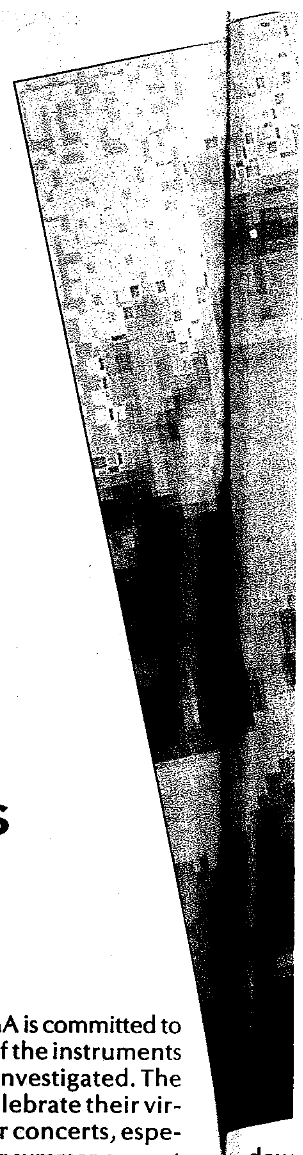
# STANFORD'S COMPUTER MUSIC LAB

Keyboard 13:12 (Issue #140)



## WHERE TODAY'S RESEARCH BECOMES TOMORROW'S PUSHBUTTON MAGIC

**BY STANLEY JUNGLEIB**

CREATIVITY WITHOUT COMPROMISE. That's a vision shared by nearly all musicians, from novicesbursting with unexpressed impulses to accomplished players striving to sharpen their chops, from high-energy performers to technophiles looking for the perfect MIDI routing. In the end, of course, creativity can be found only within oneself. But there's no question that one's environment can act as a midwife for innate talents and a proving ground for developing abilities. One of the most creatively stimulating musical environments in the world is tucked away on the campus of the renowned Stanford University in Palo Alto, California, a high-tech nerve center for cutting-edge developments in the arts of music and sound: the Center for Computer Research in Music and Acoustics—CCRMA for short, or, to insiders, *Karma*.

CCRMA seeks to lay bare the deep stuff of music. It's a place where the boundaries of musical and acoustical knowledge are pushed to the limit, where experiments in artificial intelligence and MIDI control coincide on a daily basis, and where composers are given both the most advanced technology and the freedom to work without compromises. Perhaps the greatest tribute to the Center's effectiveness is the impression you get from talking with the staff and students that even if they were working with slide rules and kazoos, they would still be there.

Under the guidance of administrative director Patte Wood, the Center supports about 40 instructors, researchers, and composers, both graduates and undergraduates. CCRMA takes great pride in a cooperative, international, interdisciplinary environment that supports the kinds of ideas that might not arise in a more structured setting. As technical director Chris Chafe puts it, "Most of what we do depends on teamwork. There's a natural sociology that develops out of that. Progress depends on sharing with others.

"It's interdisciplinary by nature," he continues. "You get interesting, unpredictable results when dissimilar people are interested in each other's work. We don't limit access to certain backgrounds or qualifications. It just doesn't work. You don't get the results."

CCRMA activities divide roughly between composition and research, but the line between the two tends to blur as research spawns compositions and compositions incorporate new discoveries. At its heart, though, CCRMA is committed to making music worthy of the instruments and techniques being investigated. The Center's composers celebrate their virtuosity through regular concerts, especially the annual outdoor summer concert at Frost Amphitheatre. The Grateful Dead play in this gently hollowed bowl of ground every spring, and CCRMA sponsors the cerebral counterpart: Listeners can lie on the grass, watch the stars, and ponder Baroque counterpoint as bizarre FM patches jet across quadraphonic space, and think, "What a long, strange trip it's been!"

