

(1966—74)

Richard Teitelbaum

One summer evening in 1966 while living in Rome, I had an unusual experience with two old friends. Seated quietly several feet apart on three corners of a large bed, we seemed for several minutes to be communicating telepathically. No one spoke or gestured, but waves of energy seemed to transmit information between us with extraordinary clarity and an almost physical intensity. It was as if our minds were open and tuned to a common frequency which facilitated transmission and reception. Although there was hardly any physical movement, whatever gestures there were seemed to possess significance and create wave patterns of their own. In retrospect, the frequency band seemed to be in the sub audio range, though at the time I did not analyze it.

The impression left by this experience was strong, and prompted further investigations. The idea of brain waves came to mind though it was a phenomenon about which I then knew virtually nothing. By chance, I found a copy of W. Grey Walter's pioneering work *The Living Brain*¹ in Rome. Studying it thoroughly, I was particularly interested in the sections on flicker and alpha feedback, and by descriptions of the hallucinatory experiences reported by some subjects. One night I had a dream, or hypnagogic vision, in which I saw three reclining figures spaced along the perimeter of a round, diaphanous "tent", all bathed in a soft blue light and all wired together in a loop so that one person's alpha brain waves controlled strobe lights and sounds perceptible to the next, he in turn passing his alpha signals similarly on to a third, and the third back to the first to close the loop.

The image haunted me, and I decided to try and realize it electronically and musically.



1966 was an exciting time for new music, perhaps the first period of great florescent activity in live electronic music (that is, electronic music performed in real time rather than created in a studio on tape). There was particularly then, a great interest by composers in the use of feedback—acoustic and electronic—as a fundamental musical process. John Cage and David Tudor had already carried out their innovative work in the early 60's, and such classic feedback pieces as David Behrman's *Wavetrain*, Max Neuhaus' *Public Supply*, and Terry Riley's tape delay feedback works were being created. In Rome, the composers who were soon to form the live electronic music group *Musica Elettronica Viva*—Frederic Rzewski, Alvin Curran, Allan Bryant, Jon Phetteplace and myself, were making similar experiments, and working together preparing the festival *Avanguardia Musicale I*, at which many works employing the new electronic techniques were presented in September of that year. It was in this stimulating creative atmosphere that I fortunately found myself when I began to develop ideas for biofeedback music.

The principal problem in trying to create music from brain waves was, of course, that most of the energy of the brain's electrical activity is in the sub-audio frequency range (the prominent alpha rhythm, for example, being 8-13 Hz). To translate these signals into sound, a number of approaches were suggested: recording the EEG (electroencephalogram) on tape and speeding it up would of course eliminate the potential of real time feedback; multiplexing to create beats with higher frequencies was a possibility; employing alpha to control a giant vibration table, capable of rocking a whole audience was one of the more fanciful (and impractical) suggestions. In discussing the problem with composer Frederic Rzewski, I learned of Alvin Lucier's *Music for Solo Performer*, in which the filtered alpha is amplified to the point of producing distortion in the loudspeaker, the essentially sinusoidal alpha waves being "modified" by the speaker to produce an audible pulse. It was also from Rzewski that

I first heard of a man named Robert Moog, in New York State, who had reputedly invented a new electronic music system employing a principle of "voltage control". Although exact information about Moog's innovations was difficult to come by in Rome at that time, it seemed, in principle, that the timbral parameters of Moog's modules would afford a most flexible and precise interface. The promise of actually "orchestrating" the physiological rhythms of the human body—heart, breath, skin, muscle, as well as brains—with whatever material from the vast gamut of electronic (and modified concrete) sounds was an exciting one, both musically and psychologically. On the other hand the richness of the available range offered many choices to best select the most efficacious sonic material to complete the consciousness-affecting feedback loop.

Returning to New York in the fall of 1966, I wrote to Moog, and received a characteristically warm and encouraging reply affirming the feasibility of the project. At the same time, I sought advice and assistance from medical electronics manufacturers and EEG biofeedback researchers, both with considerably less success. There seemed to be almost no one doing serious work in alpha feedback at the time. Finally, by chance, I made contact with Dr. Lloyd Gilden in the Psychology Department of Queens College, to discover that he was conducting experiments on the effect of alpha feedback. I immediately agreed to become a research assistant and served as both subject and experimenter in Gilden's experiments for some six months, under a grant from the Lifwynn Foundation, an organization devoted principally to the further explorations of the concepts of *cotension* and *ditension* first formulated by the late psychologist Trignant Burrow.

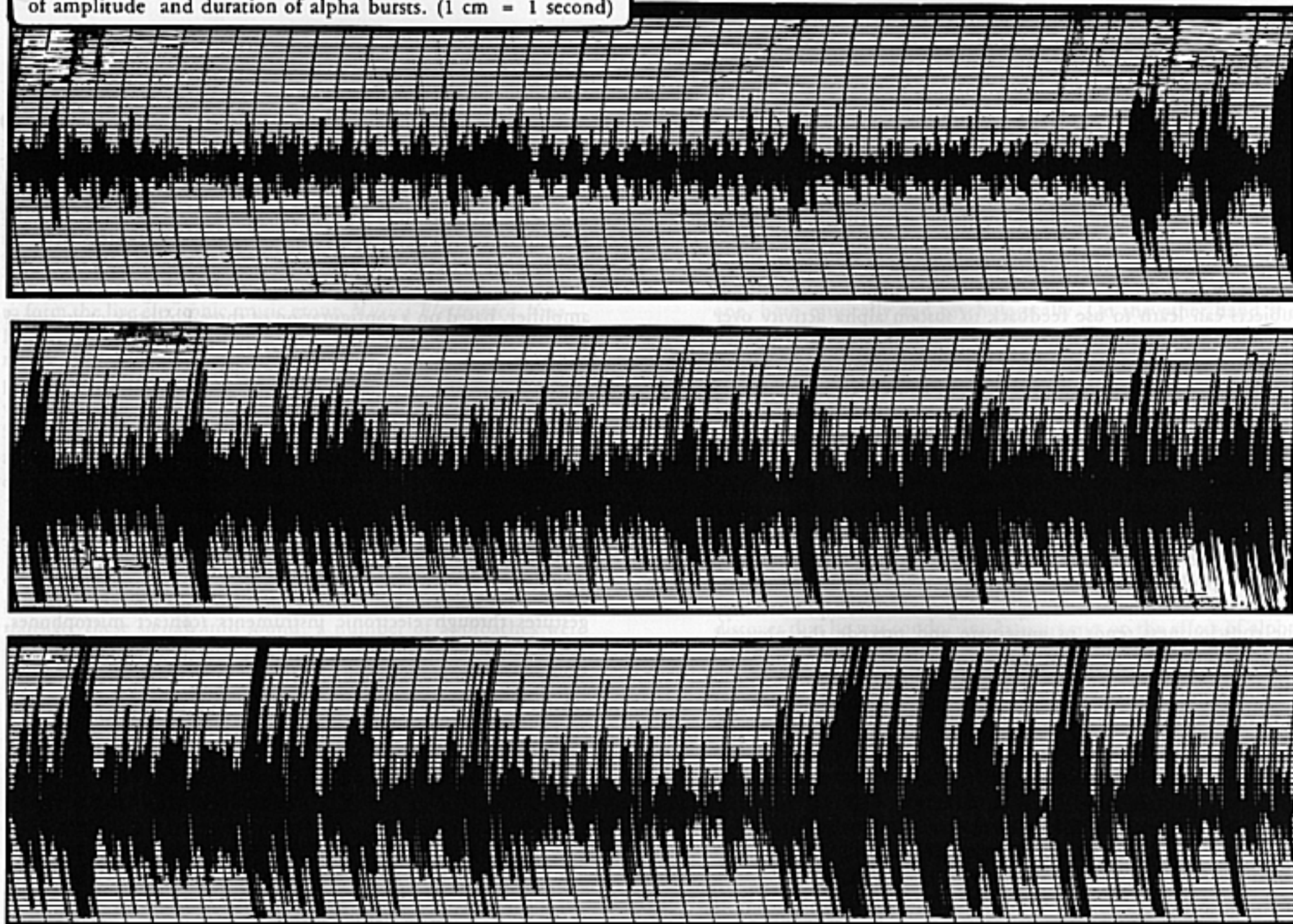
Gilden had a broad interdisciplinary background, including doctoral work with Hebb at McGill University, studies with Alan Watts in Zen meditation, and similar researches in Japan. He was then engaged in two experiments involving alpha, the first

