Book Reviews

An Inquiry into Man's Faculty for Language

Biological Foundations of Language. ERIC H. LENNEBERG. Wiley, New York, 1967. 507 pp., illus. $14.95.

Some years ago, *The New Yorker* had a cartoon of a prize-fighter looking hesitantly across the ring at a gorilla-like opponent, with the caption "I won't fight until I hear him talk." Is natural language a species-specific process based on brain functions that are strictly human and not shared by other animals? How does man's language differ from the communication patterns of other species? Does the human brain differ from that of other animals only in its capacity to perform more elaborate symbolic operations, or does human language depend on cerebral mechanisms that are unique? What are the respective roles of innate and socially acquired factors in the development of language? Is language a discrete skill that can be separated from other aspects of intelligence?

These questions are considered by Lenneberg in a remarkably comprehensive compilation of evidence from the fields of anatomy, physiology, genetics, embryology, neurology, and linguistics. The opening chapters take up the biological principles of plasticity, maturation, and differentiation and deal with species-specific relationships of form and function. Function cannot always be predicted from knowledge of form, and there are biological limitations to behavioral repertoires. Man's development of language cannot be explained by the anatomy and physiology of his vocal apparatus—although the acoustics and production of sounds are so shaped—or even by the size of his brain. Lenneberg effectively refutes the claim that speech cannot be a biological function because there are no specialized speech organs. The synkineses involved in vocalization are quite similar to those used in respiration, swallowing, and grimacing, though a degree of temporal integration is necessary for speech.

Lenneberg develops Karl Lashley's idea of a serial ordering mechanism that maintains the rhythm of speech and the integrated activity of its components. The principle, contradicting associative chain theories according to which each action serves as a stimulus for the next, is illustrated both in the control of the trotting of a gaited horse and in the designing of a house by an architect. Serial ordering involves an overall plan or schema in which elements take on form and meaning by reason of their place in patterns of relationships and sequences. While man shares with other animals capacities for categorization and generalization, Lenneberg believes that there is a uniquely human form of conceptualization which provides the propensity for phonemic, syntactic, and semantic structuring which forms the basis of all natural languages.

Man is the only animal whose brain exhibits lateralized cerebral dominance. The dominant hemisphere (usually the left) plays the more important obvious role in language. Yet a lesion in the so-called language areas of the brain does not result in a loss of language per se. Rather, a basic organization is preserved. The patient, generally, can use words, but not in their proper sequences and contexts. As R. Cohn and other aphasiologists have shown, the patient retains a class function in which the erroneous name given to an object will resemble the correct name, phonetically or semantically. While the patient has difficulty in establishing the boundaries of phonetic and semantic categories, the principle of categorization remains. It is well known that while the ability to read and write and perform other symbolic functions is affected, there is usually much less involvement of what is regarded as intelligence. Such observations provide strong evidence for the existence of a basic, biologically organized patterning mechanism.

The account of aphasia in children is highly relevant to the subject of the acquisition and the neural substrate of language. Damage to the dominant hemisphere in children under the age of puberty does not, as it so commonly does in adults, result in permanent aphasis. It is presumed that in childhood cerebral lateralization has not been accomplished and the right hemisphere is still involved in language learning. In considering further the idea of "critical periods" for language acquisition, Lenneberg reviews neuroanatomical, neurochemical, and electrophysiological data. He writes that by the time language appears the brain has reached 60 percent of the values of maturity, and that thereafter maturation slows down and reaches an asymptote at about the time that trauma to the left hemisphere begins to have permanent consequences.

While language obviously cannot be acquired in the absence of a speaking person, Lenneberg believes that social contacts serve only as the releaser or resonator of innately developing mechanisms. In support of this view, he cites the regularly successive stages that young children go through regardless of outside circumstances. Crying in infants is followed by cooing and then babbling, which is regarded as the first true language because phoneme units can be distinguished in its intonational pattern. Single words are uttered between the ages of 12 and 18 months, followed by two-word combinations which are not random compositions but constitute a primitive subject-predicate organization. They are not imitations of adult speech but indicate that certain rules of grammar have been acquired. In brain-injured, deaf, and otherwise handicapped children the rate of language learning is slowed down and the process stretched out, but the same order obtains.

The book has a polemical undercurrent with respect to the views of behaviorists. Lenneberg and Noam Chomsky (who provides an appendix) reject the ideas that language can be regarded as "verbal behavior" and that learning language is like acquiring any behavioral skill through selective reinforcement. A speaker does not have a "verbal repertoire" but rather the acquisition of language provides for infinite expansions of the rules out of which innumerable novel sound sequences can occur. These contrasting approaches have their pedagogical implications. Lenneberg maintains that programming techniques cannot be expected to hasten the biologically limited rate of development. He feels that a poor language environment does not handicap a child permanently and that

if the social environment is enriched at an early enough chronological age, the appropriate age can be speedily achieved. Inasmuch as language profoundly shapes the child's perception of his environment and influences his self-regulatory activities, the issue is an important one.