The first stages of the trip began in 1962, when an undergraduate percussionist named John Chowning arrived at Stanford, his imagination set afire by Europe's postwar experimentation with electronic music. (For more on Chowning and the early years of computer music at Stanford, see the sidebar on p. 62). By 1986, CCRMA had moved into its current location, a picturesque Renaissance-style mansion—once the University president's home—on a grassy hill known as the Knoll. The Knoll's geography reinforces both the high-tech and the aesthetic: The southern side looks down on Silicon Valley, while the western view overlooks seasonal Lagunita lake, oak-studded foothills, and Pacific sunsets. Inside, ornate woodwork meets cream-colored walls and incandescent lighting, contributing an air of comfort and class to the facility's basic informality. The win-

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*Stanley Jungleib has worked for Sequential for over eight years. He has written over 100 owners' manuals and articles, including a guest editorial in* Keyboard *in April '86. Jungleib's composition* California, *for Samson Box, Sequential Studio 440, and Prophets T8, VS, 2000, and 3000, was premiered last October at the Audio Engineering Society convention in New York.*

STANLEY JUNGLEIB, MANIPULATION BY EBERLY/LEEDS

NEWS & PUBLICATION SERVICE, STANFORD UNIVERSITY

Behind the sandstone walls of the Knoll (above), the future of computer music is plotted at Stanford's Center for Computer Research in Music and Acoustics. At right, the co-founders of CCRMA in 1975 (clockwise from L to R): Leland Smith, John Grey, John Chowning, Loren Rush, and James A. Moorer.

dows, unlike those in modern office buildings, actually open, providing a gentle breeze from the coast. The kitchen includes an espresso machine, always hot.

Three types of music systems are distributed throughout the Center. Most teaching and composition, and some research, is done on the grandfather of digital synthesizers, the Samson Box (see sidebar on p. 61). One studio is dedicated to MIDI research, and MIDI workstations are scattered throughout the building. Finally, advanced research in acoustic analysis and audio pattern recognition using artificial intelligence is performed on any of a half-dozen Symbolics or Xerox machines using the LISP language. The LISP machines are used in three ways: to explore the possibilities for music analysis by machines, as synthesizers for research into new synthesis techniques, and as high-powered MIDI controllers. A main advantage of LISP is that it allows all of these applications to be combined.

## Teaching Machines About Music

WHILE MOST ACADEMIC ELECtronic music studios serve as centers for learning and production, one of CCRMA's most important functions is research. This work touches on many areas, including digital synthesis, signal processing, computer-assisted composition, MIDI performance, graphics, machine intelligence, psychoacoustics, and digital recording. Discoveries and developments from CCRMA are an important influence on the everyday lives of musicians, as anyone who owns a DX-series synthesizer will attest—the FM synthesis used by Yamaha was developed here.

The problem of how we perceive music is at the heart of much CCRMA research. How can computers be made to hear and understand musical sounds? If we sample an instant of music, we see wave energy at various frequencies throughout the audible range, but connecting a continuous string of such timbre pictures to infer the nature of a specific musical event poses considerable difficulties. How do we know whether a frequency that's been detected is a fundamental or a harmonic? How do we distinguish two simultaneous timbres playing the same pitches? How do our ears and brains untangle a mass of sound into the structural forms behind it? These are enormous questions, questions for which no satisfactory answers yet exist. Current work in this field is quite experimental.

What are the potential fruits of investigations into machine perception of music? A computer-driven analyzer of polyphonic textures, for instance, would obviously be useful for music transcription. A score could be produced directly from a performance. Another potential application is computer assistance in editing digital audio. A musically cognizant editor would be able to edit a sampled passage from instructions given in terms of, say, a visual score. And accurate real-time computer analysis of sounding music would allow machines to interact with human players during performance.

Also, improved analysis of performed music would aid in the understanding of musical nuances. "There's an incredible amount of nuance, inflection, and so on added to a piece by a performer," Chris Chafe points out. "Right now, we can't see a lot of this data, so we can't form theories about it. Soon we'll be able to get a handle on exactly what these things are, and really begin talking about them."

