Notes

All four compositions were originally composed in a quadraphonic format. MUSIC 10, a form of Max Mathew's Music IV, highly optimized to run on a DEC PDP-10, was coded by David Poole. Four channels of digital acoustic signals were composed and recorded on a disc. Then in a separate pass the samples were converted by a DAC to an analog signal and recorded on tape.

Sabelithe – (1971) 6m30s

Chowning's fist composition using a computer, *Sabelithe* represented all that he had learned and developed, since beginning in 1964, about composing sound in a quadraphonic space and about spectral modeling using FM synthesis, discovered in 1967. In addition to spiral trajectories he composed a section where short percussive sounds followed a path —left rear-to-front, front-across, right front-to-rear — that was then followed by a second and then a third instance of the same. It was a spatial canon, in fact, for which there is a musical pitch-space analog, the 14th century caccia (chase or hunt), a precursor of the fugue. There is some irony in the fact that a 20th century technology would produce a form for which there is a 600 year-old metaphor. The brilliant Stanford music historian, Imogene Horsley, found this fact amusing and somewhere mentions *Sabelithe* in her scholarly writings.

At various points in the composition there are timbral transformations. The most dramatic is near the end where a short, "noisy," discontinuous percussive sound is gradually transformed into a Risset inspired FM brass tone — a metamorphosis, for which there are analogs in the lithographs by M. C. Escher. It is a compelling example that demonstrates the richness of FM synthesis where a large timbral space is controlled by a small parameter space. An early form of Leland Smith's Score program, coupled with the composer's spatial processing subroutines, greatly facilitated the production of the score data.

Sabelithe, an anagram of Elisabeth (Chowning), was first presented at Dinkelspiel Auditorium, Stanford University, in May 1971.

Turenas (l972) 10m

This was the first widely presented composition to make exclusive use of frequency modulation synthesis, discovered by Chowning in 1967. FM synthesis, which is integral to *Turenas*, was a gift from nature and hence the title derived from its possessive form. *Turenas* also makes use of a program, developed by the composer over a period of four years, for creating the illusion of sounds in motion through a quadraphonic sound space.

Leland Smith's program, *Score,* and the composer's spatial and synthesis algorithms, were used to create the input data for MUSIC 10, that was run on a Digital Equipment Corporation (DEC) PDP-10 computer. The samples were written on a disc and then converted to an analog signal and recorded on a 4-channel tape

recorder in a separate step. In 1978 *Turenas* was regenerated on a real-time digital synthesizer designed by Peter Samson (the Samson Box), and in 2009 Bill Schottstaedt (CCRMA) created a software emulation of the Samson Box that allowed *Turenas* to be recomputed to meet current audio standards. It is this version that is presented here.

Present at the premiere of *Turenas* in Dinkelspiel Auditorium, Stanford University on April 28, 1972, were the composers Martin Bresnick, Andrew Imbrie, Gyorgy Ligeti, Loren Rush, Leland Smith and Ivan Tcherepnin, who wrote the following notes in 1973 for a concert at Harvard University.

This computer generated tape composition makes extensive use of two major developments in computer music pioneered and developed by John Chowning, working at Stanford's Artificial Intelligence Lab. The first involves the synthesis of moving sound sources in a 360-degree sound space, which takes into account the effects of the Doppler shift. The second was a breakthrough in the synthesis of "natural" (as well as almost "supernatural") timbres in a simple but elegant way, using accurately controlled frequency modulation. This is the technical background, but the piece is not about that background.

The title "Turenas" is an anagram of "Natures", evoking the way sounds "tour" through the space, transparent and pure, produced by the most technologically sophisticated means yet tending to sound perfectly natural, as if a dream could come true.

- *Ivan Tcherepnine* (1943-1998)

Phonē (1981) 12m

The sounds in *Phonē* (from the Greek, meaning "sound" or "voice") were produced using a special configuration of the frequency modulation (FM) synthesis technique that allows the composer to simulate a wide range of timbres including the singing voice and other strongly resonant sounds. The synthesis programs are designed to permit exploration of and control over the ambiguities that can arise in the perception and identification of sound sources. The interpolation between timbres and extension of "real" vocal timbres into registers that could not exist in the real world — such as a basso “profondissimo" — and the micro-structural control of sound that determines the perceptual fusion and segregation of spectral components are important points in this composition.

The composer developed this technique of FM synthesis of the singing voice at IRCAM, Paris in 1979 using a DEC PDP-10. He realized the piece in the SAIL (Stanford Artificial Intelligence Laboratory) language at CCRMA in 1980 – 81, using the “Samson Box,” a real-time, highly optimized computer/processor designed by Peter Samson. It was premiered in the Grande Salle of the Centre Pompidou by

IRCAM, as part of Pierre Boulez's seminar *Le Compositeur et l'Ordinateur* from February 17–21, 1981.

Stria (1977) 15m49s

Chowning received one of IRCAM's first commissions from Luciano Berio to compose *Stria* for the institute's first major concert series presented by Pierre Boulez, *Perspectives of the 20th Century* and premiered October 13, 1977 at the Centre Pompidou. *Stria* was composed using the SAIL (Stanford Artificial Intelligence Laboratory) language and realized in the summer-autumn of 1977 at Stanford University's Center for Computer Research in Music and Acoustics (CCRMA), following several years of planning while away from Stanford University.

The composition of Stria was dependent upon computer program procedures, specially structured to realize the complementary relationship between pitch space (scale) and spectral space (timbre), where both the sound and form are determined by the Golden Ratio, **Φ**, from antiquity. In addition, these procedures are at times recursive allowing musical events that they describe to include the same events within themselves in a compressed form.

The sounds of Stria are based on the unique possibilities in computer synthesis of precise control over the spectral components or partials of a sound and their pitches. Most of the music we hear is composed of sounds whose partials are in the harmonic series having an octave ratio of 1:2, divided equally into 12 scale steps. *Stria* is composed of sounds whose partials are inharmonic having a pseudo-octave ratio of 1: **Φ** ≅ 1:1.618, divided into 9 equal scale steps. However, the inharmonic partials are also based on powers of **Φ**, which in this unusual application yields a transparency and order in what would normally be considered "clangorous" sounds.

Kevin Dahan and Olivier Baudouin, in separate efforts, reconstructed the composition in 2007 from the original program and data, as described in The Computer Music Journal, Autumn-Winter, 2007 [CMJ 31, 3-4]. The reconstructions allowed *Stria* to meet current audio standards. This presentation by Kevin Dahan was realized in 2011.