DEPARTMENT OF MUSIC
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29 October 1993

Memo to: Dean John Etchemendy, H&S

From: Albert Cohen, for the Executive Committee in Music

Subject: Vision statement

Dear John:

Here is the vision statement you requested on the departmental programs in Composition/Theory (draft prepared by John Chowning) and in Musicology (drafts prepared by Karol Berger and William Mahrt), on which we have worked, and to which all members of the Executive Committee subscribe.

We believe that, with modest but planned and systematic growth in these areas, we can be a leading center for the study of music among American universities.

We look forward to an opportunity to discuss issues raised by this statement with you.

Many thanks,

From its beginning Stanford has distinguished itself from its prominent forerunners. One of the most distinguishing attributes of Stanford is the evolution of a rich representation of the engineering sciences in balance with the humanities and sciences - engineering as the effective *application* of scientific study. In the case of music, Stanford was early on a leader, if not the first, in the coupling of scholarly study and performance - again the *application* of scholarship. A decade or so later, the incipient alliance of computing and music composition was directly dependent upon the close cooperation between music and the engineering sciences. It is true, therefore, that the Department of Music has both contributed to and profited from the unique attributes of this institution. As we consider the future of our department we must be both critical and imaginative and especially cognizant of that which we have done and can do excellently.

Composition and Theory

Graduate Level

For more than twenty five years the composition program at Stanford has been closely aligned with computer sound synthesis, composing programs, and score production and publishing by computer, available at the department's Center for Computer Research in Music and Acoustics (CCRMA). The emphasis on the use of the computer as a sound producing medium is not to the exclusion of the traditional media (i.e. solo and chamber instrumental music, music for voice(s), orchestra, etc.). Rather, the use of the computer is seen as a powerful complement to the traditional media.

There are a number of reasons why composers have chosen to use electronic in addition to traditional means for producing music. Two reasons are particularly important:
*   the historical evolution of acoustic instruments has been supplanted by the extraordinary generality and economy afforded by digital sound technology, and
*   programming languages and their strategies of use (often borrowed from computer science and related fields) are having a profound and lasting effect upon musical thinking.

These reasons are so compelling that we would expect the alliance of music composition and computer technology to become widespread in our institutions- which is indeed the case. By now nearly every major American university supports a computer music facility or activity of some sort. Further, there is computer music activity in all of the developed countries of the world.

That which sets apart Stanford's composition program from others that have strongly embraced computer technology is the environment in which it occurs. While composition is at the core of CCRMA, there is a variety of related research that surrounds it, ranging from programming environments for composition to computational physical modeling. The presence of such a wide range of skills, in addition to programming competence in a common environment, engenders a depth of understanding in important areas such as contemporary acoustics and perception, that is unique in university composition programs.

The teaching of composition has been partitioned between CCRMA and the music department. Compositional programming languages and composition of musical micro-structure (acoustics, sound synthesis, psychoacoustics) have been taught by the faculty

associated with CCRMA. Traditional composition, instrumentation, notation, and form have been taught by the composers in the department.

Where the Stanford program ranks in the most general sense is not easy to determine, but it has been at least among the best programs (if not the best) where computing is strongly allied with composition.

Weakness in the program-

A weakness in the program is that the composition students are given no choice of teaching styles in the department. Some composers want to identify closely with their teacher as mentor, while others prefer a rather more detached objective teaching style (unquestionably the case over the past thirty-five years). Other successful programs (e.g. Princeton, U.C. Berkeley, U.C. San Diego) have at least four or five composers on their faculty. Student composers should have some choice of teachers of composition and the opportunity for multiple exposure through the course of their graduate program.

Undergraduate Level

The undergraduate program in composition and theory has been uneven over the years. Before the addition of the junior tenure-track faculty position, the program was good or bad depending on the person in the temporary position. The good composers and teachers went on to take better positions, of course. Since J. Rockmaker has been in the junior composition/theory position, the undergraduate composition program has been greatly vitalized. For the first time, beginning composers can expect continuity from year to year.