comparing the effectiveness of various forms of sensory feedback (sound, light, sound-light); the other measuring the form of alpha activity developing with feedback practice.² These experiments were similar to those being done by Dr. Joe Kamiya at about the same time, and yielded similarly promising results. Using the alpha-controlled beeps or strobe light flashes as guides, subjects were motivated to produce as much alpha as possible. "Results indicated that auditory and visual feedback were similarly effective in facilitating the production of alpha, and that subjects can learn to use feedback to sustain alpha activity over extended periods of time."³ (See Fig. 1) Further, certain positive internal processes and states seemed to be linked as subjective correlates to the quantifiable increases in alpha activity. Such was my own experience during the many hours I spent as a subject training myself with alpha feedback, though a precise verbal description of the altered state of consciousness is difficult to give. The process resembled that of meditation, requiring a balanced combination of relaxation and attentiveness, detachment and awareness. In this biofeedback process the object of meditation is itself a time process: the rhythm of one's brain. To precisely merge with that rhythm one's consciousness of it must be neither ahead nor behind it. In willfully striving to increase alpha activity, the consciousness tends to anticipate and precede the physical event, and the alpha is actually diminished. On the other hand, if attention wanders and lags behind the "beat" the resonant coupling is again lacking, and a similar attenuation occurs. The resonance created by time-locking one's consciousness with the cortically synchronized neuronal activity that the alpha rhythm apparently represents seems to significantly reinforce and increase that synchronous activity, and in turn produces positive effects on the consciousness: a feeling of "at oneness", of being in unison with Time, in harmony with Self.

In addition to exploring these internal techniques, working as an experimenter in Gilden's lab (and at the Lifwynn Foundation) where I conducted experiments to determine the relative effects of the cotentive and ditentive states on alpha production, gave me much practical experience in experimental medical electronic procedures. I also began constructing simple voltage controlled devices under the expert guidance of composer David Behrman, before beginning to purchase modules from Robert Moog, who also designed and built for me a low cost, high-gain differential amplifier, based on a configuration of three Philbrick operational amplifiers, which had then just recently been developed. Finally, in the Fall of 1967 I made the down payment on a used Moog Synthesizer, and returned with this gear to join the Musica Elletronica Viva Group for a concert tour of Europe.

Spacecraft, the collective work performed on that tour, employed techniques analagous to biofeedback processes. Proceeding neither from score, chart nor other external image, each musician rather carried on an inner search through the recesses of his own consciousness.⁴ The images and experiences encountered on this inner space journey were translated by the performers' gestures through electronic instruments (contact microphones, synthesizers and others) into highly amplified sounds fed back from spatially distant loudspeakers—an electronically transformed "double" mirroring the performers' internal subjective states. The unusual sensations of body transcendence and ego-loss that occurred in this music—and in related biofeedback experiences—seemed aptly described in a statement written several hundred years earlier in the Jewish mystical texts of the Kabbalah: in the state of ecstasy a man "suddenly sees the shape of his self before him talking to him and he forgets his self and it is disengaged from him and he sees the shape of his self before him talking to him and predicting the future".⁵ With five musicians simultaneously

Fig. 1. Electroencephalogram showing form of alpha activity developing over time with sensory feedback. Note gradual increase of amplitude and duration of alpha bursts. (1 cm = 1 second)



engaged in the same activities—electronically mixing, intermodulating with each other and issuing from the same loudspeakers—a process of non-ordinary communication developed, guiding individual into collective consciousness, merging the many into the One.

In these performances I employed the neuro- and the physiological signals of my own body as live (real-time) musical materials, using heartbeat, chest cavity and throat contact microphones as transducers, as well as electrodes for EEG and EKG. The signals picked up by the former were generally transmitted as audio, the latter served mainly as control voltages for the Moog. Thus, in addition to the kinds of conscious "musical" gestures input by the others in the quintet, my channel also carried a loop (or loops) of psychophysical signals from my own autonomic nervous system, modifications of which could be made manually (or automatically) through the Moog, which could in turn be modified "autonomically." The interactive system created by this neuroelectronic interface was a highly integrated one, and the interpenetration of the two component parts extended as well to subjective areas of my consciousness and even subconscious. I recall, for instance, once dreaming of the Moog, set on the ground in the old overgrown apple orchard of my Connecticut childhood, surrounded by honeysuckle and flames.

At this time I also experimented with people from outside the MEV (*Musica Elettronica Viva*) group. The actor Steve Ben Israel of the Living Theatre served as a most valuable subject for many hours of research in my home lab, during which we explored a variety of sound materials for use as psycho-musical stimuli.

In the Spring of 1968 I was invited to present a performance of bio-feedback music in a concert with saxophonist Steve Lacy at the Research and Development Division of Lepetit Pharmaceutical

Company in Milan. The prospect of receiving high level "feedback" from such an expert audience encouraged me to prepare an extensive work composed entirely of a biofeedback system with which I was then experimenting. This piece, entitled *Organ Music* was presented on June 4, 1968, with Steve Lacy supplying brain waves, Irene Aebi heartbeats, and myself controlling the Moog and mix. The EEG (electroencephalograph) output in this case was not restricted to alpha, but comprised the broad spectrum from DC to about 50 cycles per second (Hz). It was applied chiefly to frequency modulate four voltage controlled oscillators, and also to control the amplitude and filtering of these audio signals (See Fig. 2). The EEG signal was split, and the degree of modulation was controllable by attenuators on each control input. The bandwidths of the audio signals could therefore be continuously varied from single (sine tone) frequencies to complex broadband sounds approaching noise. The center frequency of each oscillator was set in a separate audio range, widely spaced from treble to bass. The sound system in the auditorium at Lepetit had many loudspeakers set in the walls, completely surrounding the audience, so that one felt as if seated in the midst of a shifting storm of bio-electrical activity, a feeling analagous, perhaps, to being inside a living heart and brain.

