There is no doubt that the runoff from bare shale is extremely salt-laden. Ward found that the concentration of dissolved inorganic solids to be as high as 5000 mg/liter, about five times the salinity of the Colorado River in the region. Colony plans to install a catch basin at the toe of the shale embankment to keep the runoff from reaching Parachute Creek and thence the Colorado. To evaporate water fast enough so that it didn't overflow, such a basin would have to be quite large. Further increases in the salinity of the Colorado River might require considerable expenditures for desalinization downstream, where there is heavy demand for municipal and agricultural water.

Besides the potential for polluting the Colorado River, an oil shale industry could pollute the air with dust from mining, crushing, and disposal operations, and with sulfur dioxide emission from the retorting process. Some local impact on plants would occur, and there is considerable doubt whether shale operations could meet the recent court ruling that air quality not be degraded when it is purer than environmental standards.

Environmental degradation is certain to occur with a mature oil shale industry, and there is the potential for a very serious impact, according to Harry Johnson, although only local degradation will occur with the prototype program. All parties, including the environmental groups, agree that not enough is known from small test plots to assess the environmental damage to be expected on a larger scale, and the Department of the Interior intends to monitor the prototype program closely and use the information to decide about expanding the industry.

Since most of the rich oil shale is on federal lands, the industry cannot grow to 1 million barrels per day without additional public land leasing. Critics of the prototype leasing operation argue, however, that 5120-acre leases were certainly not needed to determine the environmental effects, that there are many loopholes in the stipulation that all affected lands should be rehabilitated, and that the enforcement provisions are inadequate.

Perhaps one of the most important concerns is that the shale industry will grow up, prove unsuccessful, and be abandoned, leaving the western slope of the Rockies in somewhat the same condition as Appalachia. There is no doubt that a 1 million-barrel-per-day oil shale industry would alter the character of the region. The industry would bring in 115,000 people, more than double the population that now lives in the counties where oil shale is found. Towns would have to expand their municipal services, mobile home settlements would be wheeled in, and many rural aspects of life in the region would disappear. If the industry failed, it could leave the region environmentally desolated and economically broke.

Although oil shale is a bounteous reserve compared to oil, it is clear that it cannot be extracted from the earth without paying a far greater environmental cost. Even so, the rate at which oil can be fired out of shale will be more dependent on the water reserves than on shale reserves. Even the estimated ceiling of 1 million barrels per day may be high, because much of the available water in the region has reportedly been cornered for surface coal mining. One would think that the major reason for urgently developing shale oil would be to utilize its portability as a liquid fuel. But, more likely than not, the first use of raw shale oil will be to burn it, in place of sulfureous coal, for generating electricity in the far Southwest.—WILLIAM D. METZ

Book Reviews

Beginning Grammar

A First Language. The Early Stages. ROGER BROWN. Harvard University Press, Cambridge, Mass., 1973. xx, 438 pp., illus. $15.

Blown by the winds of the changing *Zeitgeist*, the study of language development has shifted direction several times during the last 80-odd years. A promising start was made before World War I, but this, along with the mentalistic psychology it assumed, was displaced by the behaviorist revolutions in both psychology and linguistics. The early work was forgotten. In the middle 1950's, alongside a revival of interest in the higher mental processes, there was a resumption of communication between the disciplines, and psycholinguistics was first named and then came into being. The *Zeitgeist* change in psychology was followed—and massively fueled—by the paradigm change in linguistics to Chomsky's generative grammar. The formalisms of generative grammar provided a valuable tool of analysis for a number of longitudinal studies of early syntactic development, the first wave of which began in the late 1950's. Roger Brown is one of the pioneers of this work, and his book presents a scholarly and extraordinarily rich discussion of all the issues that have arisen.

The book is divided into a long introduction and two chapters, each itself the length of a small book. The first and longer chapter is devoted to stage I, which begins with the first appearance of word combinations and lasts for some months, during which the basic word order and main constituents of simple sentences are acquired. The other chapter provides a thoughtful discussion of original data on the next stage of development. Because the major problems that exercise the field concern stage I, my review will focus on the first chapter. In it Brown presents a detailed stocktaking of 15 years of work, drawing on observations of three children who were his own subjects and of other children described in the open literature and unpublished sources, including several children who were acquiring languages other than English.

The first wave of the research Brown describes was conditioned by the state of linguistics at the time, which placed the research focus on syntax, semantic structure being regarded as a murky subject that had better not influence a syntactic description. Children's utter-

ances were analyzed distributionally and discussion of their meanings was studiously avoided. First results appeared in 1963–64 and introduced two concepts. One was Brown's own, "telegraphic speech," referring to children's omission of small elements like prepositions and auxiliaries; Brown now dismisses this concept as accurate but uninteresting. The other was "pivot grammar," the idea that children's first productive phrase-making formulas joined a constant and a variable term (for example, *see x, more x, big x, x there*, the x-term being variable). The constants were called "pivots," and the variable terms came to be referred to as the "open" class. Pivot grammar enjoyed a vogue, and was reformulated by McNeill, who added a formula, "open-plus-open," which Brown appears to assign mistakenly to the original formulation, and which he properly argues is far too undifferentiated. Brown argues at length that pivot grammar was a blind alley. His critique of it has something of the shotgun: he does not separate some distributional problems in the original data, which are readily explicable by the semantics of the formulas, from the essential critical point that the children initially sampled were unrepresentative; many children later described, notably by Bloom and Bowerman, began with productive constructions that were not of the constant-plus-variable type. Pivot grammar appears to be one of a now fairly long list of "universals" that have been proved nonuniversal by the next few children studied.