Weakness in the program-

The core of the undergraduate music major consists of the music history and the music theory sequences of courses. The weakness in the undergraduate program is found in the theory sequence and the very limited time that Rockmaker can devote to teaching composition. Harmony and counterpoint are a fundamental part of the comprehensive undergraduate major. They are not only the first of many skills that a composer must master, they are also the key to every student's musical literacy or ability to analyze and understand musical structure at the functional level.[1] whatever concentration the student chooses to pursue - Composition, Music History, or Performance. This knowledge is as important to the study of music as is calculus to the study of physics. J. Rockmaker has been given responsibility for this program and it is a discouraging task. The teaching needs are being met on an ad hoc basis because there is no continuing faculty dedicated to helping Rockmaker in teaching the courses. The initial energy and enthusiasm of our junior colleague will surely wane given such meager means to realize this most important course sequence of our program. We should not allow our colleagues, especially junior faculty, to continue in such discouraging circumstances.

The new undergraduate music concentration in Music, Science, and Technology (MST) was designed to meet the special interests and needs of engineering and science majors who also have strong musical interests and abilities. The program places special emphasis on the acoustic and perceptual foundations of music and the musical ramifications of a rapidly evolving technology. Again, as with the graduate composition

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[1] That which W. Mahrt calls *intrinsic musical processes* .

program, it is a course of study designed around the unique attributes of Stanford and profile of its student body. The quality of the undergraduate theory sequence is especially critical to this program if we are to meet our objective of musical literacy.

Steps to Take to Bring Composition/Theory to the Highest Level

Because the activities of CCRMA are so well integrated into the composition program, it is not necessary to increase the number of composers in the department to four or five in order to compete with other top ranked schools. But it is essential to bring the number of composers in the department to three in order to provide graduate level composers the desired choice and to put the under graduate theory program at the high level that our students deserve.

1. The replacement for L. Smith should be a mature composer/theorist with broad experience in composing for traditional media. This background will provide our students with a sure criticism that stems from extensive experience in composing for a variety of media and combinations. This composer should also have substantial experience and skills in composition combining computers and digital sound technology with traditional media.[2] Extensive theoretical knowledge in computer music and related fields is not a requirement, as that is already well covered by the faculty at CCRMA.

2. The additional junior level position should be filled by a composer/theorist who also has interest in what we do well at Stanford. This third position in composition would allow the needed flexibility in the undergraduate and graduate programs.
- The undergraduate theory sequence can then be shared by well-trained and dedicated teachers, as is the undergraduate music-history sequence.[3]
- The faculty would have the time to develop, with the faculty at CCRMA, a computer based ear-traing program that would place ear-training in an optimal learning context and at the same time free graduate student assistants for more important assignments.
- This additional position would also provide space in the teaching loads to make all three composers available to students at the graduate level.
- This position would have the further benefit of relieving the music historians from the chore of teaching beginning theory and allow their greater participation in cross-campus interdisciplinary programs.

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[2] There is one composer, Jonathan Harvey, who stands out as he would be an exceptionally well-suited complement to our program. He is an English composer of great international stature who has had a number of commissions from Boulez at IRCAM, the London Opera, the German Radio in Cologne, etc. If we were able to interest him (and I think that we could), he could not come earlier than 1995/96 as next year he has been invited to be the Bloch Professor of Music by U. C. Berkeley. This is a visiting appointment of great distinction that has included Roger Sessions, Leonard Meyer, and Gunther Schuller in the past.

[3] With the addition of a junior composer, the number of required courses for the theory sequence and the faculty available to teach them would be:
Music Theory: 7 courses, 3 faculty, course to faculty ratio = 2.3

With this third appointment in composition, Stanford can assure a world class reputation in composition and technology as well as bring its undergraduate theory sequence to the high level already reached in the music history sequence.

Toward an Integrated Department

Some see computers and the associated technology and software as tools that simply allow the user to accomplish a task in a shorter amount of time or with greater efficiency. In the humanities this is a common view - the computer is useful as a word processor or as a bibliographic tool. Others see the computer as an enormously powerful complement to thinking where the hardware and programming languages themselves represent thousands of man years of thought about thought. It is a machine that is unique in that its conceivers cannot foresee all of the uses to which it will be put. There are two areas of our department's scholarly activity in addition to computer music that can be enriched by computers and further extend the uses to which they are put.

