

Picking Up The Threads of a History More Extensive Than Previously Known: Percy Grainger's Work with Music Technology.

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Abstract:

Although Percy Grainger's work with what he called Free Music, a music of gliding tones and beatless rhythms, is known to some, even to those who know about it, it has long been assumed that the work consisted of a few badly made recordings, a couple of drawings, and the remnants of a machine or two at the Grainger Museum in Melbourne. Research conducted last year for ABC Classic FM at the Grainger Museum, University of Melbourne has revealed that Grainger's work with Free Music was much more extensive than previously thought, with about an hour of sound recordings, and many other documents existing. The recordings reveal Grainger's open-ended and improvisatory approach to music technology. These recordings will be discussed, as well as showing the plans for his last machine, the Electric Eye Tone Tool, and demonstrating our contemporary reconstruction of it.

Although Percy Grainger's work with what he called Free Music, a music of gliding tones and beatless rhythms, is known to some, even to those who know about it, it has long been assumed that the work consisted of a few badly made recordings, a couple of drawings, and the remnants of a machine or two at the Grainger Museum in Melbourne, as well as several computer and electronic realisations by others of his Free Music 1 and 2. Last year, for ABC Classic FM, I made a radio show about Grainger's Free Music, which included research in the archives of the Grainger Museum, as well as making a contemporary reconstruction of Burnett Cross and Percy Grainger's final machine, the Electric Eye Tone Tool. What I found was that, contrary to common knowledge, Grainger's work with music technology from the mid 1940s until his death in 1961 was deeply and continuously involving; work in which he anticipated, in his highly individual way, many of the techniques of music technology today; and work which was extensively, if a bit haphazardly documented. Far from the 2 or 3 minutes of recorded material that is the common perception of Grainger's recorded

Free Music output, there is in fact, about an hour of recorded material, as well as a volume of sketches, scores, and plans. And some of the recordings, although probably just sketches, are compositionally astounding, and should be much better known than they currently are. This work involved a bit of detective work, and cross referencing, and was limited to the archives at the Grainger Museum at the University of Melbourne. A search of overseas collections might reveal even more material. Clearly, Grainger's work with Free Music was not a dead end, or even a magnificent failure, but part of a sustained research effort which left threads of inquiry to be continued, and which we are now just beginning to take up again.

Grainger's first work with music technology was with recording technology, in the first decade of the 20th century, when he was one of the first composers to make field recordings of folk musicians. In the early 1920s, he also worked with cutting player piano rolls by hand, in order to hear the rhythmically complex music of his *Sea Song Sketch* from 1907 played accurately. This

early work with music technology planted the seeds to a free-wheeling approach to music technology that was to come to fruition in his work of the late 1940s and 1950s. However, this work was motivated by his idea of Free Music, which he had been developing since his teenage years in the 1890s. Central to Grainger's work with Free Music was the concept of the gliding tone. In the 1930s, Grainger worked with Leon Theremin and his theremins, and wrote at least three scores for theremin ensemble (*Free Music 1 and 2*, and *Beatless Music* of 1937, the latter an arrangement for six theremins of the 1907 *Sea Song Sketch*) and had Leon Theremin not returned to Russia in the late 1930s, Grainger probably would have done much more with him. (In terms of correcting the historical record, it might also be mentioned that Theremin's return to Russia was not the kidnapping that was reported for many years, but was staged by Theremin and his NKVD associates to look that way - full details are in Albert Glinsky's 2000 book *Theremin: Ether Music and Espionage*.)¹ However, Grainger's frustration with the rhythmic control of the theremin, and his desire for more precise pitch control probably would have led him to construct devices for more accurate and repeatable control, which was indeed the path he eventually took with the physicist and engineer Burnett Cross.

When I approached the Grainger Museum for this research, they were very cooperative and helpful, but were in the middle of a building crisis, major structural flaws having just been found in the building. As a result, I had to work around various structural and time constraints, but was still able to uncover a lot of material. Grainger and Cross had made a number of 78 rpm recordings with a home record cutting unit between 1948 and 1954. All of the recordings in the Museum had been transferred to CD by Filmsound Australia. However, each CD was simply labelled with the names of whatever was on the jacket of

the 78 rpm recording. Many of these labels were erroneous, or had been confused in the half century of the recordings lying in the archive, so I found I had to listen to every track on every CD to find that often mislabelled gem, which was in fact, a missing free music recording. There were also a number of drawings of various free music machines in the archives, and it was quite interesting trying to figure out which version of which machine was used for a particular recording. (Grainger and Cross were constantly rebuilding their machines as new ideas occurred.) A number of recordings also required close listening to find out exactly what was being done. This was especially the case with *The Lonely Desert Man Sees the Tents of the Happy Tribes* recordings. This is a series of six 78 rpm sides which contain various parts for reed organ, marimba, voices, and what sounds like either a cello or a Solovox - an early monophonic synthesizer made by the Hammond corporation. The recordings also contain a number of comments by Percy, Ella Grainger, Burnett Cross, and an engineer referred to as Howie, who was probably Howard Cross, Burnett's brother. From these comments, and by listening carefully to the kind of surface noise and equalization in each subsequent recording, I realized that what was happening was that Grainger was recording a part on one 78 rpm disc recorder, and then playing that back on another 78 rpm disc player, playing along with that, recording the result, and then playing that recording back while recording another part along with the mix. This was a primitive, but still effective way of multitracking.