Some of the difficulties involved in machine perception of music don't require a great deal of technical knowledge to appreciate. Consider the process of tracking pitch. With conventional technology, it takes a couple of periods of a waveform to determine its pitch. At a frequency as low as 100Hz, this takes about 20ms. Thus, the tracking is necessarily a little behind. Why doesn't the human ear have this problem? It doesn't need to wait to analyze low pitches; in fact, given a musical context, it recognizes them more or less instantaneously.

Neurophysiological studies point out that hearing can depend upon contexts that have been constructed at a higher level of perception. That is, when you are listening to a musical line, it is quite likely that your ear is functioning as a very responsive filter, accepting tones in the region that your mind expects. (This is roughly the same mechanism that allows

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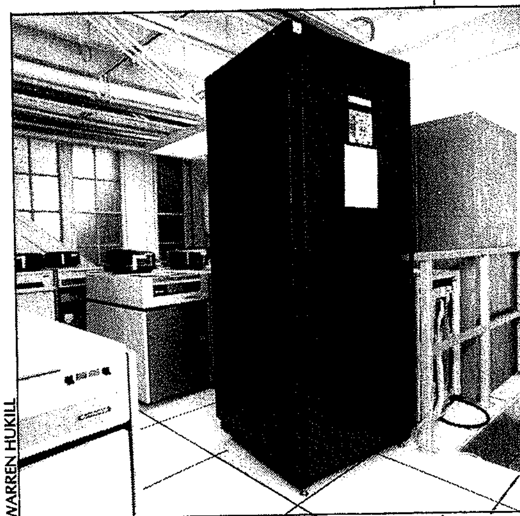
# PLA It Again, Sam

## CCRMA'S SAMSON BOX DIGITAL SYNTHESIZER

**BY STANLEY JUNGLEIB**

According to John Chowning, it's the Stradivarius of digital synthesizers. The Systems Concepts Digital Synthesizer, a.k.a the Samson Box, was designed by Peter Samson and serves as CCRMA's central teaching and research tool. Built between 1973 and 1975 and installed in 1977, it was intended to be the biggest and most powerful digital synthesizer of its time. Samson's goal was to produce a real-time synthesis capability comparable to that of a string quartet, using both additive and subtractive methods. The staff at CCRMA contributed ideas as well. "At that time, FM was involved in the basic work for a lot of software synthesis, so that was a good candidate for inclusion in the system," John Chowning recalls, "and the spatialization and reverberation memory had to be included as well, for research purposes. It really was state-of-the-art."



WARREN HUKILL

**CCRMA's Samson Box: "The Stradivarius of digital synthesizers."**

The instrument is a fully programmable general-purpose synthesizer powered by the Center's main computer system. Depending on the selected sampling rate, up to 256 oscillator/generators are available. There are 128 modifiers (computational elements somewhat akin to DX operators) available for modulation, mixing, resonance, noise, clipping distortion, and other sonic characteristics. In addition, 32 delay units form the basis for reverbation, and can also be used for digital filtering. The Samson Box can be configured for different synthesis techniques in any combination, including FM, subtractive, and additive. There is no physical, real-time controller input; the sounds that come out are determined by a composition program written by the user.

"It reminds me of a sculptor's studio," says CCRMA's technical coordinator Chris Chafe. "All of the work takes place in one chamber, and the pieces that come out are very finely crafted. You're always perfecting the finished result. Composers aren't used to that. Traditionally, you don't have the sonic integration of medium and score."

"Sonic integration" is an understatement. Originally, the Samson Box provided an integration not only of medium and score, but of audience as well. The Samson Box's audio output used to be routed simultaneously to all of the Center's audio terminals. In other words, anyone in the building was treated to whatever work was in progress at any given moment. The constant interchange of ideas that this engendered inspired vigorous musical thought and execution. These days, for practicality's sake, the mainframe's audio switcher routes the Samson Box's output only to the composer's terminal, although the old arrangement can be switched in at the composer's option.