Performance

Until the past few years computer sound synthesis at a high level of quality was limited to large computers in laboratories. Now, with small but powerful work stations, digital synthesis can be easily moved into concert environments. At CCRMA there exists a long-standing interest and experience in ways to relate the computer synthesis technology to performance. Here we note some alliances between performance and technology that cross the boundaries of sub-disciplines and are already being realized.

- Over the past three years some remarkable links have been made between seemingly distant areas of research within the university. These links were the result of the particular interests of a graduate student in Mechanical Engineering, Brent Gillespie. The areas and faculty participants are:
  1. Force Feedback Systems and Haptic Displays - Prof. Cutkosky, Mechanical Eng.
  2. Early Keyboard Instruments - Prof. George Barth, Music
  3. Electronic Instrument Controllers - Profs. Chafe and Mathews, CCRMA
  4. Instrument Simulation by Wave guides - Prof. J. Smith, CCRMA

  For years we have realized that no matter how high the quality of sound reached in the electronic simulation of keyboard instruments such as the piano, there would never be wide spread acceptance of these electronic instruments until the *feel* of the keyboard was like that of the acoustic instrument to be simulated. The complicated mechanism between the key that is depressed and the hammer strike at the string provides information to the performer that is critical to fine performance. With the cooperation of the above faculty working in their own areas of research, a general solution has been defined: the *programmable active keyboard*. The realization of such a device would have considerable consequences in scholarship/performance in that it could replicate the touch and sound of any historical keyboard instrument at relatively little cost. It would have all of the advantages that come with an electronic simulation: arbitrary tuning systems, acoustic isolation through headphones, light weight, and "player piano" capability. The realization of such a device would also have an enormous impact on the music industry. (The manner in which this idea developed is itself notable as it was dependent upon an interaction between disciplines that can only happen at a well-balanced and forward looking research university and perhaps only one with the particular profile of Stanford - *see appendix* A).

- The graduate student in piano performance practice, Ruth Oppenheim, did an analysis and performance study of Jean-Claude Risset's new compositions for the DiskKlavier,

a computer controlled acoustic piano in the tradition of the "player piano". These works are elegant examples of human-machine interaction, and even more than the now famous works of Conlon Nancarrow, show a direction of composition and performance in this medium that has unlimited expressive and acoustic potential.

- There is a rapidly developing interest in the use of the Mathews' Radio Baton as an accompaniment medium for performance ranging from solo instruments to choruses. Here, the computer and synthesizer comprise the indefatigable accompanist. The conducting-like gestures of the soloist or performer moving the baton (transmitter) near a special surface (receiver) is converted into control signals for a synthesizer providing dynamic control over arbitrary musical parameters such as time, loudness, vibrato rate, etc. As more and more music is converted into a machine readable representation the value of this simple but elegant concept increases.

The importance of the position in piano performance to our programs is such that its reinstatement should be seriously considered.

Musicology

Music scholarship (with performance and composition) is based upon a representation that is primarily print on paper and sound recordings housed in libraries. What will the platform for our work be like at the turn of the century and will we be ready for it? Do we, who are scholars and creators in that discipline which has the most complex symbols and problematic representation of all, have at Stanford a unique opportunity to guide and make use of the inevitable consequences of the rapidly evolving electronic technology and high speed networking? It seems that we do.

- Stanford has already clearly indicated its general commitment to the computer based library.
- The music faculty has a broad representation of expertise including theory, performance practice, criticism, aesthetics, etc.
- The department is closely aligned with one of the most powerful of the computer based music representations, the printing program *SCORE*.
- Some department faculty have already established a working relationship with the *Center for Computer Assisted Research in the Humanities (CCARH)*, which has developed another of the most powerful music representations and which center is a rich resource for information regarding the general area of computing and music research. Located in Menlo Park, CCARH has two exceptional researchers, Eleanor Selfridge-Field, an excellent historian who has extensive knowledge and publications in the area of computing and music research, and Walter Hewlett, the center's founder and a visionary in the relation of technology and music research.
- The project in computer based sound archiving, directed by M. Mathews and funded by the Mellon Foundation, is already established at Stanford with complimentary efforts underway in Germany and in Japan. The archive is unique in that it will be "paperless" as all of the associated graphic materials will be stored in digital form by using optical scanning devices.
- Within the department there already exists excellent computing resources and expertise in all areas of sound representation, data reduction, instrument simulation, etc.

