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COMPUTERS AND MUSICAL STYLE

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CONTENTS

CHAPTER ONE

A BRIEF BACKGROUND OF AUTOMATED MUSIC COMPOSITION

INTRODUCTION

Before describing my own work, it would be useful to review some of the other events and discoveries that have preceded it. This will place my own research in context and allow readers the opportunity to measure its relative significance.

A brief history of automated music composition could extend back to the carillons of the medieval era or before. Barrel organs, player pianos, and music boxes could also be included. However, such developments should be considered related to performance; that is, the outcome of their mechanical output is for the most part predictable. For the purposes of this book, only those instruments, machines, or programs that create new works qualify for inclusion. These are "automata" capable of creating original music.

HARDWARE

Among the most ancient "hardware" of composing instruments, aeolian harps and wind chimes tenuously fall into the category of "composers" since the outcome of their performance, in both cases, depends on the direction and amount of wind that nature provides unpredictably. Wind or aeolian bells have for centuries been a part of many world cultures. *Gunte* is the Hindu term for bells, and they are found adorning the temple roofs of many villages in India and Tibet. This is also true for China (Edgerly 1942), where they are called *feng-ling*. In Japan they are the *furin*, and in Burma the *khew* hang from temple and cave roofs alike.

Despite the fact that today aeolian harps are observed as musical novelties, there have been periods when their production and use have been prolific. King David's *kinnor*, a wind-played lyre, supposedly sang at night from the force of the north wind (Marcuse 1975). Saint Dunstan (d. 988) was suspected of sorcery for having experimented with a "harp" that played of its own accord when hung in the breeze (Buchner 1959). Giovanni Battista Porta's *Magiae naturalis* discussed the aeolian harp as a serious musical instrument capable of wonderful sonorities and unexpected sounds (Porta 1558). Athanasius Kircher (around 1650) designed elaborate wind-performed instruments (Kircher 1646; Buchner 1959).

The eighteenth-century English poet James Thompson discussed the aeolian harp, and the "ghostly sound of chords" became a part of the lore. Samuel Johnson (1700–1748) wrote in *Castle of Indolence*: "The God of Winds drew Sounds of deep Delight: Whence, with just Cause, The Harp of Aeolus it hight. Ah me! what Hand can touch the Strings so fine?" G. C. Gattoni of Como, Italy, created his *armonica meteorologica* in 1785. This huge instrument, also called the *arpa gigantesca*, had fifteen metal strings, which Gattoni strung between his house and a nearby tower. The strings, vibrated by the wind, supposedly forecast the weather as well as created interesting sounds. In the eighteenth and nineteenth centuries the French celebrated the *harpe d'eole*, their version of the aeolian harp. These and other references are discussed in detail in Marcuse (1975).

The aeolian harp enjoyed special popularity in Europe during the Romantic period, particularly with builders like Longman and Broderip, William Jones, and Clementi and Company in England and Heinrich Christoph Koch and Friedrich Kaufmann in Germany (Buchner 1959). Kaufmann, of Dresden, was one of the most famous builders of musical automata. An entire book (Kastner 1856) was devoted to the construction and care of aeolian harps.

Variations of aeolian harps have been numerous through the ages. The aeolian bow is such a case. Aeolian bows are typically constructed with horsehair or rattan attached to bamboo, much as in traditional string instrument bows. These then hum at different pitches. The instrument is suspended from trees in Indonesia, swung from a performer's hand in Indonesia, Malaysia, and West Africa, and attached to kites in China, Korea, Japan, Thailand, and certain parts of Indonesia. Some historians also claim that musical arrows were at one time popular in China (Edgerly 1942). These were tubular arrows that sang while flying through the air.

In Bali, there is the *pinchakan*, a bamboo rattle operated by the wind, and the *bulu parinda*, large aeolian pipes hung from the tops of trees. There is also the tradition of placing bamboo tubes along irrigation channels of terraced rice paddies so they would, when full, tip over and knock against a rock. The sound of each tube would be tuned to a different pitch of a scale so the farmer could immediately locate a blocked irrigation channel by noticing an absent pitch in the scale. In Japan, the "deer scarer" is a bamboo hydraulic, tipping when full and, according to tradition, scaring the deer away. The use of bells on domestic herds of sheep and cattle is ubiquitous.

The pealing of bells, known throughout Europe during the Gothic and post-Gothic eras, also represents an example of automatic composition. Special bells, rung by campanologists pulling ropes, create unpredictable melodies based on gravity's effects on the bells' swinging motions. Titles of songs such as "Eight-Splice Surprise Major" (Schafer 1973) indicate the nature of the results of the "calling of changes" during performance.

Other unusual automatic instruments include the gilded brass ball, a sealed ball that when rolled created ever different music (described by Bonanni 1722), and the *sundari* of Bali, an impressive aeolian flute that works in the rice fields (see McPhee 1966). More recently, modern fountain chimes, large hydraulic instruments created by many instrument builders including Bernard and François Baschet as well as Ward Hartenstein, create new and varied music.