Samson Box compositions are written using the PLA composition language. PLA code is converted into a note list, which is passed through a compiler to translate it into Samson Box instructions. At a later time, these instructions are fed into the Samson Box, which computes all the sounds called for by the composition program. Since the Samson Box doesn't allow for real-time interaction, musicians coming from the world of MIDI have a hard time adjusting to the detached work rhythm of creating a score, waiting for it to compile, hearing the result sometimes hours later, making changes, waiting for the score to recompile, and so on.

Fundamentally, the power of the Samson Box is that any note can have its own programmed set of parameters. The composer has complete and arbitrary control over changes in timbre over time. You can set your patch parameters to fixed amounts, for specific sounds, or you can have the PLA program recalculate them constantly depending on any number of variables which you might choose or define. The main drawback, of course, is that the instrument can't be controlled in real time. Research applications such as exploring machine perception of music require much faster real-time systems.

When a machine in the Samson Box's position reaches ten years of age, questions naturally arise regarding its continued usefulness. Is it time for the gold watch and testimonial banquet? No chance; the Samson Box is still vital. "It's still used extensively," Chowning insists. "It still has a great deal of music in it. Though, of course, there will be systems that will do the same things much more efficiently, it will be some years before the software will be nearly as highly developed as that which exists for the Samson Box."

Nonetheless, even its creator writes, "In an increasing number of cases, its capabilities are close to the minimum needed for serious work." Composers at CCRMA respect the Samson Box for the technological marvel it is and take advantage of its strengths, while still looking forward to the next generation of decentralized musical workstations. ■


John Chowning today, at Yamaha KX88 keyboard, with DX7 to rear and Yamaha RM4108 mixer on top of KX88.

# JOHN CHOWNING AND THE EARLY DAYS OF CCRMA

**BY STANLEY JUNGLEIB**

THE FACULTY AT CCRMA INCLUDES such computer music pioneers as Max Mathews, the originator of digital synthesis, and John Pierce, who presided over groundbreaking research at Bell Telephone Laboratories from 1935 to 1971. The driving force behind the Center, though, is John Chowning, famous for his discovery of the digital frequency modulation (FM) technique now employed by Yamaha in their DX-series synthesizers. The story of CCRMA, and indeed of electronic music at Stanford, is very much the story of Chowning's evolution from violinist and jazz percussionist to one of the world's foremost champions of computer music.

Chowning began as a student of the violin, but switched to jazz drumming as a teenager. After a stint at the Navy School of Music during the Korean War, he landed in Paris, where he studied composition with Nadia Boulanger. During that time he became familiar with the budding European electronic music scene through the works of Boulez, Stockhausen, Berio, and others.

When he arrived at Stanford as a composition student in 1962, Chowning found no electronic music. The music department had little interest, except for one composition teacher, Leland Smith. "An electronic music studio would have been very expensive," Chowning points out, "so there was no possibility of getting the administration to support that. But computers are general-purpose devices, and the

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# BILL SCHOTTSTAEDT SOUND SCULPTOR AT CCRMA

**BY STANLEY JUNGLEIB**

COMPUTER COMPOSITION REquires both intuitive and logical skills. The ability to anyalze the inner processes of an imaginative musical statement and to express that analysis as an algorithm ranks quite a few notches above the ability to do one's own tax returns. Bill Schottstaedt not only possesses these abilities; he also invented the computer language, dubbed PLA, in which such algorithms are formulated at CCRMA. Furthermore, he developed the FM algorithm responsible for producing CCRMA's basic sound library, which includes such categories as strings, bells, explosions, percussion (glass, metal, and wood), insects, frogs, voices, and 50 species of North American birds. Through PLA, his FM work, his unrivalled command of the Samson Box digital synthesizer, and the strength of his compositions, Schottstaedt exerts a powerful influence on all composers at CCRMA.

As a composer, Schottstaedt leans toward finely crafted sound sculpture as opposed to improvisation. He is attracted to computer composition partly because it gives him pitch and timbre control that he can't get in any other medium.

