as data, it becomes possible to build list structures of various kinds. A number of examples of different data structures are given, including multidimensional arrays, complex numbers, ring structures such as those used in graphics, and threaded lists. The notion that complex structures may be built up from simple ones through a hierarchy of definitions is emphasized.

In the final chapter, concerned with extensible languages, the authors discuss the incorporation of definitions into Algol in order to produce Algol D. The definitional method deals not only with the specification of the structures themselves but also with the specification of operators on the structures. Since the same operator may have different meanings when applied to different structures, the process of determining the meaning of an operator is context-dependent. Given a context, it is then possible to invoke an appropriate substitution of text in order to replace an occurrence of a defined operator by its definition. The process of context determination and replacement is discussed in some detail. The book concludes with a discussion of macro schemes suggested by other people.

In summary, this is a worthwhile and meaty book, though one that presents a highly personal and limited view of its field.

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40[12].—RONALD BLUM, Editor, *Computers in Undergraduate Science Education*, Commission on College Physics, College Park, Maryland, 1971, x + 499 pp., 23 cm. Available from American Institute of Physics, 335 East 45th Street, New York, New York 10017.

These conference proceedings contain quite a number of papers dealing with the use of computers in college physics instruction, as well as some dealing with broader aspects of the use of computers in universities. None of the material here is of lasting significance, though the book has a certain pragmatic value for those actively engaged in educational projects using the computer as a tool. The numerous reports on active projects and their results do provide a standard of comparison for workers in the field. For other readers, the book may be worth skimming as a matter of interest but does not merit detailed study.

Fortunately, the authors of most of the papers seem to have tried to present their results honestly without exaggerating their successes. I was rather charmed by an article by Edwin F. Taylor entitled "History of a failure in computer interactive instruction," which begins with the sentence "This paper deals with an elegant and technically successful computer interactive display that has not influenced many students."

The first groups of papers discuss applications where the computer is used by students as an experimental tool. Some of these applications require the student to know how to program, while others do not. The simulation of the behavior of physical systems does seem to aid in developing physical intuition in a simpler way than through the use of elaborate laboratory experiments. Later sections of the book discuss more general systems of computer-aided instruction, and these sections are much less physics-dependent than the earlier ones. However, most of the interesting CAI systems have been discussed elsewhere in more detail. I did get the distinct impression that CAI systems have managed to become cost-effective, and that their use will be spreading in colleges and universities. A final section of the book deals with the political problems of computing at universities, and with the prognoses for the future.

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41[13.35].—I. H. MUFTI, *Computational Methods in Optimal Control Problems*, Springer-Verlag, New York, 1970, 45 pp., 26 cm. Price $1.70.

This short monograph is a member of the series, *Lecture Notes in Operations Research and Mathematical Systems*, edited by M. Beckmann and H. P. Kunzi. The author accomplishes his stated purpose of presenting in a concise manner the major points of several computational methods for solving certain optimal control problems. Each method discussed is iterative and uses successive linearization to obtain functions that are solutions of a set of necessary conditions of optimality associated with the given problem. These conditions consist of a set of algebraic and differential equations and inequalities (called the minimum principle of Pontryagin) that any optimal solution of the given problem must satisfy.

The reader is assumed to possess more than a passing acquaintance with variational calculus; no general explanatory comments are included. Algorithms for the solution of problems with no state or control constraints are presented first, progressing to problems with control constraints and 'terminal' state constraints. Problems in which the state trajectories must remain in a set not equal to the entire space are not considered.

This report contains no statements regarding the advantages or disadvantages of any of the methods discussed, and there are no examples or exercises. A good reference for such comments and examples is *Applied Optimal Control* by A. E. Bryson, Jr. and Y. C. Ho, Blaisdell Publishing Co., 1969, Chapter 7.

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