One of the first hints of machine composition came from mathematician Ada Lovelace around 1840. Her colleague Charles Babbage had invented a "calculating engine," now considered to be the precursor of the modern-day computer, and she wrote: "Supposing, for instance, that the fundamental relations of pitched sound in the signs of harmony and of musical composition were susceptible of such expression and adaptations, the engine might compose elaborate and scientific pieces of music of any degree of complexity or extent" (Bowles 1970, p. 4).

Communications expert Elisha Gray invented the "musical telegraph" in 1874. This single-octave keyboard device produced arbitrary music during telegraph communications as a by-product of Morse code letter representations. Each key was attached to a single-tone "transmitter," which used spring-loaded metal reeds to transform electricity into sound. Interestingly, the device was polyphonic and anticipated telegraph multiplexers (which transmit more than one signal simultaneously over a single wire).

One player piano composer does deserve mention in the category of mechanical performance of formalized music: Conlon Nancarrow. Since the late 1940s, he has "composed" a series of *Studies for Player Piano,* many of which are the result of strict applications of mathematical formulae (Cope 1989b). Many of those numbered in the thirties and forties take the form of strict canonic realizations of mathematic proportions. These are performed on one of his two player pianos in his Mexico City home. Hence, there is a mechanical performance of a mechanically composed work: an integrated musical automaton.

Mathematician Joseph Schillinger, whose major books (1948; 1978) brought forth great controversy, developed schemata for composition of new works by machines. His Rhythmicon (which was built by Leon Theremin and composed and performed rhythmic patterns) and Musamaton (his name for automatic instruments that varied extant music) were examples of his often complex mathematical theories, which were nonetheless intended for the musically uninitiated.

Chance music, championed by John Cage and others since the early 1950s, especially when paired with the use of machines, is worthy of mention here. Cage's *Reunion* (completed in 1968), for example, is a work performed (most notably) by Cage and Marcel Duchamp by playing chess. The sounds were triggered for release to loudspeakers by special photoelectric switches located in the chessboard. Cage's *Cartridge Music* (completed in 1960) is another example of the rigorous application of a formalism, in this case a score consisting of random overlays of various sheets with abstract lines, circles, and dots (Cope 1989b). The translations of these "scores" by performers using phonograph cartridges attached to amplifiers represents a kind of automata. So does Charles Dodge's *Earth's Magnetic Field* (completed in 1970), in which the computer musically translates indices of change in the magnetic field of earth.

Steve Reich's *Pendulum Music* (completed in 1968) is another example of automatic music hardware. The work requires that microphones be attached to the ends of long cables, which are in turn plugged into amplifier–loudspeaker systems. The microphones are then hung from the ceiling of the performance area, all at the same distance from the floor, and directly above their associated speaker. They are set into motion when performers pull back the cables and release them in unison. As the microphones pass by their respective speakers, feedback is generated. This begins as short bursts and then lengthens as the microphone pendulums lose energy.

During the performance, the performers join the audience in watching and listening to the work. Their only remaining duty is to unplug the amplifiers in unison when the feedback becomes continuous.

Pauline Oliveros's *I of IV* (completed in 1966) uses two tape recorders and a single tape loop to create double feedback. The complex arrangement creates reverberation in thick layers that continuously fold over one another. Even though one can control the entering sound, the looping system is so complex as to be completely unpredictable in its manipulation of that sound. Many of Oliveros's works, particularly from the 1960s and 1970s, exist only in the form of diagrams of machines or machine arrangements. Many other composers, such as Allen Strange (*The Music of Dod*, completed in 1977), Gordon Mumma (*Hornpipe*, completed in 1967) and David Behrman (*On the Other Ocean,* completed in 1977), among others, have created original machines that play seriously active roles in the compositional process with their inventors (Cope 1989b).

Brian Eno has created many different devices that play and create automatically. He says: "Since I have always preferred making plans to executing them, I have gravitated towards situations and systems that, once set into operation, could create music with little or no intervention on my part. That is to say, I tend towards the roles of planner and programmer, and then become an audience to the results" (Holmes 1985, p. 143). Many of his works are machines or machine setups themselves. Often, situations are created where a kind of ambient music will continue indefinitely, all created by the circumstance set in motion by Eno but then out of his control.

Obviously, automatic music composition is best suited to the modern-day computer and the synthesizers they can control. For the most part, however, composers and programmers have tended toward the study of pitch (tuning systems), timbre, and space rather than toward the actual computer ordering of sounds as in composition. Certainly the creation of new machines specifically designed as composers of music has not been at the forefront of new designs of, say, computer-controlled synthesizers. Most work has instead resulted in software.

SOFTWARE

The "software" of early automatic music may have originated with Pythagoras (circa 500 B.C.), who believed that music and mathematics were not separate studies; an understanding of one was thought to lead directly to the understanding of the other. He was the first known