best of the lot. It deserves a wide readership, both among historians of science and technology and among computer professionals, for whom the breathtaking pace of innovation and impact of computing have overshadowed the remarkable personal story of its beginnings.

PAUL E. CERUZZI
*Department of History,*
*Clemson University,*
*Clemson, South Carolina 29631*

## Software

**History of Programming Languages.** Papers from a conference, June 1978. RICHARD L. WEXELBLAT, Ed. Academic Press, New York, 1981. xxiv, 760 pp., illus. $45. ACM Monograph Series.

Modern computing systems are as much a product of software as of hardware. One of the most important parts of such software is the set of compilers and interpreters that enable a computer to be programmed in a so-called high-level language. The first such programming languages date from the early 1950's, and their history is as interesting as that of the computers whose usability they so greatly increased. In 1977, when the conference of which the present book is a record was held, comparatively little had been done to record or study this history. The conference was in fact a deliberate attempt to remedy this situation, at least with regard to a selected set of programming languages, namely ALGOL 60, APL, APT, BASIC, COBOL, FORTRAN, GPSS, JOSS, JOVIAL, LISP, PL/1, SIMULA, and SNOBOL. The reasoning behind this choice from among the literally hundreds of programming languages that have been designed and implemented in the last 30 years is quite understandable. Though each language had been introduced at least ten years earlier, all were still in active use and had undoubtedly had a major influence on the field of computing. Indeed, most present-day computer users will be familiar with, and have had their view of how computers should be programmed colored (for better or worse) by, one or another of the chosen languages. Very rarely, however, will they have any clear idea of the circumstances surrounding the development of the language or of the motivations and intentions of its developers. Any such user with even a modicum of interest in the past should find the present book fascinating, consisting, as it does, largely of accounts given by the original developers themselves. For example, FORTRAN programmers will learn that one of the major spurs to the development in 1954 of their language by a team at IBM led by John Backus was the advent of hardware for performing floating-point arithmetic. COBOL programmers will learn that its designers thought they were developing in 1959 just "a short-range composite approach (good for at least the next year or two) to a common business language for programming digital computers." And ALGOL programmers will get, all too clearly, an impression of the intensity of the debates that occurred in the international committee whose deliberations led to Peter Naur's magnificent ALGOL 60 Report.

This book is not, however, a mere collection of personal reminiscences by pioneers. Rather it is the outcome of a carefully organized process that sought to maximize the historical value of the conference. Thus for each language one, or in some cases two, of the leading figures in its original conception and development were invited to prepare a detailed written account of the origins of and rationale behind the design of the language. Each was given guidance as to the information it was hoped his or her paper would contain. This guidance, in the form of a lengthy questionnaire, covered both general matters and specific technical questions relative to the particular language and was complemented by a careful and constructive reviewing process.

Each author was, as a result, motivated to supplement his or her personal recollections by undertaking extensive historical research. The resulting accounts are all excellent and full of fascinating and often surprising information, though they are far from uniform in style and differ greatly in emphasis. For example, the accounts of languages designed by committees, such as COBOL and ALGOL, tend to stress the often painful process by which agreement on the various major features of the languages was reached. In contrast, the papers on languages that were essentially, at least initially, the product of a single individual typically concentrate more on the reasoning behind the various detailed technical decisions that were made; a prime example of such a paper is that by Kenneth Iverson on APL.

The papers were made available in draft form before the conference, at which ample time was provided for discussion and questions. The published proceedings include, in addition to the final versions of the papers, transcripts of the actual conference presentations and of the discussion sessions and technical summaries of each language. These last play an important role in helping readers to appreciate the accounts of programming languages with which they are unfamiliar. The book, therefore, provides, as was hoped, a very valuable and readable source of historical information on the development of some of the most important and influential programming languages. Yet for all its serious intent, the conference was obviously an enjoyable and entertaining affair, and this is well reflected in the present volume. Thus this is a book that should appeal not just to people with a serious interest in the history of computing but to anybody who has experienced the delights and frustrations of computer programming and who has an appropriate curiosity as to the origins of the language or languages that provide the arena for his or her programming exertions.

BRIAN RANDELL
*Computing Laboratory, University of Newcastle upon Tyne, Newcastle upon Tyne NE1 7RU, England*

## Vertebrate Morphology

**Basic Structure and Evolution of Vertebrates.** ERIK JARVIK. Academic Press, New York, 1980. In two volumes. Vol. 1, xvi, 576 pp., illus. $94.50. Vol. 2, xiv, 338 pp., illus. $56.50.

Vertebrate morphology is not a fashionable subject. The textbook most commonly cited is still E. S. Goodrich's *Studies on the Structure and Development of Vertebrates* (1930), now more than 50 years old. The heyday of the subject was over by about 1920, when it seemed that the comparative anatomy and embryology of vertebrates were well enough understood for the framework of morphology to be permanent, so that attention could be turned to newer fields. Then in 1921 Erik Stensiö published the first of a series of brilliant monographs, analyzing fossil lower vertebrates in an entirely novel way. Before Stensiö fossil fishes had been treated much like fossil invertebrates—as shells, whose external features were sufficient for diagnosis. Stensiö's innovation was to treat fossil anatomy in the same detail as is found in classical morphologists' work on Recent fishes. By new and painstaking methods of preparing fossils and by close comparison with Recent adults and embryos, Stensiö reconstructed not only bone but cartilage, nerves, vessels, and muscles in group after group of Paleozoic and early Mesozoic fishes. Goodrich viewed Sten-