62[Z].—D. S. EVANS, *Digital Data, Their Derivation and Reduction for Analysis and Process Control*, Interscience Publishers, Inc., New York, 1961, ii + 82 p., 19 cm. Price $2.95.

This amazingly small monograph presents, with typical English economy of words, a detailed introduction to the considerations involved in producing digital data from mechanical position analogs, such as shaft rotation or linear displacement.

Chapter I, Incremental Measurements, is introductory in nature, and states the prime reasons and principles for automatic digitizing, namely, to conserve manpower and to avoid human failure in applications where both accuracy and speed become increasingly important. The relations among physical, graphical, and digital representations of quantity are discussed, as are the limitations of scaling with respect to ultimate accuracy and precision. The chief advantages, methods, and system considerations are even summarized.

Chapters II and III, Digital Counting Devices and Direct Reading from Coded Scales, give brief, clear presentations of the several counting, direct reading, mechanical, and optical devices for analog-to-digital data conversion in the author's experience. The codes employed, methods to avoid ambiguities in read-outs, and detailed characteristics of each device are presented. A valuable feature here is the listing of performance figures and system requirements for seven specific digitizers.

Chapter IV, Ancillary Equipment, introduces some of the additional hardware and techniques required in incorporating mechanical analog-to-digital converters into data systems. The final chapter, Chapter V, System Arrangement and Application, approaches the analog-to-digital data flow from an over-all system view, indicating some of the end uses to which decoders are often put, and which type of device is then selected.

The author has succeeded in proving, that much valuable and easily applied information can be supplied in a very small volume, which includes 63 excellent figures and photographs within its 78 pages of text.

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63[Z].—LEJAREN HILLER, JR. & LEONARD M. ISAACSON, *Experimental Music Composition with an Electronic Computer*, McGraw-Hill Book Co., Inc., New York, 1959, vii + 197 p., 24 cm. Price $6.00.

This book is an exposition of the use of programming techniques, mathematics, and musical theory in the composition of music on the ILLIAC computer at the University of Illinois. It is based on the results of a set of experiments designed to determine whether high-speed computers could be used effectively to "compose" music and to analyze musical structures. No attempt was made to generate electronic (synthetic) music, so the performance of the music composed was reserved for conventional musical instruments. Within the limited scope of their aims, the authors were successful not only in carrying out their experiments, but also in producing this neat and scholarly description of their work.

After presenting a chapter on the nature of the aesthetic problem in music, a brief account is given of recent technical and artistic developments in both experimentally composed music and electronically performed music. Here the authors mention the use of mathematical formulations to supply foundations for constructing "supposedly aesthetically significant art structures"; for example, G. D. Birkhoff's theory of aesthetic measure and J. Schillinger's theory of mathematical aesthetics, but none of these formulations are employed in their experiments. This background is followed by an analysis of the technical problems involved and a brief description of the programming operations of a digital computer; then a detailed account of each of the experiments is given.

In developing their computer codes, the authors employed basic concepts from information theory and applied the Monte Carlo method. Random sequences of integers were equated to notes in the (Western) musical scale and also to rhythmic patterns, dynamics, and playing techniques. These random integers were then screened by applying tests expressing various rules of composition (depending on the experiment) and accepted or rejected, depending on the rules in effect. For example, the first experiments began with the simplest rules for writing polyphonic music in C-major in cantus firmus settings, using only the 15 notes from low C to C above middle C. The second experiment produced four-part first-species counterpoint in the same note range. Later experiments were based on the chromatic scale, and provided for the generation of rhythmic patterns, dynamic markings, and playing instructions for stringed instruments (legato, staccato, etc.). The last set of experiments produced what the authors call "Markoff chain music" of zero order and of higher orders. (The music is defined to be of zero order, if the generation of the interval I_n between the notes $n - 1$ and n is independent of the choice of the interval I_{n-1}; it is of first order, if the choice of I_n is dependent on I_{n-1}, etc.)

The programming details are given for each experiment along with explanatory flow-charts, lists of composition rules employed, and tables summarizing the calculations performed. The results of the experiments, that is, the computer-constructed music, were combined by the authors into a composition for string quartet, entitled "The ILLIAC Suite," which was transcribed by hand into conventional musical notation, and is given in the Appendix of the book.

It should be emphasized that the authors do not advocate that computers should replace composers. They only show that computers can serve as useful aids to composers in experimenting with new methods and rules in the field of composition, in studying the classical forms of music (sonata, fugue, etc.), in analyzing the styles of specific composers, and in throwing some light on the aesthetic nature of music.

Numerous references are given in the form of footnotes throughout the book; it would have been helpful if these references had been listed in the form of a bibliography at the end of the book.

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