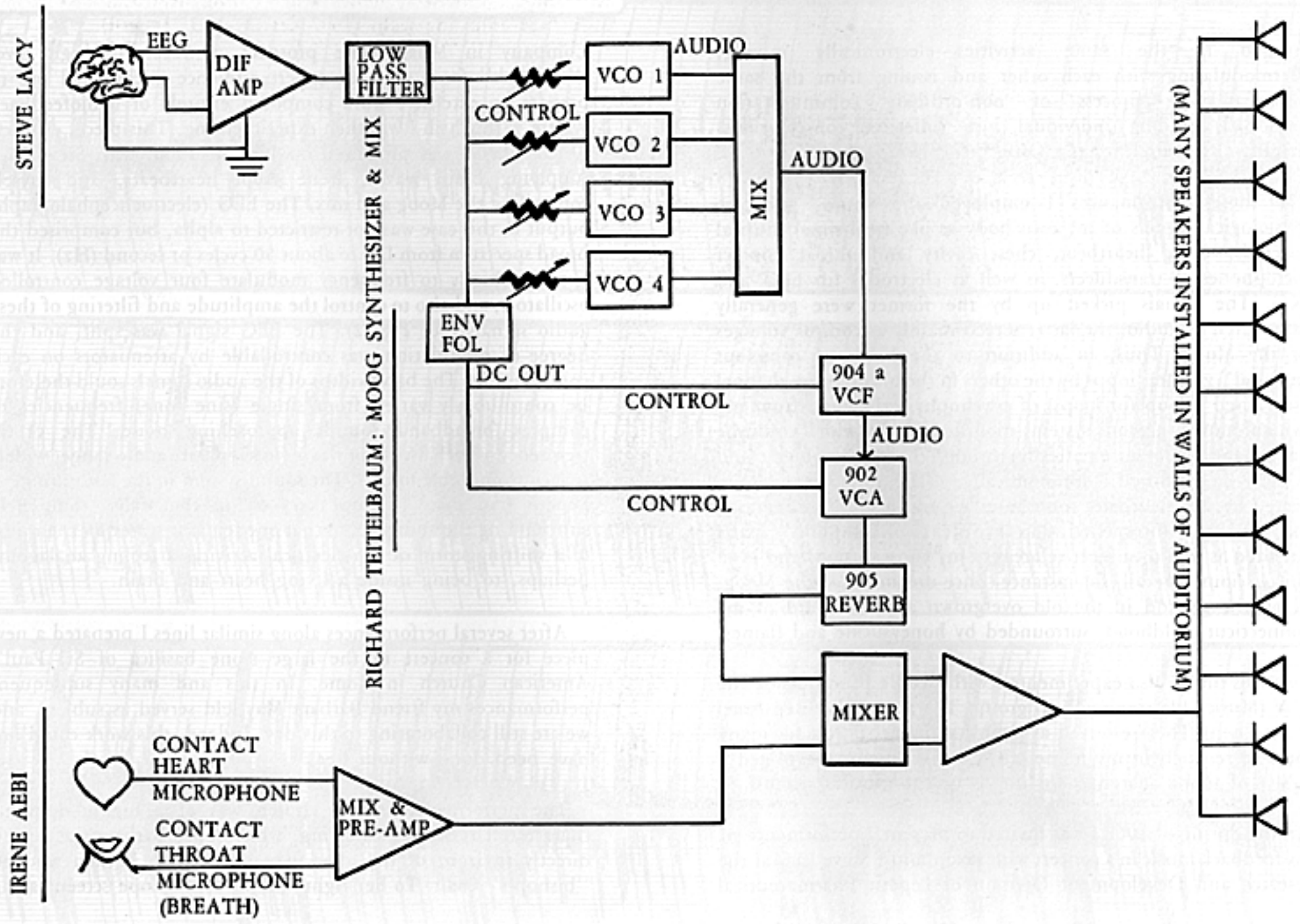
After several performances along similar lines I prepared a new piece for a concert in the large stone basilica of St. Paul's American Church in Rome. In this and many subsequent performances my friend Barbara Mayfield served as subject, and we are still collaborating to this day. Indeed, this work could not have been done without her.

The performance in the church was of a highly dramatic character. Dressed in a flowing, white robe, Barbara was seated directly in front of the altar in a huge, high backed wooden "bishop's" chair. To her right was an oscilloscope screen facing

'ORGAN MUSIC' BY RICHARD TEITELBAUM

LEPETIT PHARMACEUTICAL CO., MILAN, JUNE 4, 1968

FIG. 2: Diagram showing basic patch for 'Organ Music.'



First performance of Organ Music, at Lepetit Pharmaceutical Co., Milan, Italy, June 4, 1968. From left to right: Richard Teitelbaum with Moog synthesizer, Irene Aebi holding heartbeat pick-up, Steve Lacy adjusting scalp electrodes. (photo: Lepetit).



...and time I slowly "relaxed" the...
 ...my response to Barbara's...
 ...musical intensity. Thus, in a...
 ...of my own... several