There are two unsolved problems that are of great importance to the area of computing and music research:

- *optical character recognition (OCR) for musical symbols,* a far more difficult problem than alphabetic text and the key to the conversion of all printed music to machine readable data bases,
- *automatic music transcription,* the means by which music as acoustic signals is transformed into music notation.

The researchers at CCARH are well along in identifying solutions for OCR and research at CCRMA has made some dents in the problem of automatic music transcription, a far more difficult problem.

We can expect that the opportunities to forge technological alliances with performance will increase as we can expect new paradigms for understanding musical processes to emerge from musicological studies. In the near future, the common ground on which musicology, performance, and composition will all find their materials will be integrated in computer based music notational, lexical, graphic, and acoustic representations. We will have much to gain if we define this common ground and much to share having done it together.

Future graduates of our doctoral programs can make a distinct contribution to scholarly and creative musical activity if they not only have a deep understanding of their chosen area of study, but also have a deep understanding and experience in the practical application of the technologies which will inevitably interfuse with our academic lives.

Appendix A

The Programmable Keyboard

Three years ago, Brent Gillespie, a beginning graduate student in mechanical engineering, came to talk to us at CCRMA because he is also a pianist and had heard of our contributions to the synthesizer industry. In the course of our discussion we spoke about the problem of electronic keyboards, noted above, and Brent expressed some interest in looking at the problem from the point of view of the work his professor was pursuing in force feed-back systems and haptic displays.

George Barth had recently acquired replica of a forte-piano from ca 1780 that had been specially built for him at a cost of some $20,000. His interest is in linking the study of performance of a particular repertoire to the instrument for which it was composed. The obvious difficulty here is that any students of Barth who want to teach or perform in similar vein are required to convince their own institution to spend $20,000 for a similar replica. It seemed that studies of this sort would never find widespread acceptance because of the costs of the instruments.

B. Gillespie saw no reason that a programmable keyboard could not simulate the feel of any keyboard instrument as long as measurements and analysis could be made. Digital simulation of the sound of an arbitrary keyboard instrument seemed equally tractable using the physical modeling strategies under development at CCRMA. Further, loudspeaker arrays could be used to replicate the radiation patterns of sound boards. However, the most difficult aspect of the research would be the programmable keyboard. The development of such an electronic replica would progress from analysis, to simulation using general purpose systems, proto-typing, and finally the fine tuning involving an expert and knowledgeable performer on old instruments. Great progress has been made over the past three years as Gillespie is well into the second stage of research.

In discussing the idea, we realized that here was an opportunity to pursue a research path that was intrinsically interesting from the point of view each of the various disciplines. It is also a project that is dependent upon unique attributes of Stanford, an imaginative graduate student working with his faculty advisor in a cutting edge area of engineering, extensive sound synthesis expertise and interest in new controllers at CCRMA, a fine performer/scholar of the piano, its evolution, and precursors, and a department that owns some of these old instruments that can be used for measurements, analysis, and comparison.

Research leading to a keyboard having programmable touch that could simulate the touch and sound of any keyboard instrument, would not only find scholarly applications but extensive applications in the music industry as well.

Appendix B

A Brief History of Computer Music at Stanford

Max'Mathews first programmed a computer to synthesize sounds at Bell Telephone Labs more than thirty years ago. In 1963 his work was published and noted by a few composers which led to beginning activities in computer music at Princeton and at Stanford. With the help of M. V. Mathews and the encouragement of his advisor Leland Smith, J. Chowning, a doctoral candidate in music composition, set up the first on-line sound synthesis programs in the autumn of 1964.