In the mid-1960's the dominant linguistic theory became more comprehensive and found a place for semantic structure, which became the new research frontier. A second wave of research in language development began, and Lois Bloom introduced an innovation that Brown calls the "method of rich interpretation." This uses the apparent meaning of a child's utterances, and posits that the grammatical structure of an utterance is in some simple relation to the type of meaning it conveys. Brown examines the rationale of this approach exhaustively, and finds it well justified, although, like Bloom, he resists its extension to one-word utterances, for which proposition-like semantic structures are not yet well demonstrated.

Brown goes on to present what is probably the most significant empirical result established for stage I and one that concurs with the conclusions of other investigators: the types of meanings found in corpora comprise a relatively small set which is, moreover, universal, the same small set being found regardless of what language a child is acquiring. The meanings fall into two groups. One group comprises what Brown calls "operations of reference," that is, indications of the presence, recurrence, or nonexistence or disappearance of an item named (*here x, more x, x all gone*, and the like). He argues that the "pivot look" of many early corpora is due to the prevalence of these meanings (although it seems to me that constant-plus-variable constructions are not confined to these particular meanings). The other group of meanings comprises relations of a more predicational sort: agent-action, action-object, possessor-possessed, indication of the location of an action or thing, indication of a property of a thing. Brown emphasizes the correspondence of these meanings to the kinds of relations that Piaget has described as the terminal product of the sensorimotor intelligence of the first 18 months of life.

Despite the consensus on what children express, opinions differ on the precise nature of their rule systems that relate meaning to grammatical structure. In the orthodox theory of the adult language, a grammar generates sentences as strings of grammatical categories, which are understood to be interpreted by a semantic component. We also have Schlesinger's alternative proposal that the rules are a direct mapping of the relational meanings into overt sentences. And there is Fillmore's case grammar, which classifies the roles played by noun phrases into a small set (for example, agent, instrument, locative); deep structures consisting of a verb and a string of these "cases" are mapped into the surface structure by transformations. Brown analyzes in admirable detail the goodness of fit of each of these systems to the observational data. Each system has some difficulties, and the nature of the child's system is ultimately left unresolved. Brown's painstaking and thoughtful discussion is a major contribution, and anyone reading it will end up with a rather complete picture of where the study of the early combinational structure of language has now arrived.

A work so rich in detail is bound to provide things to quibble at. The thing that most persistently bothers me is that Brown writes as if children differed little from each other in stage I. The conclusions at the end of the book claim an invariant order of emergence among children, but this is not documented for stage I, and all the evidence I have seen indicates considerable individual variation in the order of development of the formulas expressing each of the meanings. If there is such variation, study of the individual differences must yield information about the interdependencies among the formulas, and thus might well help define the nature of the rule system acquired. For this reason I am sorry that Brown did not publish his three samples from stage I. These would have been invaluable to researchers and useful to other readers in providing a feel for what the data are like. There are only eight corpora of word combinations in the accessible literature. Since no single investigator can study more than a few children, a data base for comparing children cannot accumulate unless investigators publish their corpora.

The other long chapter traces the emergence, during the next stage of development of Brown's three subjects, of 14 small morphemes (noun and verb inflections, articles, spatial prepositions, and forms of "be"). For each of these there is a period when it is sometimes present and sometimes absent in contexts where it would be obligatory in adult speech. The order of mastery turns out to be nearly invariant in the three children. A meticulous marshaling of evidence establishes that it does not depend on the frequency of occurrence of the morphemes in parental speech but is a function of their relative semantic and grammatical complexity. Thus, some important new facts are established, the demonstrated independence of frequency of exposure being a particularly useful contribution.

The mystery of what causes the child to improve his language over time is a background issue throughout the book. A specific facet of this problem to which both parts of the book draw attention is the pervasive optionality of components: major constituents like subjects, objects, and verbs are sometimes present and sometimes absent, and then later always present when required; the small morphemes follow the same developmental course. There is no evidence for any kind of selection pressure: parents understand their children's primitive or incomplete utterences perfectly well, and while they

reinforce for truth, they do not appear to reinforce for grammatical completeness or well-formedness.

Brown brings to the work the attractive personal style and unusual lucidity for which he is well known. However, the field's unresolved issues that demand examination of much complicated detail, together with Brown's resolute refusal to oversimplify, tax these attributes severely. Readers from outside the immediate area will find the book difficult. Nevertheless, I predict that its thoroughness and thoughtfulness will make it the outstanding work on its topics until either the issues it analyzes are resolved or the *Zeitgeist* changes again.