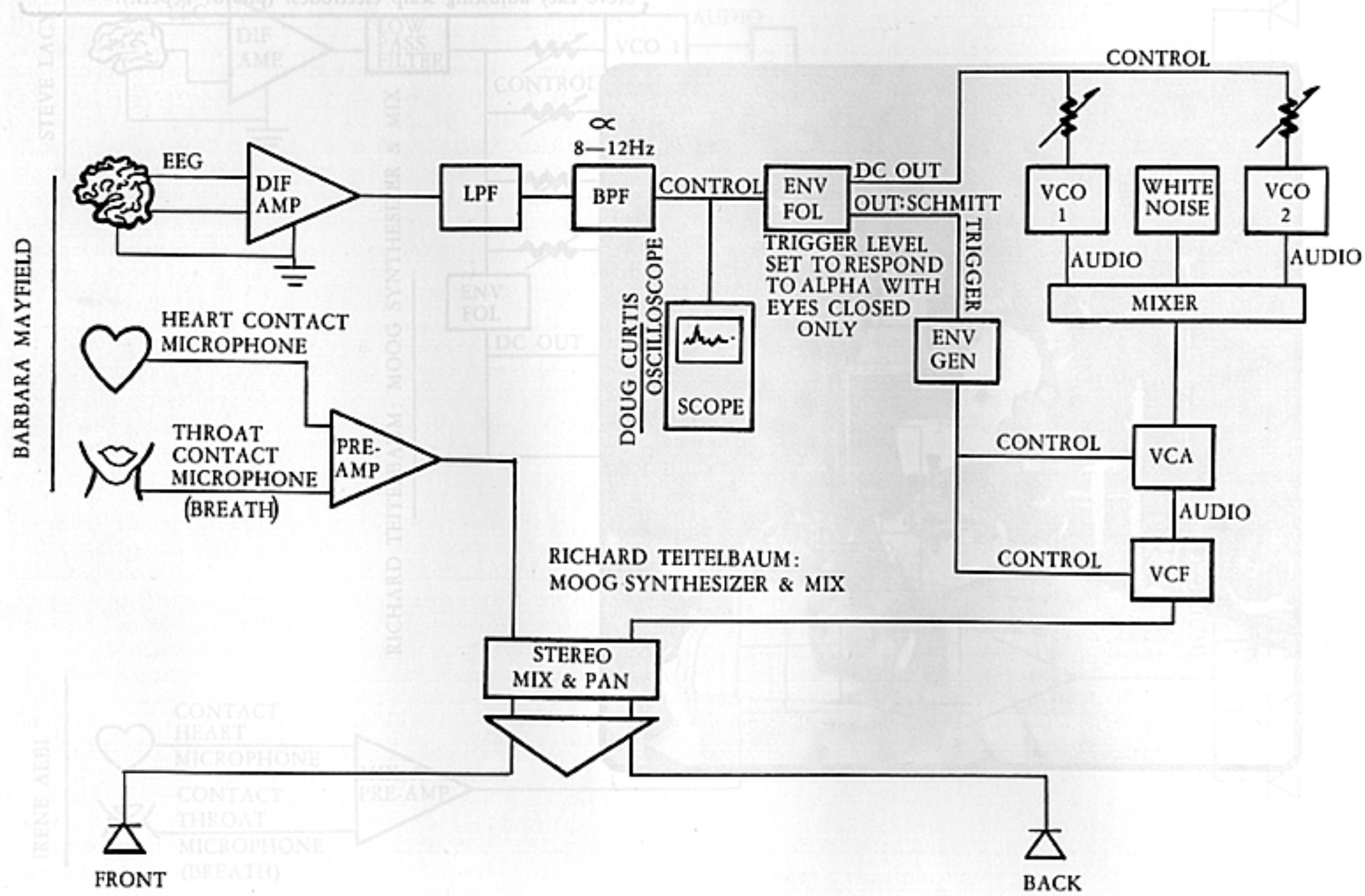
...once decided my function in this role: "The...
 ...the feedback loop...
 ...of the subject, realizing that person's...
 ...with utmost care, rendered...
 ...complete test. The...
 ...created for his...
 ...the guide...
 ...and to make a...
 ...the sound image...
 ...which leads the...
 ...planes of Reality...
 ...HEART CONTACT...
 ...MICROPHONE...
 ...THROAT...
 ...CONTACT...
 ...MICROPHONE...
 ...BREATH...
 ...high differential amplifier...
 ...an expanded version of...
 ...in concert at the American...
 ...with Barbara Mayfield and...
 ...and throat microphone...
 ...and myself guiding the...
 ...electronically generated sound...
 ...employed concrete sound...
 ...real-time alpha in the...
 ...of two contrasting...
 ...The...
 ...on the tape were gated by the...
 ...mirroring the live...
 ...by the throat microphones...
 ...between the performers...
 ...meditation space

BIBBY TAYLOR

FIG. 3: Diagram showing basic patch for 'In Tune.'

'IN TUNE' BY RICHARD TEITELBAUM

(AMERICAN CHURCH, ROME, DECEMBER 4, 1968)



the audience, providing a visual display of her brain waves. The high, stone vaulted church was darkened except for the scope and a single, high intensity spot light on Barbara. This visual set-up was arranged in collaboration with artist Milton Cohen.

The composition, entitled *In Tune*, began with Barbara's softly amplified breathing, then her heartbeats gradually faded in, allowing her and the audience both to identify and focus on their more familiar biological sounds. Both breath and heart emanated from a large loudspeaker lying in the area of the altar, unseen. After continuing to sit motionless, staring wide eyed out into the darkened church for some time, Barbara slowly closed her eyes. In so doing she increased the amplitude of her alpha sufficiently to exceed the threshold level I had set on the Moog envelope followers. This caused them to trigger a loud and startling burst of electronic sounds, which thundered unexpectedly from the back of the church, where a loudspeaker on a separate channel had been placed on the floor behind the audience, facing upwards. Echoing back down from the high stone vault at ten times a second, these alpha-triggered bursts had an effect on her which Barbara later described as "like levitation". Able to start or stop the sound simply by closing and opening her eyes, she continued to "play" her eyes in this way for a while, before finally closing them and turning to internal control. As EEG researchers well know, alpha amplitude is markedly increased when one is in a non-visualizing, eyes-closed state. By careful adjustment of the threshold level on a Schmitt trigger circuit such as the Moog envelope follower, the synthesizer can be readily controlled by eyelid position (see Fig. 3). With her eyes finally closed, Barbara's alpha continued to effect the rhythm, amplitude and frequency of the electronic sounds. At the same time I slowly "played" the system manually, guided both by my responses to Barbara's neurophysiological activity and my musical intuitions. Thus, in a sense, we played a "duet" between her internal and my external

control—but a duet in which I served only as accompanist. As I once described my function in this role: "The guide must submerge his ego...He enters the feedback loop as one more component in the service of the subject, realizing that person's vulnerable state. He acts with utmost care, tenderness and love. The subject responds with complete trust. The guide recognizes that the music is being created not for himself, nor for any audience, but solely for the subject. The guide gathers together the subject's body rhythms and helps make a sound image of electronically extended organism. The sound image thus created becomes an object of meditation which leads the subject to experience and explore new planes of Reality."⁶