In 1966 Chowning was appointed to the faculty and the first course in computer music composition was taught here to graduate student composers from both Stanford and U. C. Berkeley. That same year, L. Smith became involved and began the research in music representation that would ultimately lead to his music printing program "Score". In 1967 Chowning discovered a means for synthesizing complex tones that was computationally economical and rich in timbral diversity. Known as Frequency Modulation Synthesis it soon became the principle means of sound generation in computer music. In the ensuing years the field has flourished. It has attracted increasing numbers of composers as well as engineers and scientists who have found music an important domain of application for their research[1].

CCRMA is Formed

In 1975, coincident with funding from the National Endowment of the Arts and the National Science Foundation, the Department of Music with the leadership of A. Cohen, founded the *Center for Computer Research in Music and Acoustics* (CCRMA). In 1977, a similar music research activity, IRCAM, was launched in Paris under the direction of Pierre Boulez and supported by the French government. A close relation was established between the two centers as Boulez had used CCRMA as a model for IRCAM. The close relationship continues to this day. For example, graduate students in computer music theory and composition are able to spend several quarters studying at IRCAM after having been admitted to candidacy.

As a result of the broad multi-disciplinary interest and participation at CCRMA computer music research includes a number of areas[2]:
- programming environments for composition
- musical acoustics (signal processing analysis, synthesis, and computational physical modeling)
- music representation and publishing
- psychoacoustics, perceptual and cognitive psychology
- performer and computer interfaces and new musical controllers
- music theory - early music tuning systems
- room acoustics (concert hall simulation)

As noted above there were two faculties willing to support initial investigations into computer music in their departments. By now computer music is found in nearly all American universities and in all of the developed countries of the world. CCRMA has

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[1] Electrical engineers have found music, in addition to speech, a challenging domain for signal processing. Both psychologists and computer scientists have found the problem of automatic music transcription from acoustic signals to be challenging, if not daunting. Mechanical engineers find the area of electronic instrument controllers to be interesting in relation to force-feedback systems.

[2] It is important to note that some of the above areas have "migrated" over the years from one discipline to another according to changes in the discipline, funding practices, etc. Acoustics, for example, was once a sub-discipline within physics, but is now most likely to be found in the engineering sciences. Musical acoustics, a sub-discipline of acoustics is now robustly associated with computer music.

distinguished itself from all others by its multi-disciplinary nature and most especially by its central focus on composition.

The position of CCRMA within the field is unquestionably an enviable one:
- the center is well-integrated with composition in the Department of Music
- it has maintained strong links through teaching and common research interests to other departments
- through its Industrial Affiliates program, CCRMA is able to support graduate students from other departments thereby assuring the continuance of a rich multi-disciplinary environment
- through the Office of Technology Licensing, CCRMA's inventions, by both faculty and students, are expected to continue to provide sufficient income to meet its operating costs and add to its endowment

Faculty and Staff

In order to meet offers to critical personnel from other universities, Chowning asked for three Associate Professor (Research) positions in 1988. These positions were approved by then Dean of H&S, N. Wessels. In the context of this request, the scope of CCRMA's work and programs was defined, as it would affect staff and facilities into the future. The staff has not grown and it is not expected to grow in the future.

Faculty-

J. Chowning	Professor and Director
C. Chafe	Associate Professor (Research) and Technical Director
J. Smith	Associate Professor (Research)
—————	Associate Professor (Research) unfilled since 1991
M. Mathews	Professor (Research)[3] (without salary)
J. Pierce	Visiting Professor (Emeritus) (without salary)

Staff-

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P. Wood	Administrative Director
H. Kugler	Secretary
J. Kadis	Audio Engineer and Instructor
F. Lopez-Lescano	System Engineer and Administrator
B. Schottstaedt	Software Engineer