In a work of this scope, it is inevitable that specialists will find some shortcomings and oversimplifications. The non-aphasic changes in language occurring after brain injury could have been more adequately handled. The data on the electrophysiological correlates of development date from the '30's and '40's and are not precise enough to be used in the fashion in which Lenneberg employs them. The consideration of the differences between the speech of lower-class and that of middle-class children only touches on an important subject which is germane to relationships of biological and social factors. On the whole, the book is excellent. It is well written and organized, and the appendices by Chomsky on generative grammar and Marx on historical aspects are useful. It should be read by anyone interested in language and child development.

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Phosphorus and Its Compounds

Topics in Phosphorus Chemistry. Vol. 4. MARTIN GRAYSON and EDWARD J. GRIFFITH, Eds. Interscience (Wiley), New York, 1967. 537 pp., illus. $25.

The fourth volume of this infant series is a lusty one both as to size and price. Returning to a format similar to that of the first volume, the present one contains six sections.

"The structures and reactions of cyclopolyphosphines," by A. H. Cowley and R. P. Pinnell, covers the chemistry of compounds containing a cycle of phosphorus atoms. These compounds, discovered in the 19th century by Michaelis, remained *in obscura* for nearly a century and are now undergoing a revival owing to the clear need for better understanding of the chemistry of phosphorus as the element, a form in which these cyclic structures exist naturally. The chapter describes the appropriate chemistry but does not go into the more imaginative and spectacular transition states postulated by some for the various reactions. The authors' restraint in this matter is only to be applauded, in my opinion. "The natural occurrence of compounds with the carbon-phosphorus bond," by L. D. Quin, gives a surprisingly extensive literature coverage and discussion of 2-aminoethylphosphonic acid and related substances that occur in some living organisms. While these compounds are "freaks" and are components of not more than a handful of biological forms, their very existence in natural state of life is one of the most challenging and curious aspects of biochemistry of phosphorus; it surely gives a further support to the idea of chemical individuality of living species. In "Photochemical and radiation-induced reactions of phosphorus compounds," M. Halmann discusses at length the radiation-induced chemistry of various compounds of phosphorus. It is significant that most of the 100-odd references deal with information less than ten years old. The summary of mass-spectrometric study of phosphorus compounds should be of general interest to chemists working with phosphorus compounds. The title of D. S. Payne's paper, "The chemistry of phosphorus halides," is a misnomer by the author's own admission; it omits the fluorides of phosphorus, which are probably the most numerous halides of the lot. It attempts to give an encyclopedic coverage of synthesis and reactions of the halides of phosphorus with various states of oxidation of the latter. Inorganic chemistry is clearly more detailed than is organic chemistry in this chapter. Organic chemists are likely to be disappointed by the dismissal of points of interest to them.

"Progress in the chemistry of fertilizer and soil phosphorus," by G. E. G. Mattingly and O. Talibudeen, is a chapter of a type that is new to this series and one that should be welcomed. It makes up a large part of the book, describing in some detail the recent progress in the manufacture and the chemistry of phosphorus fertilizers, and outlining the progress made in recent years in the area of soil chemistry of phosphorus. While much of this material is descriptive in nature, and unavoidably so, one cannot forget that it is the manufacturing profit in making just such chemicals that has made possible much of the exploration of the exotic and sophisticated chemistry of phosphorus that occupied many pages in chemical journals in recent years. Lest this chapter be scorned by some in our profession, I wish to point out that a better understanding of utilization of the chemistry discussed in this chapter can well lead to an alteration in the nutritional balance in much of this world of ours; surely that is not a goal to be despised.

"Phosphorus-nitrogen chemistry," by E. Fluck, deals with the bulky topic of nitrogen-bound phosphorus compounds, linear and cyclic in structure, organic and inorganic in composition. The longest chapter in the book, it is not very well digested, and one must struggle line by line through the English-German language in which it is composed. The use of Arabic numerals for tagging the formulas is an inconvenience to the reader, for the numerals bear too much similarity to those denoting equations and literature references.

The book is well recommended to phosphorus chemists. I am sure that the various research grants that support the bulk of research in this branch of chemistry can be made to accommodate its price.

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Men at Work

Scientists in Organizations. Productive Climates for Research and Development. DONALD C. PELZ and FRANK M. ANDREWS. Wiley, New York, 1966. 332 pp., illus. $10.

The authors have addressed this book to scientists, engineers, and research administrators; the presentation suggests, however, that it was written for social scientists, particularly for those who do not mind wading through thickets of correlation tables, intricate graphs, and sample questionnaires to harvest a scanty offering of theories and useful concepts. The study is a testament to what can be done with government funds, survey methodology, and a computer if one wants to collect and manipulate data that may be relevant to an interesting problem. Certainly a great deal of activity can be generated and much time can be spent in such an enterprise.