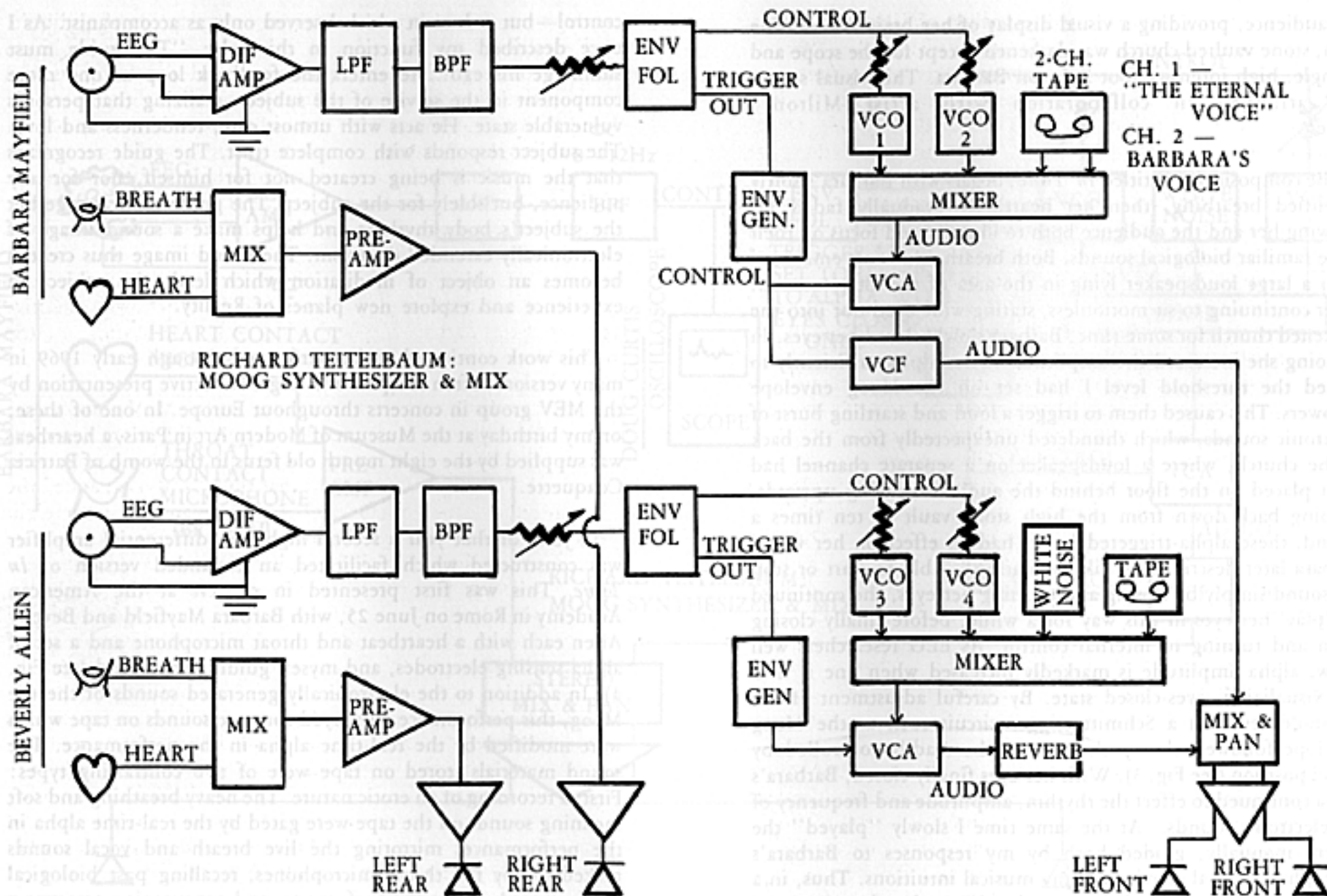
This work continued to be performed through early 1969 in many versions, often as a part of a larger collective presentation by the MEV group in concerts throughout Europe. In one of these, on my birthday at the Museum of Modern Art in Paris, a heartbeat was supplied by the eight month old fetus in the womb of Patricia Coquette.

In June of that year a second high-gain differential amplifier was constructed which facilitated an expanded version of *In Tune*. This was first presented in concert at the American Academy in Rome on June 25, with Barbara Mayfield and Beverly Allen each with a heartbeat and throat microphone and a set of alpha sensing electrodes, and myself guiding the sound (see Fig. 4). In addition to the electronically generated sounds of the the Moog, this performance employed concrete sounds on tape which were modified by the real-time alpha in the performance. The sound materials stored on tape were of two contrasting types: First, a recording of an erotic nature. The heavy breathing and soft moaning sounds on the tape were gated by the real-time alpha in the performance, mirroring the live breath and vocal sounds picked up by the throat microphones, recalling past biological connections between the performers, and encouraging access to a psycho-sexual meditation space.

FIG. 4 showing patch for 'In Tune' (expanded version).

'IN TUNE' BY RICHARD TEITELBAUM

(AMERICAN ACADEMY, ROME, JUNE 25, 1969)



The other tape tracks contained recordings of Tibetan Buddhist chanting and instrumental music, particularly the "Eternal Voice" sung by members of the Gelugpa Sect, Jyume Monastery (Tibet III, A Musical Anthology of the Orient, UNESCO Series). In a footnote in his edition of the *Tibetan Book of the Dead*, Evans-Wentz comments that "the *lamas* maintain that the combined instrumental sounds psychically produce in the devotee an attitude of deep veneration and faith because they are the counterparts of the natural sounds which one's own body is heard producing when the fingers are put in the ears to shut out external sounds. Stopping the ears thus, there are heard a thudding sound, like that of a big drum being beaten; a clashing sound, as of cymbals; a sloughing sound, as of a wind moving through the forest—as when a conch shell is blown; a ringing as of bells; a sharp tapping sound as when a timbrel is used; a moaning sound like that of a calrionet; a bass moaning sound as if made by a big trumpet; and a shriller sound, as of a thigh-bone trumpet. Not only is this interesting as a theory of Tibetan sacred music, but gives the clue to the esoteric interpretation of the symbolical natural sounds of Truth...which are said to be, or proceed from the intellectual faculties within the human mentality."⁷ Thus the central process in Tibetan sacred music bears a striking resemblance to that of biofeedback music: the externalization of internal sounds, and the resultant "attitude of deep veneration" which their sensory feedback produces. By routing this ancient, internally derived music through the inner control of the performers' live alpha we sought to activate additional recursive cycles, looping large expanses of time, space and culture.

In performance the clearly defined, individual body-sound images presented at the outset through associated loudspeakers near each performer gradually gave way, through mixing, panning and cross fading, to loss of individual body image and to merging of hearts, breaths, voices, brains, musics and consciousness. In mixing, particularly the concrete taped materials, the effort was

made to maintain levels hovering about thresholds of audibility and intelligibility, to maximize the effect of dream-like aural hallucination. The use of alpha to control the low pass and regenerative filter was a particularly effective technique for subtly highlighting the remarkable multi-harmonic chanting of the Tibetan monks. As guide, I sought to gather together the sounds and bio-rhythms into a sound vision which would guide the subjects through a voyage of discovery both internal and external, and to eventual merging in an altered state of consciousness. Even the audience seemed to enter into a trance-like state, thereby entering into the feedback loop themselves and lending positive reinforcement to the whole process. Describing her own subjective response later, Barbara Mayfield said it was "like having an astral body through the wires".

In this, and subsequent performances by the MEV group in the fall of 1969 we experimented increasingly with more conscious means of feedback control, utilizing Yogic breathing techniques to control heart rate and alpha. At that time we also expanded the piece to allow group performances by as many as six or eight performers, all simultaneously interconnected. Often these were structured in pairs—a married couple feeding back alpha to each other, another playing a heartbeat duet, etc. Gradually, influenced in large measure by the aesthetic bent of the group at the time, which was very much towards expressive improvisation, these realizations of IN TUNE became highly "performed", expressionistic, even aggressive. Such "bio-musical" improvisations often contained vocal and instrumental sounds extraneous to the biological ones, as well as intentional muscle movements by the performers, producing artifacts in the circuit. Musically they were quite effective, but other aspects of the work—exploring channels of non-ordinary communications and altered states of awareness—seemed to be somewhat attenuated. This shift further sharpened a contradiction already inherent in the idea of performing an inner directed, meditational piece before a concert

audience. For this, and other reasons we continued to perform IN TUNE only a few more times on our return to the United States for a concert tour early in 1970.