"I'm not interested in the performer," Schottstaedt asserted at a presentation of his work playfully titled, *Music Concrete: Counterperceptual Gestalt Or Oreo Cook-*

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the ear to quickly identify different musical styles, or to focus in on one voice in a crowd.) The ear has an idea of what it will hear, and doesn't question its perceptions from moment to moment until the expectation and the actuality don't match up.

To emulate this perceptual process with a machine requires artificial intelligence techniques. If the machine's microprocessor has some clue about what the musician is going to do, if it is already looking at the right range of values ahead of time, then it will have an easier time keeping up with changes. Of course, music is full of broken predictions, so this is a tricky area. Research shows that a system that knows how to adapt its analytical strategy to changing musical conditions can be very effective: The system keeps in its "mind" a model of the timbre it is supposed to be analyzing. With this information, it looks at the input in a number of ways to detect different classes of events. As the system builds a processing history, it uses successful predictions to further tune its perception.

Using such techniques, senior research associate Bernard Mont-Reynaud has demonstrated some remarkable examples of music transcription. His initial work resulted in a system that can transcribe, both metrically and melodically, a monophonic line from Bach or Mozart, or a drum part, with no restrictions on variations in tempo. Eventually, Mont-Reynaud's program achieved the rather amazing ability to transcribe music of the complexity of Scott Joplin's piano rag "The Entertainer."

## New Horizons In Synthesis

A NEW SYNTHESIS TECHNIQUE called physical modelling also occupies a great deal of research time, mostly that of Chafe, David Jaffe, and Julius Smith. Physical modelling creates compelling simulations of acoustic instruments. It relies on a combination of waveshaping synthesis (using one wave to distort another), a specific processing algorithm, and digital filtering.

Most methods of synthesis require you to build sounds as whole entities, using oscillators, filters, envelope generators, and so forth. In physical modelling, complex waveforms are created by simulating the physical and mechanical attributes of the instrument whose sound you wish to create. These include such characteristics as instrument class, string length and stiffness (for string instruments), air column size (for wind instruments), body material, and resonating chamber size. You virtually build the instrument by specifying its properties. This approach allows you to create the sound of a bigger and more complex acoustic instrument than you could ever actually build. For instance, a 25-foot grand piano would pose no problem.

As it happens, CCRMA's implementation of this technique is especially good for plucked and bowed strings, but it can be extended to simulate reed instruments, brasses, flutes, and pipe organ. When you apply a musical score to the model, performance parameters can be factored into the definition of the sound. For example, the effects of bow velocity, embouchure, or hammer hardness can be programmed, as well as articulations such as dynamics, slurs, picking direction, and the like. To hear an example of the physical modelling in action, listen to Jaffe's string simulations in *Silicon Valley Breakdown* (available on the CD *Dinosaur Music*—see discography below).

The various areas of research will come into focus when a single LISP workstation is used to anaylze a polyphonic texture, interpret it as a physical model, resynthesize the original sounds, and route control outputs to MIDI destinations. In the realm of string simulations, violin bow velocity could be mapped to the amplitude envelope and bow pressure to the FM index. That would be the first step toward a MIDI-controlled string instrument as engaging as the real thing.



## MIDI As A Second Language

ALMOST AS REMARKABLE AS CCRMA's basic research is the degree to which the Center has embraced MIDI. The computer music community originally regarded MIDI with indifference at best, and MIDI-bashing continues in some quarters. Some academic composers think that MIDI is already technically obsolete, and many feel that peformance-oriented synthesizers are not flexible enough to bother with. Some simply seem to be jealous that they weren't able to take years nurturing the MIDI spec through the bureaucracy of academia. MIDI was developed in a grass-roots campaign fought in the streets of commercial reality, and CCRMA's staff recognizes that the victory of MIDI was based on its open architecture, universality, low cost, and real-time capabilities. Visiting Professor Emeritus John Pierce has called MIDI "one of the greatest inventions in the history of music."