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Animal Viruses

Viruses and Invertebrates. A. J. GIBBS, Ed. North-Holland, Amsterdam, and Elsevier, New York, 1973. xvi, 674 pp., illus. $60. Frontiers of Biology, vol. 31.

It is not surprising that a team made up mostly of Australian and British virologists, who have long been among the leaders in medical virology, particularly in the study of structure, function, and immunochemistry, should prepare an outstanding volume in comparative virology.

This book is divided into five major sections. The first contains brief historical accounts by Andrewes, Smith, and Watson of the three major groups of viruses. Each is rather subjective but all succeed in presenting most of the important contributions. This is not the strongest section of the book.

The second section describes the viruses and the invertebrates with which they are associated. In general, this section is very well done. The newest systems of virus nomenclature and acronymic designation are effectively combined by Bellet, Fenner, and Gibbs to provide the most up-to-date scheme for virus classification. There follow nine chapters (by Hoogstraal, Lee, Eastop, Kisimoto, Selman, Entwistle, Mattingly, Hooper, and Mound) devoted to the structure and habits of mites, ticks, aphids, thrips, leafhoppers, beetles, mosquitoes, flies, and nematodes. Modes of virus acquisition, multiplication, and dissemination are emphasized.

The third section covers virus penetration, replication, and physiological reactions in invertebrates and in cultured cells from invertebrates. Gaps in our knowledge are clearly evident, and the contributors (Dalgarno and Davey, Harrap, Lafferty and Crichton, and Grace) present most of the current information in an objective manner.

In the fourth section, more specific virus-host associations are presented (by Hoogstraal, Slykhuis, Marshall, Longworth, Bailey, Roivainen, Peters, Garrett, Sinha, Harrison, and Gibbs) in ten detailed and comprehensive chapters. This section complements section 2 very well, and the two constitute the most useful part of the book. Associations affecting man, other mammals, birds, and plants are included.

Section 5 summarizes the progress that has been made in the manipulation of viruses for the benefit of man. Bailey's chapter on the control of invertebrates is objective, succinct, and fairly comprehensive. The same may be said for the next chapter, by Gordon Smith and Surtees, on the control of viruses spread by invertebrates to man and mammals. The final chapter of the book, by Heathcote, is also thorough in its treatment of plant viruses spread by invertebrates.

Despite its high price this volume will undoubtedly become indispensable to the research scholar who is interested in the relationships of viruses with man, mammals, and birds, with plants, as well as with invertebrates. It is obvious from this book that there is much to learn about all of these associations, and the authors have posed many of the important questions remaining to be answered.

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The Herpes Group

The Herpesviruses. ALBERT S. KAPLAN, Ed. Academic Press, New York, 1973. xvi, 740 pp., illus. $31.

The recent findings that herpesviruses are associated with cancer in animals and—though the evidence is less conclusive—in humans led to an upsurge of interest in them. The book is offered as a collection of "the currently available information on *all* the herpesviruses." *All* herpesviruses? The editor states that "it would be clearly impudent and possibly impossible for one individual to attempt to write authoritatively about all aspects of herpesviruses" and promises that this volume will not be a "mere annotated bibliography."

The book is admirably organized in 21 chapters that fall roughly into three groups. The first group comprises chapters by P. Wildy, unquestionably the doyen of modern herpesvirology, two chapters by D. H. Watson on electron microscopy of the virus and its development, a chapter by G. A. Gentry and C. C. Randall on physical and chemical properties, and chapters by R. W. Darlington and A. Granoff and by T. Ben-Porat and A. S. Kaplan on replication. The second group deals with immunology of herpesviruses, interferon, and latent infections. The last contains 12 chapters dealing with individual or groups of herpesviruses, the relation to the disease they produce, and chemotherapy.

Not too surprisingly, the best chapters in the book are in the third group. I would like to single out the chapter by George Klein on the Epstein-Barr virus as a model of concise, factual, authoritative writing. The chapters by D. G. McKercher on herpesviruses and lower animals, by P. M. Biggs on Marek's disease, by K. Wolf on herpesviruses and lower vertebrates, by W. E. Rawls on herpes simplex, and by F. Deinhardt on herpes saimiri come close seconds and should be most useful to both expert and neophyte.

Omissions, biases, and poor editing abound in the first and second sections. Nowhere, for example, is there a thorough discussion of the role of cellular immunity in herpetic infections. Judging by what has been left out, most of the bibliography dates to 1971 (chapters on virus structure) or the middle of 1972 (viral replication). Contrary to the editorial promise, it is hard to view the chapter on physical and chemical properties of herpesviruses as anything more than an annotated bibliography; it is written to offend no one, least of all the editor. Uncritical statements concerning herpes simplex viruses causing cell proliferation (p. 117) rather than piling up of dead cells and amitotic nuclear division (p. 115) rather than nuclear fragmentation in infected cells are made in the chapter by Darlington and Granoff. If some of the chapters lack critical insight, the chapter by Ben-Porat and Kaplan suffers from an overindulgence in speculation based, sometimes, on no facts at all. I was particularly amused by the rather critical discussion (p. 172)