It was also at that time that I entered the World Music program at Wesleyan University in Connecticut. Direct contact with the traditional instruments and musicians of Indonesia, Japan, Ghana, Korea, India and elsewhere produced revelations as to the efficacy of these traditional "technologies" which made my current electronic experimentation seem "primitive" by contrast. In studying Shakuhachi with Kodo Araki V, I encountered a musical technique of consciousness alteration which is—like biofeedback music—intended primarily to benefit the performer rather than the listener—a fact I quickly experienced through the powerful effects of the hyperventilation required to produce a sound on that end-blown Japanese bamboo flute. Studying Javanese gamelan with Pok Prawoto, I experienced that remarkable "gamelan consciousness" by which an entire orchestra of percussionists learns to "fit together" with no conductor, relating to each other almost telepathically through the music—as much through the spaces around the sounds as through the notes themselves. Or, in learning to play in a West African Drum Ensemble with Abragam Adzenyah, having the wonderful sensation of that organismic unity one feels when locked in to the complex cross rhythms of that most intricate and exciting music. These were researches into some of the most highly developed techniques of musical consciousness alteration known, and provided invaluable information when I later returned to the electronic path.

This return has been gradual, and has sometimes crossed amusing byways. While teaching music at the California Institute of the Arts in 1971 I offered an informal course in biofeedback music and psychophysics, partially in conjunction with Prof. Jim Hurtak who was then applying Tibetan tantric art as visual stimulus during alpha feedback training. Biofeedback was by then so popular in California that our lecture-demonstrations were even

attended by some famous Hollywood stars. It was largely in response to the overblown media "hypes" then current about biofeedback that composers Serge Tcherepnin, Kristina Melcher and I were inspired to collaborate on *Alpha Bean Lima Brain* for the Eighth Annual New York Avant-Garde Festival. This piece was designed so the alpha waves in California would make beans jump in New York, control signals activated by my alpha at Cal Arts transmitted over telephone lines to New York to activate solenoids mounted under large enamel pots full of dry white beans. The intermedia group PULSA generously provided technical assistance at the New York end. Naturally, film of this performance was featured on the NBC evening news in Los Angeles.

A somewhat more serious piece, *Bean Brain* was presented a few months later in collaboration with Alison Knowles and Peter van Riper at the University of California at San Diego. This "mini-media show of lived electronic muzak" explored subliminal stimuli by presenting a variety of audio, video and biological information in a cocktail party atmosphere, with loudness levels set to blend with the ambient sound of the audience's conversations. Materials included live and taped alpha-controlled sounds, a live plant controlling an audio oscillator, a taped lecture by plant communications pioneer Cleve Backster, and a videotape of John Cage's brainwaves, which I had shot earlier that year in conjunction with Nam June Paik and David Rosenboom (see photo on following page). The effect of all this was to put into the air, unobtrusively, some of the many types of signals by which we are normally always surrounded but not generally aware of, such as sound, light, radio, biological, telepathic waves—and others yet to be discovered: a didactic model of our everyday electro-magnetic environment. The performance concluded with a video taped reading by Cage of one of the marvelous paradoxes from his book *Silence*⁸. "If there are those among you who wish to get somewhere, let them leave at any moment. What we require is silence. But what silence requires is that I go on talking!"

Another and very promising use of video was explored the following year in collaboration with Dan Sandin and Jim Wiseman at the University of Illinois, Chicago Circle Campus. There the output of my EEG amplifier was interfaced with the *Image Processor*, a modular, voltage controlled video synthesizer designed by Sandin. This system offers a variety of functions which may be controlled by external signals. In the short tape we produced a close up image of a subject's face was modulated by her alpha while she watched the image on a monitor in real-time feedback. The image was further processed by the Paik-Abe video synthesizer. Much interesting work remains to be done in this rapidly developing field.

During the past year at York University we have concentrated our investigations in one area particularly: the effect of the practice of T'ai Chi Chu'an, a Chinese martial art and meditative technique, on brain activity. With the aid of an FM telemetry system⁹ capable of transmitting biological signals, we have monitored EEG during the practice of T'ai Chi in several subjects, including Barbara Mayfield, who has studied the art for several years.¹⁰ Preliminary observation indicates a marked increase in EEG alpha activity during T'ai Chi practice, both with and without sensory feedback. Concerning the latter, we have become increasingly selective in choosing a limited class of sound material for sensory feedback. In addition we have employed closely related sound-producing objects as auditory stimuli, notably Oriental percussion instruments traditionally associated with meditative functions. A notable characteristic of these meditative sound objects is the production of distinct and powerful acoustic beatings among their complexly related overtones and partials. By employing alpha-triggered sine tones at or near the fundamentals or partials of these instruments, strong reinforcements of these acoustic phenomena are introduced as a simultaneous sensory correlate of the alpha activity to create a loop. Study of the psycho-physical response to such meditative auditory stimuli is a most promising field for further inquiry.

In a recent T'ai Chi experiment we added the use of a large-scale capacitance field surrounding the subject. This system, created by electronic composer Liz Phillips, translates the rate and size of physical gestures made within the field into voltages which may be applied to synthesizer control inputs. By using this system simultaneously with the transmitted alpha a "duet" of loops between the slow, external movements and the internal EEG rhythms is set up, allowing "cross-correlations" between the two to be made both by the subject and the experimenter. Another interesting feature of this recent experiment was the use of alpha to trigger both positive and negative envelopes, gating various harmonic partials of an electronic drone through a voltage controlled mixer. In this way the presence of alpha was associated with sound on some channels and with silence on others, resulting in continuously shifting "weightings" within the fixed drone—a kind of homeostatic balancing recalling the Chinese theory of Yin-Yang on which the practice of T'ai Chi is based."

Our most recent biofeedback piece, *Tai Chi Alpha Tala* employs the alpha rhythms transmitted by FM from the Tai Chi performer as control signals to advance a 30 position (Arp) sequencer on which a pentatonic melody has been pre-set. The rhythm of this melody (based on the South Indian raga Mohanaa) is thereby controlled exclusively by the alpha activity of the subject and is in turn accompanied on mrdangam by a South Indian drummer, who searches for recurrent patterns, or cycles ("talas") within the alpha, supporting and reinforcing them. The skills and talent of the drummer in this most highly developed rhythmic tradition are thus employed to add a further dimension to the real-time feedback, with a speed and accuracy surpassing anything even a computerized system could now achieve.

The work also seeks to explore methods of interface between diverse cultures (in this instance Chinese, Indian and Western) through the use of cultural and biological "universals": the pentatonic Scale (which has been called "the prototype of all

scales"¹²) found in most cultures throughout the world, and the alpha rhythm of the human brain.

Tai Chi Alpha Tala is dedicated to David Rosenboom and drummer Trichy Sankaran, and was first performed with them at York University on November 25, 1974. It has also been performed at the Kitchen in New York, and more recently a video tape version has been made, utilizing the alpha to control the video image through the Dan Sandin and Paik-Abe Video synthesizers in collaboration with Jim Wiseman and Paul Challacombe. This piece, produced under a grant from the Illinois Arts Council was telecast on WWTW, Channel 11 in Chicago in May, 1975.