Funding History

From the beginning of the work in computer music in 1964 until 1975 there was no support except for limited access to the computer system of the Artificial Intelligence Project directed by John McCarthy. In 1975 two grants were obtained from NSF in support of research in signal processing and psychoacoustics and a one time grant from the National Endowment for the Arts to acquire a specially designed real-time digital synthesizer processor. As
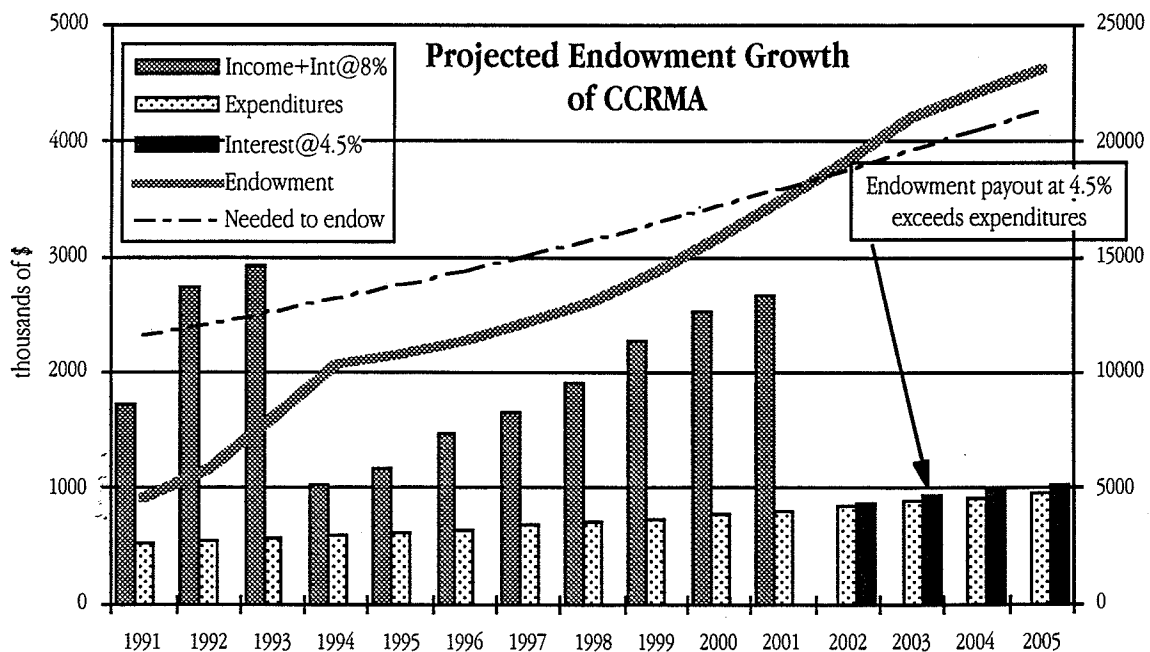
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[3] John Pierce and Max Mathews both spent the greater part of their distinguished careers as research scientists at Bell Telephone Laboratories in Murray Hill, NJ. Following his retirement from CalTech 1982, Pierce came to CCRMA in order to pursue his long held interest in acoustics and perception. Max Mathews retired early from BTL and was appointed to the CCRMA faculty in 1987. In both cases the retirement benefits were sufficient that they needed no salary in order to pursue their interests in music related research. CCRMA provides them with any equipment and administrative support that they need. They both have made extraordinary contributions since coming to Stanford, not the least of which is the forming of a course Psychophysics and Cognitive Psychology for Musicians with Roger Shepard in Psychology.

federal budgets came under pressure, CCRMA was no longer able to regain support. Funding from NSF was difficult to continue since the work was not central to the agency's mission nor was CCRMA within the its traditional lines of funding.   In 1981 CCRMA received a five year grant from the System Development Foundation (SDF). In 1977 Dean Halsey Royden advocated that eventual royalty income in excess of CCRMA's operating costs would be used to build a fund for an endowment for the center.

In 1975 Stanford had granted YAMAHA Corporation of Japan a world-wide exclusive license to develop the FM Synthesis technique for musical instruments.   By 1982, the evolution of the LSI technology together with YAMAHA's and CCRMA's development of the FM algorithm, allowed the production of a series of musical instruments and devices that quickly achieved a remarkable success. The royalty income has increased every year and is expected to continue to increase through the end of the patent term and license in April of 1994.

no support	———————— NSF ————	SDF ————————	Royalty Income ————————	
1964	1975	1981	1985	1993

