Preface

Whether or not computers have now attained their infancy, as is often heard today in this computerized world, their use in the field of music is still at an embryonic stage. This book documents the efforts of a number of composers and music researchers who use the computer in their work, and it illustrates the wide range of possibilities offered by the computer in music composition and research. A third area, computer-assisted instruction in music theory, has emerged too recently to assess its effectiveness or possibilities.

Although the present stage of the computer's contribution to music is embryonic, it would be a mistake to assume that we know what lies ahead, nor can it be said that the uses of the computer in music have evolved systematically. One is struck, throughout these essays, by the multiplicity of ideas and procedures and by the diversity of techniques, terminology, and goals. Those who work with the computer in music today know both the joys and disappointments of being pioneers, the excitement of discovery, and the frustration of failure. Only someone who has prepared programs and data for computer processing can fully realize how misleading in its suggestion of ease is the phrase ". . . and then he fed it to the computer."

The emphasis in several of these essays is on methodology rather than on results. There is still much to be learned, and for most of his work the researcher is dependent upon hardware (equipment) and software (programs) designed for business and the sciences.¹ Developments in both equipment and programs have come at a dizzying pace during the past decade, and it is a challenge to the person in this new area to maintain the flexibility necessary to move with rapid changes and not become tied to outmoded systems.

The range of opportunities and possibilities enjoyed by the composer is, in some respects, wider than that enjoyed by the researcher.

¹ Programming languages designed exclusively for music purposes include MIR, developed by Michael Kassler and described in Chapter XX, and MUSICOMP, by Lejaren Hiller, described briefly in Chapter IV.

The composer may use the computer to write music which will ultimately be played on standard orchestral instruments by performers reading from conventional notation. The style of his compositions may range from a simple counterpoint, based on the so-called rules of an eighteenth-century theorist, to the most recent serial or aleatory techniques. Efforts to imitate older styles have had limited success, and there is little interest in this area today.

The composer may choose instead to develop a vast range of sounds and totally new compositional devices. Some of the sounds may be generated by the computer itself, or the composer may link his efforts on the computer with the remarkable devices in the electronic-music studios found on many campuses. Mr. Brün forcefully argues that "traditional musical procedures have entered the stage where all further possible permutations will no longer possess any new meaning."² The widespread use of electronically produced sounds as background to films and television entertainment as well as in popular music adds strength to Mr. Brün's arguments. Whatever procedures are chosen, the many possibilities available pose a challenge to the imagination as well as to the technical skill of the composer. A number of these composers know mathematics, and their literature, as shown by Mr. Hiller's survey, is heavily sprinkled with such expressions as "second order transition probabilities," "random number generators," "sets," "permutation scheme," and "binary choice," to name but a few. In some of this work the new composer imitates, or has the machine imitate, the thought processes of the traditional composer. But it becomes apparent that more and more of the decisions can be left to the computer, and we find ourselves confronted with basic esthetic questions—questions that are succinctly summarized by Mr. Strang.³

The researcher, whether in music or some other area, has tended to use the computer to carry out more effectively, or on much larger quantities of data, research methods already developed. In music these include harmonic analysis, various types of indices, and elaborate statistical studies. Among his aims are analysis of harmonic devices, systematic descriptions of the styles of particular composers, comparisons of different styles, and the development of data banks of themes to cite borrowings among composers or to collate widely scattered sources.

The music researcher is immediately confronted with a basic need

² See Chapter II.

³ See Chapter III.

when he looks to the computer as a tool. He must convert either the sound of music or the printed musical score to machine-readable data. The first possibility poses complex engineering problems. While it is theoretically possible to digitalize music, that is, to describe every tone by a mathematical measurement of the fundamental pitch and harmonics which comprise the tone, thus far only a limited amount has been accomplished in this field. Attempts to convert the printed score itself have been more successful. One can use letters and numbers to represent the symbols on the page of printed music, and store this representation in the computer memory ready for the various manipulations requested in the researcher's programs.

As yet there is no agreement among scholars on a single music representation. Some researchers have dealt only with the elements of notation of particular relevance to their projects. Others have chosen to represent all the elements of notation. A choice must be made between utilizing a limited system which permits rapid encoding of materials needed for a specific project only or using a broader system permitting greater flexibility and greater possibility of sharing with other researchers for their particular needs. It is unlikely that there will be widespread agreement on a particular representation, and the need for such a *lingua franca* is being reduced with the development of translation programs.

No matter whether one uses a specific or general representation, the encoding of music is tedious and time consuming. It is also expensive, since everything that is encoded must be keypunched. Two hardware developments, long hoped for, would greatly speed this part of the musicologist's work. One is an optical scanner that could read music and convert its reading to the representation. Such a machine is probably farther in the future than was thought a few years ago. A second development, the automated printing of music from a representation, appears to be much nearer. The computer plotter and the photocomposition machine are two devices now undergoing the necessary programming or engineering to permit them to print music.⁴

⁴ The computer plotter has been programmed to draw a staff and music notation (news article on A. James Gabura's application in *Digital Plotting Newsletter*, May/June 1967, and Jeffry Raskin, "A Hardware-Independent Computer Graphics System," Master's thesis in Computing Science, Pennsylvania State University, 1967). The Ford-Columbia representation, already in use by a number of researchers, was developed by Stefan Bauer-Mengelberg as a graphics-oriented representation for use in a photocomposition machine known as the Photon. The editor, in his work in thematic indexing by computer, is currently testing the use

No one knows what the future holds for computing and music. Those of us who have worked with the computer have found it both a willing and a demanding tool—willing to do prodigious amounts of work in little time but demanding precise and well-thought-out instructions. It is hoped that this book will summarize, for researchers, composers, and other interested readers, the present use of the computer in music and will stimulate efforts to make the computer work more effectively in music composition and research.

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of special music characters developed for his project by the IBM Glendale Laboratory at Endicott, N.Y., for use on the high-speed computer printer.