His colleagues at CCRMA evidently agree. In an overview of the Center's activities, Smith, Chafe, and Wood state that CCRMA intends to "influence the music industry's understanding as to where available power is best applied, and participate in the definition of future technology." And, it turns out, a good MIDI facility also helps attract good students.

Chafe has been putting MIDI to work to further his academic concerns. The piece he is now working on uses a Macintosh running LISP to control the Sequential Studio 440 and some FM boxes. The aim is to take advantage of the contrasting sounds of FM and sampling. With sampling, he points out, you get accurate sounds, but you can't change them. With FM, it's harder to get accurate replicas of real-world sounds, but you have enough control over them to push them into new timbral dimensions. Interesting effects turn up when you splice together sounds created using both methods, a technique he originally experimented with using the Samson Box. "I generated the score by creating a musical Osterizer," he says of his Samson Box pieces. "You stick sampled sounds and FM sounds into the Osterizer and swirl them up. Playing with those swirl patterns is the root of the piece." In Chafe's eyes, MIDI is the ideal tool for elaborating upon such ideas.

## Friends In The Industry

THE CENTER'S RELIANCE ON POWERful computers is an expensive habit, and the frustrations of grant-seeking come with the territory. While hard-science facilities can rely on Federal funding to pay many of the bills, little Federal money reaches CCRMA. Except where there may be a discovery that can be applied to sensory perception in robots, the government is none too eager to finance a computer music studio. Funding is left up to the private sector, and as a result, there have always been ties between CCRMA and the musical instrument industry.

For example, director John Chowning has worked with Yamaha since 1967. When you buy a piece of Yamaha FM gear, some of your cash ends up in Stanford's pocket. Conversely, Yamaha is very well represented at CCRMA. Their power amps are in almost every room, and Yamaha FM tone generators, sequencers, drum machines, controllers, and signal processors abound. The only non-Yamaha MIDI devices around are a Sequential Studio 440 drum machine/sampler/sequencer and some Opcode Macintosh interfaces.

Passport Designs president Dave Kusek states that he "searched the entire world for the best music printing technology." He found it at Stanford in Leland Smith's SCORE program. Smith had been perfecting his engraver-quality manuscript system since the early '70s. Passport licensed the program, ported it to the IBM PC, and is adding a mouse-assisted user interface, MIDI input, and four tracks of MIDI playback. The package is scheduled for commercial release in the fall of '88.

In addition, CCRMA actively invites manufacturers to support research, and has begun a new program to organize its industrial associates. The Center even sponsors an annual three-day presentation of research results and trends to entice commercial enterprises to enlist their services and license their technologies. Unfortunately, some of the more speculative research may not pay off quickly enough for the needs of a small company, which tends to limit the game to the bigger players.

It's clear that CCRMA's research activities will have a direct impact on the design of music-related technologies in the foreseeable future, even if the musical concepts explored there remain arcane. Ultimately, though, all activities at the Center are motivated by a desire to untangle the mystery that lies at the core of musical sound. The unifying characteristic of music produced at CCRMA, according to Chowning, "isn't so much related to the hardware as it is to an idea about synthesis which the hardware reflects. No matter how the overall aesthetic of pieces that come from CCRMA may differ—and the range is vast—there's one constant within this body of work: the attention that every composer gives to the microstructure of sound. We have vast experience, gained over years of trying to understand the perceptual aspect of sound, of what one needs to do to make a sound lively, and, at a very deep level, attractive to the ear. This is a body of knowledge that is available to every new composer who comes here.

"This is an attitude," he concludes, "that new composers quickly understand is valuable."

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## MIND OVER MIDI

*Continued from page 155*

data" command, and have the server worry about the dialog that a Casio CZ-1 needs. All of this would take a load off of the poor, overworked host computer in a large setup. The server would probably be programmed from the host computer upon power-up, telling each the characteristics of the attached units.

Sound pretty fantastic? The technology is essentially here now. LAN chip prices will inevitably fall with time, making the server reasonably priced. A pretty massive software package for the host computer would be necessary. This would have to work in conjunction with a top-flight sequencer program. The main problem is a chicken/egg syndrome between hardware and software. Both aspects have to be committed. Generally, the software and hardware expertise doesn't coexist in the same company, but the future will come.