During these past eight years, research in biofeedback has expanded at an astonishing rate. Surely it holds great promise for the future. But the question arises: to what use will these developments be put, whom will they serve? With some of the most technically "advanced" psychology work currently being carried out in our prisons in the guise of aversion therapy and the like, there is clearly great cause for concern. The promise held out by recent technological innovations still leaves unanswered the basic concern as to their use.

The current trend towards cross-disciplinary interactions fostering communication and collaboration between scientists and artists is a most positive one. As a field which is itself "inherently interdisciplinary",¹³ feedback psycho-physiology would seem to be fertile ground for the new breed of generalists that is beginning to emerge. Such broad perspectives in the new discipline would in itself rank as a major innovation, helping to insure the humane application of the technical advances.

York University
August, 1974

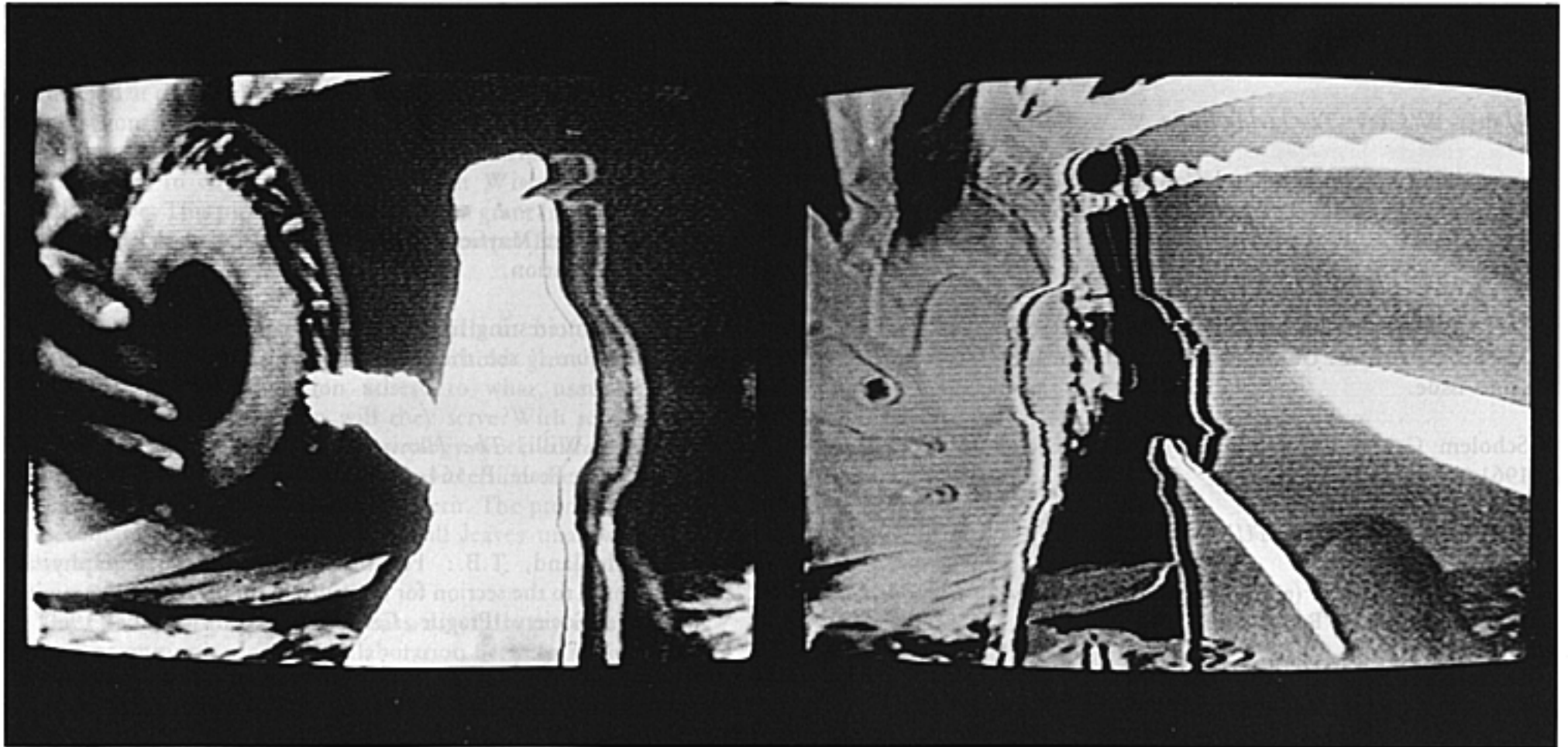


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...the first, through the world, and the
alpha mind, only the first, alpha

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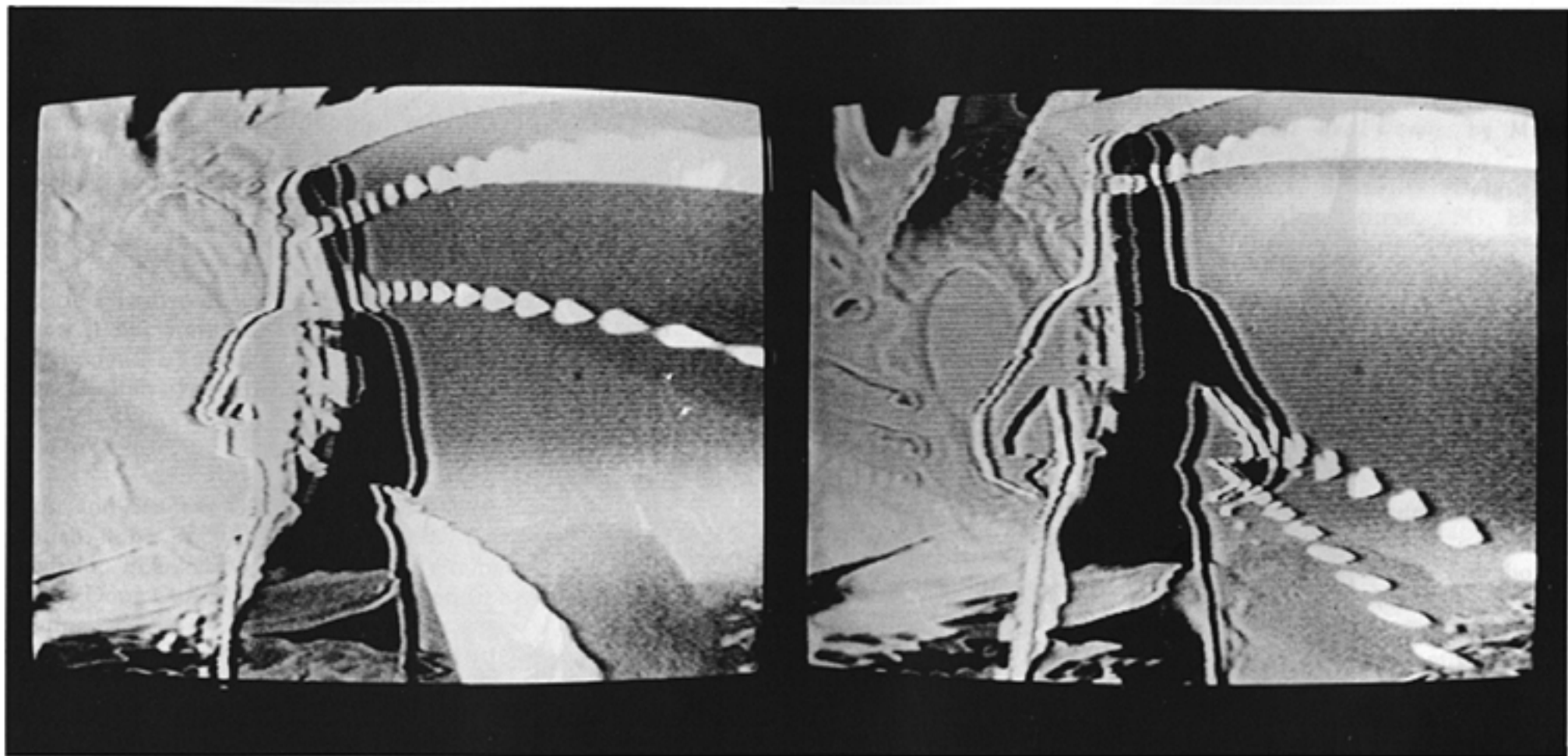


