$$\frac{\text{viscous force}}{\text{coriolis force}} \quad \text{not} \quad \frac{\text{viscous force}}{\text{centrifugal force}}.$$

In any case, it appears that this is a useful booklet for those in these fields.

D. S.

40 [13.35].—N. V. FINDLER & B. MELTZER, Editors, *Artificial Intelligence and Heuristic Programming*, American Elsevier Inc., New York, 1971, viii + 327 pp., 24 cm. Price $17.50.

This book consists of a series of papers based on lectures given at the First Advanced Study Institute on Artificial Intelligence and Heuristic Programming, held in Menaggio, Italy, on August 3–15, 1970. The papers cover a wide range of topics in Artificial Intelligence: theorem proving, problem-oriented languages, game playing, problem solving, heuristic search, question-answering systems, natural language analysis, picture processing, and cognitive learning. Five papers are tutorials dealing with well-established results in Artificial Intelligence. These are well-written, pertinent papers which should appeal to nonspecialists who wish to learn more about a particular area of AI. The other eight papers are descriptions of recent research in the field, and, in general, can be readily assimilated by those with a certain minimal background in Artificial Intelligence.

The 13 papers presented in this volume are listed below. The first two are clear, concise tutorials on theorem proving. Robinson's paper focuses on the deduction problem, i.e., determining whether a given assumption A logically implies a given conclusion C, and shows that resolution is an interesting way to attack this problem. The paper by Meltzer discusses the efficiency of automatic proof procedures, particularly with regard to the resolution method of theorem proving. Related issues like completeness and proof complexity are also considered, and guidelines for the design of efficient proof procedures are suggested.

The next two papers are accounts of recent research related to problem-oriented languages. The paper by Elcock describes ABSYS, a language for writing programs in the form of unordered, declarative statements. When these programs consist of sets of problem constraints, their compilation is a problem-solving task, and, thus, the compiler for ABSYS can be considered a problem-solving compiler. Findler's paper provides brief descriptions of seven AI projects that are being programmed in AMPPL-II, an associative memory, parallel processing language imbedded in FORTRAN IV.

The next three papers discuss recent work in problem solving, with emphasis on heuristic search. Sandewall, in his paper, introduces a number of quite useful concepts for defining heuristic methods in a general, compact way. These concepts are then used to describe the SAINT program and the unit preference strategy in resolution. The paper by Michie contains a discussion of graph searching algorithms and their application in the formation of plans by machine. To fully appreciate this interesting paper, one should be moderately familiar with the POP-2 language and Michie's work on memo functions. The paper by Pitrat discusses a language for describing the rules of board games like chess, go-moku, and tic-tac-toe. General

search techniques (for finding a win) based on the rules of the game and the definition of the winning condition are presented.

The next paper is a tutorial on the frame problem in the context of intelligent robot systems. This is the problem of maintaining and updating the current context or "frame of reference" each time new information is created during problem solving. Raphael describes the problem in a clear, informative manner, and presents lucid evaluations of the primary approaches proposed for solving the frame problem.

The next four papers deal with language and picture processing. Lindsay's paper describes a natural language parsing system, JIGSAW1, based on labelled dependency analysis, which uses both syntax and semantics to guide the parsing. An interesting analogy is drawn between the combined use of syntax and semantics to parse a sentence and the combined use of contour information and picture information to put together a jigsaw puzzle. Simmon's paper describes a generative teaching program which has a semantic net data base and is able to use this information to generate and score quizzes. The paper by Palme is an interesting tutorial on question-answering systems. The one by Clowes is a short, provocative tutorial on picture descriptions. Most of the approaches discussed by Clowes rely on syntax-directed analysis of two-dimensional patterns.

The last paper, by Kochen, discusses the problem of formulating a model of cognitive learning. Examples of how a learning system can learn to maximize the utility of a situation when given a series of situation descriptions are presented. Also, a number of definitions and theorems about cognitive learning are introduced and stated in mathematical terms.

Building Deduction Machines ..... J. A. Robinson
Prolegomena to a Theory of Efficiency of Proof Procedures ..... B. Meltzer
Problem-Solving Compilers ..... E. W. Elcock
A Survey of Seven Projects Using the Same Language ..... N. V. Findler
Heuristic Search: Concepts and Methods ..... E. J. Sandewall
Formation and Execution of Plans by Machine ..... D. Michie
A General Game-Playing Program ..... J. Pitrat
The Frame Problem in Problem-Solving Systems ..... B. Raphael
Jigsaw Heuristics and a Language Learning Model ..... R. K. Lindsay
Natural Language for Instructional Communication ..... R. F. Simmons
Making Computers Understand Natural Language ..... J. Palme
Picture Descriptions ..... M. Clowes
Cognitive Learning Processes: an Explication ..... M. Kochen
Computer Simulation of Verbal Learning and Concept Formation ... L. W. Gregg (abstract only)

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41 [13.35].—F. GÉCSEG & I. PEÁK, *Algebraic Theory of Automata*, Akademiai Kiadó, Budapest, 1972, xiii + 326 pp., 25 cm. Price $13.00.