In closing, I would like to thank Bill Buxton for his paper on LANs and MIDI, which he presented before the Audio Engineering Society music conference earlier this year in L.A. ■

## COMPUTER MUSIC

*Continued from page 65*


volumes. Includes Chowning's landmark 1973 article on FM.

Strawn, John, ed., *Digital Audio Engineering, An Anthology,* Los Altos: Cambridge, MA: MIT Press, 1985. The most important articles from *Computer Music Journal*'s first three William Kaufmann, 1985. Includes Peter Samson's discussion of CCRMA's Systems Concepts Digital Synthesizer, a.k.a. the Samson Box.


### Music From CCRMA: A Selected Discography

All titles are available from CCRMA, Department Of Music, Stanford University, Stanford, CA 94305. Add $1.00 for postage and handling. California residents add 7% sales tax.

**Cassettes:**

*The Science Of Musical Sound,* works by Pierce (1959, 1966), Lewin (1961), Mathews (1961), Moorer (1978), Risset (1979), Morrill (1979), and Chowning (1981), CCRMA, $8.95.

*Computer Music From CCRMA, Vol. 1,* works by Chowning (1972), Moorer (1978), Schottstaedt (1978, 1982), Schloss (1980), Chafe (1981), Berger (1981), and Jaffe (1982), CCRMA, $8.95.

*Computer Music From CCRMA, Vol. 2,* works by Marin, Wolman, Nunez, Malouf, and Krupowicz (all 1985), CCRMA, $8.95.

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## COMPUTER MUSIC

**CD:**

*Dinosaur Music,* works by Jaffe (1982), Schottstaedt (1982, 1985, 1986), and Chafe (1986), CCRMA, $8.95.

**LP:**

*Computer Music,* by Michael McNabb (1983), 1750 Arch Records, S-1800, $6.95.

## JOHN CHOWNING

*Continued from page 62*

idea of using them for music was very attractive because the computers were already there.

"My first idea about using computers in music was based on an article that Max Mathews had written in *Science* in 1963," he continues. "I visited Max at Bell Laboratories the next year, and he gave me a box of IBM cards containing the Music IV program [a computer synthesis language devised by Mathews]." With Smith's encouragement and help from the new Stanford Artificial Intelligience Laboratory, Chowning got Music IV up and running, and thus the Stanford electronic music program whirred into existence in September 1964.

Chowning joined the faculty two years later. The computer music system, still under the auspices of the Artificial Intelligence Lab, settled in a strange and lonely building far from the main campus, and Smith and Chowning rolled up their sleeves. Smith was working on the music composition interface and input language; eventually his SCORE program would become a fixture at a number of major computer music centers. During his research hours, Chowning grappled with synthesis techniques, timbre, reverb, and the Doppler effect. The fruit of his efforts can be heard in the 1972 composition *Turenas* (available on *Computer Music From CCRMA, Vol. 1;* see discography on p. 156), a virtuoso demonstration of sound design using the FM techniques that Chowning had "stumbled upon" during the early years. *Turenas* immediately put Stanford on the computer music map. When Chowning's paper describing FM appeared in 1973, Stanford patented the technique. Ten years later, Yamaha introduced the DX7.

As the computer music program's reputation grew, students gathered, and it became clear that the project required its own computer and synthesis resources. After working with Pierre Boulez on the design of IRCAM (Paris' state-of-the-art electronic music facility), Chowning formed CCRMA in 1975 with John Grey, Andy Moorer, and Loren Rush. As its first major hardware project, the organization commenced development of the legendary Samson Box, the world's most powerful digital synthesizer to date. (For more on the Samson Box, see p. 61.)

