to acetylcholine and the biogenic amines, certain amino acids, and a whole host of peptides, are now thought to act as neurotransmitters (or at least as neuromodulators) in the nervous system. Presumably, each of these molecules interacts with receptors at the synapse, and a variety of histological methods are also available to localize their distribution in tissue sections.

The book edited by Emson is a timely review of what is currently known about the cellular distribution of putative neurotransmitters and their receptors in the mammalian nervous system. The vast literature on the topic is rather thoroughly covered in 13 review chapters. The material in the book is arranged along topographical lines so that each chapter deals with a major subdivision of the nervous system, such as the peripheral system, the spinal cord, the thalamus, and the retina. And since each chapter systematically reviews what is known about the cellular localization of putative neurotransmitters, workers in all branches of neuroscience will find the book an invaluable and convenient guide to a vast literature.

The book is particularly interesting because it appears at a time when chemical neuroanatomy is moving from one era to another, more mature era. The first, which is summarized here, involved the development of radically new techniques and at least conceptually was based largely on the descriptive neuroanatomical approach of the 19th century. Thus, a great deal of the work focused on determining which cell types and fiber systems contain a particular neuroactive substance. The second era, which has slowly gained momentum, involves the experimental dissection of biochemically specific pathways and the elucidation of their precise role in the functional systems that have been established with more traditional anatomical, electrophysiological, and behavioral approaches. The beauty and specificity of immunohistochemical staining have tended to seduce workers into focusing on small groups of neurons without considering their relationship to classical neuroanatomical circuitry. There are at least two reasons for this. First, a great many peptides have been localized preferentially in parts of the brain that are the

least understood, such as the limbic region, the hypothalamus, and the central gray matter. And second, there are still formidable technical barriers to establishing synaptic relationships between two biochemically specific cell types. This book clearly illustrates the power of modern neuroanatomical techniques. At the same time it reinforces Cajal's observation more than 50 years ago that understanding the architecture of the nervous system is a work not of years but of centuries.

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France in the Stone Age

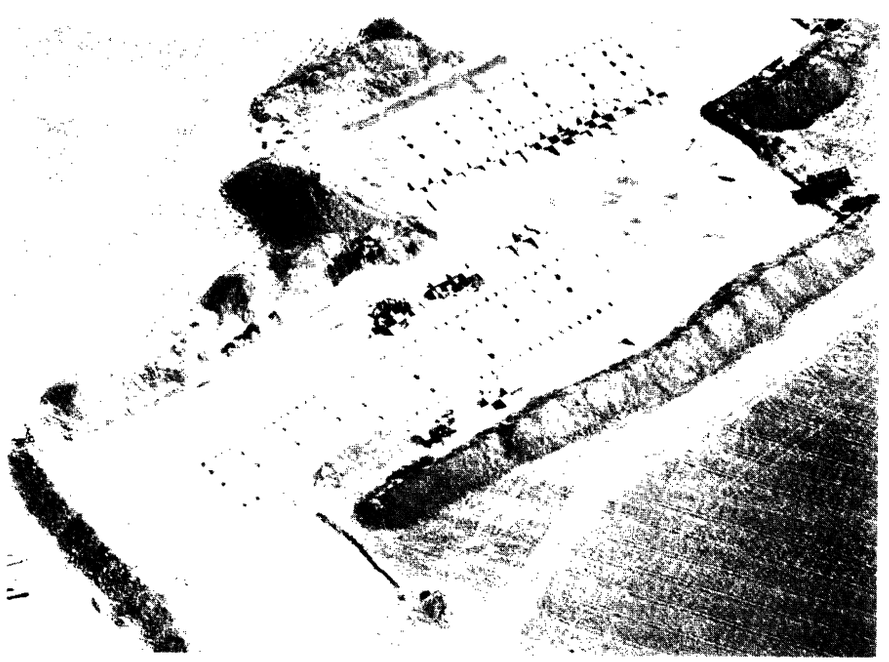
Ancient France. Neolithic Societies and Their Landscapes, 6000–2000 B.C. CHRISTOPHER SCARRE, Ed. Edinburgh University Press, Edinburgh, 1984 (U.S. distributor, Columbia University Press, New York). viii, 390 pp., illus. $35.

The earliest food-producing societies of France have never received the attention they deserve from European prehistorians. There are several reasons for this. Neolithic habitation sites are by and large open-air stations rather than caves or extant buildings, and thus stratigraphic interpretation is much more difficult. The pottery found on many Neolithic sites is not the spectacular painted wares or *terra sigillata* of later antiquity but often is plainly decorated if ornamented at all. There has been an understandable tendency to gravitate toward mortuary sites, especially the megalithic tombs of the Atlantic seaboard, rather than to systematically investigate the rubbish pits of Neolithic settlements. What little was known about the French Neolithic until about 10 years ago largely concerned the burial rite and funerary architecture of what might have been a fairly limited segment of Neolithic society.

Ancient France, edited by Christopher Scarre, makes a major effort toward filling the resulting gap. This volume is a collection of nine essays by young British archeologists who have been engaged in joint research with French scholars. The tradition of British involvement in French Neolithic archeology goes back over 50 years, first taking the form of a search for comparative material to enable better understanding of the British Neolithic, then of active collaboration with French research teams. The interpretative framework used by the contributors to *Ancient France* follows current trends in British (and, to a lesser degree, American) archeology, with a focus on understanding the social and economic factors underlying the archeological records. The contributors are the students of British archeologists who came into prominence during the late 1960's and early 1970's, but there is an important difference between these contributions and those of a decade ago. One now finds an emerging realization that theory is of little use without a firm data base to which it can be related, and the contributors to *Ancient France* have recognized the value of discussing the range of variation in artifacts and settlement configurations before trying to explain their implications.

The contributions to *Ancient France* take two different approaches to their coverage of the French Neolithic. The first three chapters treat the Early, Middle, and Late Neolithic of northeastern France, the region north and east of the Seine. Five of the remaining essays deal with more limited areas but cover the whole span of the Neolithic from the first appearance of food production to the transition to the Bronze Age. The concluding essay by Scarre presents a synthesis of broad trends in the French Neolithic.

Ilett's paper describes the earliest food-producing communities of northeastern France, which represent the westernmost expansion of the central European Linear Pottery and Rössen cultures. The most interesting aspect of these communities is their distribution at the microregional level. In an 80-kilometer stretch of the Aisne valley, for example, nine Linear Pottery settlements have been found, spaced an average of seven kilometers apart. Such a low density of settlement contrasts with the tightly clustered patterns observed for this culture in other parts of central Europe. Ilett briefly mentions the occurrence at these sites of the so-called "Limburg pottery," which differs from "typical" Linear Pottery ceramics in its bone temper, grooved decoration, and thickened rims. In the short time since the writing of Ilett's chapter, it has become apparent that "Limburg pottery"



"Aerial view of two longhouses on the western edge of the Bandkeramik settlement at Cuiry-lès-Chaudardes (1976 excavations). The house on the lower left is 39 m long; its groundplan is partially disturbed by First World War trenches. The other house is 28 m long. Lateral construction pits are being investigated in metre squares." (From M. Ilett's paper in *Ancient France*; photo, Michel Boureux]