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Sequence of images from alpha-controlled video synthesized version of Tai Chi Alpha Tala.

Photos by Dug Spitznagel.

August 1974



October 20, 1968; Mayfield; Tenetbaum
Lisorno, Italy, December

Mark Johnson, brainwaves; R. Yetterbaum; Moog
mix; J. Fullerman, brainwave controlled light



An informal session in alpha-strobe light feedback training with the PULSA group at Automation House in New York, 1971. From left to right: Maryanne Amacher, Mack Rumsey, Richard Teitelbaum, Toni Fuge, Patrick Clancy (wired) and others.

**PUBLIC PERFORMANCES, RECORDINGS AND
BROADCASTS OF BIOFEEDBACK MUSIC**

by Richard Teitelbaum

55

SPACECRAFT

Biological signals incorporated into performances of collective live electronic work by *Musica Elettronica Viva* group 1967-68, including: Radio Bremen; Sudwestfunk, Baden-Baden, Bayerische Rundfunk, Nurnburg; Palais des Beaux-Arts, Buxelles; and others.

ORGAN MUSIC

Lepetit Pharmaceutical Company, Milan, Italy, June 4, 1968; Steve Lacy, brainwaves; Irene Aebi, heartbeats; R. Teitelbaum, Moog and mix.
Beat 72, Italy, July, 1968

IN TUNE

Artist and Student Center, St. Paul's American Church, Rome, Italy, December 4, 1968; Barbara Mayfield, EEG, EKG, Breath; R. Teitelbaum, Moog; Doug Curtis, Oscilloscope; Milton Cohen, lighting.
Deposito d'Arte Presente, Teatro Stabile di Torino, Turin, Italy, December 15, 1968; Mayfield, Teitelbaum.
Le Rough et Noire, S.Giovanni Valdarno, Italy, December 20, 1968; Mayfield, Teitelbaum.
Casa della Cultura, Livorno, Italy, December 22, 1968
Teatro Politeama, Sixth Annual International Avant-garde Festival, Palermo, Italy, December 30, 1968; Mayfield, Teitelbaum.
Museum of Modern Art, Paris, France, May 19, 1969; Mayfield, Teitelbaum, Coquette.

American Academy in Rome, Italy, June 25, 1969; Mayfield, Allen, EEG, EKG, breath, Teitelbaum, Moog and mix
Soundtrace for *Il Seme de l'Uomo*, by Marco Ferreri, July, 1969.
Palais des Beaux-Arts, Bruxelles, Belgium, - September 23, 1969, Alvin Curran, EEG, EKG; MEV, Teitelbaum
Purcell Room, South Bank, London, England, October 10, 1969; MEV
BBC Recording and Broadcasting; Maidavale Studios London; October 1969
Festival Actual, Amougies, Belgium, October 28, 1969; Mayfield, Teitelbaum, MEV.
Henie-Onstad Center, Oslo, Norway, November 11, 1969; MEV.
Radio Denmark, Copenhagen, Denmark, November 14, 1969; MEV.
Museum of Modern Art (Fylkingen) Stockholm, Sweden, November 17, 1969; MEV
Accademia Filharmonica Romana, Teatro Olimpico, Rome; February 5, 1970; (tape mix version).
Brooklyn Academy of Music, New York City, February 20, 1970, David Behrman, Shigeko Kubota, heartbeats, breath; Barbara Mayfield, Mark Johnson, brainwaves, R. Teitelbaum, Moog, mix; J. Fulleman, brainwaves controlled light system.
Experimental Theatre, Performing Arts Center, State University of N.Y., Albany, February 28, 1970; MEV.
State University of New York at Stony Brook, N.Y., March 3, 1970; MEV.

ALPHA BEAN
LIMA BRAIN

EEG Telecommunications link from California Institute of the Arts to 69th Regiment Armory, New York City; Eighth Annual Avant-garde Festival, November, 1971; collaboration with Kristina Melcher, Serge Tcherepnin, PULSA.

BEAN BRAIN

Live Electronic Muzak Mini media show, for live and taped alpha waves, live plant controlled oscillator, audio and video tape, beans; University of California at San Diego, Spring, 1972; with Alison Knowles, Peter van Riper, Ed Williams, PULSA.

BRAIN IMAGE

Experimental video tape generated by EEG interface with Dan Sandin Image Processor, Paik-Abe Video Synthesizer; Chicago Illinois, Spring, 1973; Sandin, Wiseman, Morton, Teitelbaum, Cindy.

UNTITLED PIECE

For Tai Chi Chuan performer with FM telemetry system for alpha transmission, Moog synthesizer, bells, and gongs; Sir George Williams University, Montreal, Quebec, May 14, 1974; Barbara Mayfield, T'ai Chi and alpha; Byron, Vincent, percussion, Teitelbaum Moog, etc.

T'AI CHI
BRAIN WAVE

Collaborative work with Barbara Mayfield and Liz Phillips, for Tai Chi performer with alpha transmitter, capacitance field, Moog synthesizer and other voltage controlled modules, percussion; Mayfield, Phillips, Byron, Rosenboom, Teitelbaum; York University, Toronto, Ontario, Canada, July 29, 1974.

TAI CHI ALPHA TALA

For Tai Chi performer with FM telemetry system, synthesizer with sequencer and South Indian Drummer (Mrdangam). Barbara Mayfield, Tai chi and Alpha; David Rosenboom and Richard Teitelbaum, synthesizer and electronics; Trichy Sankaran, Mrdangam; York University, November 25, 1974.

The Kitchen, New York, December 20, 1974; Barbara Mayfield, Richard Teitelbaum, Sharda Sahai (Tabla)

Videotape version *TV Song*: Produced for WTTW, Channel 11, Chicago, Illinois; B. Mayfield, R. Teitelbaum, D. Rosenboom, T. Sankaran; Jim Wiseman, Paul Challacombe, video synthesizer