The Samson Box was installed in 1977, and within two years the AI Lab left the building to computer music. CCRMA now stood as an independent entity with Chowning at the helm. The Center's pioneering spirit combined with its remote location to conjure a close-knit tribal/familial atmosphere among the students and teachers. Quarterly concerts stimulated interest in the Center, inspired and attracted students, and cultivated a certain mystique within the Stanford community. Three million dollars from the System Development Foundation, which arrived in 1980, put CCRMA firmly on its feet and established the center's current agenda. The United States' most innovative and well-equipped electronic music facility to date had arrived.

## BILL SCHOTTSTAEDT

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*ie?* "The selection of pitches is the privilege of the composer," he insists, not the performer. "Most players have inaccurate and idiosyncratic pitch control," he laments, "which renders the subtleties of alternative tuning systems unimportant." Schottstaedt also complains that a performer's onstage movements distract from the music. ("Why can't they just sit still?" he asks.) He prefers fixed sounds sources with minimal reverb, if any. In fact, his latest work rejects CCRMA's quad sound system in favor of a single monophonic channel.

Schottstaedt's aesthetic is logical, unequivocal, and utterly purged of cheap sentimentality and vague intentions. In a sense, though, his music's specificity validates the richness of expression that appears on the flip side of Schottstaedt's musical coin. Formalism doesn't prevent his music from striking many listeners as the most beautiful and effective computer music of recent years. Such pieces as *Leviathan* (1987, not available commercially) present a vibrant, rich tonal tapestry light years beyond the blips and bleeps that many associate with computer music. Which is not to mention that the *musique concrète* techniques used in the piece are a great lesson in the art of sampling.

Although *Leviathan* is a strictly organized, unequivocally *pitched* piece of music, all of its sound materials were taken from a standard sound effects LP. Fourteen sounds chosen for their noisy character were sampled: train, rooster, creaking ship's mast, water pump, thunderstorm, and so on. The intention, the composer says, was to use noise to create a piece that "a composition teacher would be perfectly happy with. This much noise means that you can pick out any pitch that you like [by looping]." The computer program for the piece assembles over 15,000 fragments of these sounds, each with computer-controlled looping, into an organizational scheme that is partly automated and partly determined painstakingly by the composer.

To keep the loops interesting, Schottsteadt randomized the loop start and end points, so that a slightly different sound would play with each iteration of a given sample. He also used dynamic loops. For one particularly bone-chilling segment, he took the sound of a creaking ship's mast and slid a short loop down it to create a modulated timbre that Chris Chafe has described as the sound of "a compound fracture grating on ice."

Schottstaedt sometimes complains that he has taken the Samson Box as far as it can go, but he continues to come up with new music. He developed a post-PLA language called JETSAM that included more functions than PLA, but today he rejects both, insisting that you don't need a composition language, you only need a good computer language. And which language is the prime candidate? LISP, of course. The composer just used it to create an expert system which writes species counterpoint in any standard mode for up to six voices. Clearly, it will be some time before Bill Schottstaedt has taken CCRMA's resources to their limits. ■

## ZIMERMAN

*Continued from page 56*

*We understand you collect manuscripts of compositions.*

Facsimiles, of course. I have some original manuscripts also, but mostly handwriting copies. It's quite interesting—from the handwriting you have a much more precise view of the composer, of his character. It sometimes gives some little flame of information that from the printed music is not so easy to get.

*Has your knowledge of psychology affected the way you play?*

Certainly the way I work, yes. Simply by knowing how the brain works, knowing how all these subconscious processes go on in the brain, you can use them consciously. You can understand sometimes why something works or why something doesn't.

*If your daughter, in a few years, were to show some talent for playing piano, and if you were willing to teach her, how would you go about it?*

You know, I wouldn't like her to be a pianist. It's a profession that depends on so much—one must be so lucky to get to the top. There are so many pianists who teach in schools and who are unhappy, and they switch to other professions. A very small percentage are lucky enough to do what one learned at school, simply to perform. To make music onstage. And if you're a woman, I guess it's still more difficult. There are so few women who manage to have a normal, happy family life, and still be a performing artist. The probability of producing such a person is almost zero. So I would like her to do something else. ■