Funding History
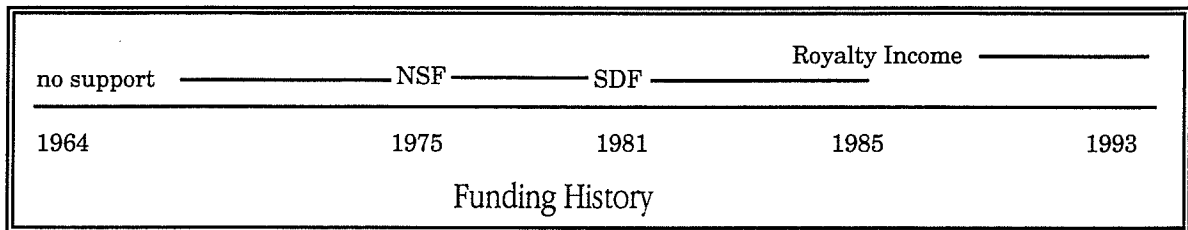
In 1987 additional patents were issued based upon the work of Julius Smith of the CCRMA faculty. Non-exclusive licenses have been granted to YAMAHA and a number of American companies which are developing the integrated circuits for the next generation synthesis engines.   A projection of the CCRMA's earnings from royalties, expenditures, and endowment fund is shown below.

Projected Endowment Growth of CCRMA

Legend: Income+Int@8%; Expenditures; Interest@4.5%; Endowment; Needed to endow

Endowment payout at 4.5% exceeds expenditures

Musicology

Musicology (the scholarly study of music, as distinguished from the composition and performance of music) is customarily divided into three branches: historical (the study of art music in the West); theoretical (the theory of Western art music); and comparative (or ethnomusicology, the study of popular music and of the non-Western music traditions). The historical branch forms the center of musicological studies in all of the best academic music departments in the U.S.; many of these departments also have programs in music theory; only some have programs in ethnomusicology.

Since the founding of the university, Stanford has been dedicated to practical studies, and it continues to be distinguished by the integration of theoretical and practical studies on the highest level. In music, this was realized by the integral study of theory and history, as well as the programs in computer music and performance practice. At Stanford, we have had for many years a Ph.D. in historical musicology and we continue to consider this program indispensable, both as a component of music studies within the department and as a component of historical humanistic studies within the university. When independent theory programs started to be set up at various universities in the 1960s, we decided against developing one ourselves, convinced that the separation of history and theory will impoverish both. We continue to believe that this was a correct decision and feel vindicated by the notable recent signs of re-convergence of historical and theoretical branches. Nevertheless, for the sake of the breadth and comprehensiveness of our programs, it would be desirable to have represented among our faculty interests systematic music theory and ethnomusicolgy.

Musicology at Stanford has long had an individual profile and, rather than duplicating research directions well represented at other universities, we would like to continue to emphasize our distinctive character. Musicologists study specific musical texts or groups of texts in a large variety of contexts (contexts provided by other texts, by ideas about music, by artistic, social, and political practices and institutions). What is distinctive about musicology at Stanford is our emphasis on close reading of musical texts, especially for intrinsic musical processes--how musical tones interrelate to form a complex musical artistic language. What is also distinctive is the use of appropriate contexts to illuminate the texts; thus, conclusions about works illuminate contexts and vice versa. The close complementarity of these two processes is what is most distinctive and is the basis of our own integration of the study of theory and history. We understand our central business as the interpretation of musical works, and we take the term "interpretation" in the broadest possible sense, to include the investigation of historical performance practices, as well as the historically informed analysis and criticism of music, and the history of music theory. We would like to continue to emphasize this individual profile for musicology here, not only because of its suitability to the nature of the institution and what is best of the existing program, but also because we are convinced of its intrinsic scholarly and educational value.

We wish to continue the study of performance practice as an integral part of the Ph.D. program in musicology, based upon existing strengths in faculty and resources. Interdisciplinary work should also have its place: faculty members should be able to participate more widely in interdisciplinary work across campus.

We are currently considering the nature of the musicological appointments, that is: the balance between historical specificity and a more general kind of scholarly excellence among them, the sequencing of all the departmental searches, and the question of relative professional maturity of new appointees. This process will include appointments in both musicology and composition/theory.