Related to this is an amusing anecdote by Burnett Cross about a recording of *Bold William Taylor*, a folksong arrangement of Percy's. Cross had sung in amateur choirs and was a baritone. In the early 1950s, Grainger asked him if he would learn the voice part, "irregular rhythms, variations, Lincolnshire dialect and all." Cross did so,

in his baritone range, at a slower tempo than required. In copying the record, they sped it up to the required tempo and pitch, and this sped up version was used by Grainger in a Knoxville, Tennessee performance with a group of live string and reed players. Cross reports that many years later, he met Peter Pears, the internationally famed tenor. Pears said, "Burnett Cross? Burnett Cross? The man who sang *Bold William Taylor!* Marvelous! Marvelous!" And so, through technology, Cross, the amateur baritone, became an internationally known tenor.²

Grainger not only anticipated multitrack recording, he also anticipated sequencing and interactive performance with sequencers. In the mid-1940s, he purchased three Hammond Solovoxes. These were monophonic synthesizers with some degree of timbral control. Grainger cut a piano roll by hand of his rhythmically complex *Sea Song Sketch*, and then placed the roll in his player piano. This piano had a mechanism which allowed the action of the piano to be moved enough so that the hammers would not strike the strings. This resulted in a silent piano whose keys would still move up and down. He then mounted the Solovoxes above and below the piano keyboard, and with an ingenious arrangement of strings, wires and pieces of wood and cardboard, had the moving keys activate the keys of the Solovoxes. (See Illustration 1) The Solovox also had a volume control which a live player could manipulate. In the 1950 recording of Percy, Ella, and Burnett manipulating this contraption, Ella and Burnett are manipulating the volumes of the three instruments, Percy is turning the machine on and off, and playing another part live on a reed organ. The piece is about 30 seconds long, and the recording consists of 4 takes of the piece, with Grainger sometimes commenting between the takes. To me, this seems like an early example of having a sequencer control electronic instruments while live performers further interact with the electronic instruments in

real time. A performance with, for example, the IRCAM ISP workstation and an acoustic instrument may be a bit more complex, but conceptually it inhabits much the same territory as this early experiment of Grainger's. It should also be mentioned that there are some recordings in the archive of *Early One Morning*, another folksong arrangement, played by Solovoxes and Reed Organ. Though not as mechanically innovative as the *Sea Song* recordings, these recordings do stand as some of the earliest recordings of live keyboard synthesizer playing.

With the work on the Butterfly Piano, Grainger's Free Music work takes a very big leap. For this is the first work in the series of Free Music recordings, work that seeks to go beyond the pitch - rhythm paradigm of traditional musical organization. Grainger wanted to obtain gliding tones. He was interested in how close discrete tones needed to be in order to obtain the illusion of a gliding tone. Using a "Knoxville" piano, a small 3 and ½ octave piano with full size keys and a real piano action, Grainger restrung it and retuned it so that the instrument played just over an octave of 36 tone equal tempered tuning, which he then dubbed The Butterfly Piano. (See Illustration 2) A piano roll was cut by hand, with sequences Grainger was interested in hearing, and a vorsetzer unit was placed on the keys of the piano. Six recordings were made of this piano roll. In these, Grainger makes considerable comments about exploring the effects of closely tuned tones used in trills to obtain a timbrally richer effect than normal repeated notes could give. He also speeds up and slows down the speed of the roll, to explore the capabilities of the vorsetzer mechanism to produce differing results from the same roll. His work here is not only significant for its exploring of the pseudo-glides of 36 tone equal temperament, but also for his attitude towards his mechanism, the piano roll, which he regards as a source of variation in

its own right, and not just as a reproducing mechanism.

Following the work on the Butterfly Piano, Grainger and Cross turned their attention to one of Grainger's favorite timbres, the reed organ. Two sets of 126 reeds were retuned to 48 tone per octave equal temperament, giving just over 5 octaves of range in this tuning. The relative ease (until you try it! I speak from the experience of retuning an accordion into just intonation) of retuning free reeds prompted not only Grainger, but other microtonal experimenters, such as Harry Partch, to also work with making retuned reed organs in these same decades. The reed box machine went through a number of incarnations, trying out different combinations of hoses, hills and dales paper rolls and so on. Illustration 3 shows Version 6 from 1950. The first recordings of the reed box, from Jan 29 1951, sound as if this mechanism is being used, but the later recordings from the same day are far too complex in sound to have been produced in this way, so I'm not sure if the machine in this illustration was actually used in any recordings. Soon after this, however, Grainger and Cross abandoned the hills and dales paper roll approach for the reed box, and mounted the reeds in four large cardboard boxes, which they then played with hand-cut paper rolls. This machine was used for the recording that Percy introduces with the words "First Gliding Chords on Reed Box Tone Tool, September the 30th, 1951." This recording has been released on the CD of *Leonardo Music Journal No 6*.³ However, some of the most amazing reed box recordings are from the earlier January 1951 session, in which a combination of up to 28 reeds, some in 12 tone equal temperament and some in 48 tone equal temperament are combined to make experiments in timbral synthesis. Some of the thickest and most amazing sounds ever produced by free reeds are in the January 1951 recording that Howard Cross introduces with a snicker and the

words "This is done using both the upper and lower levels." This is some of the wildest tone cluster music ever, and it was made with harmonium reeds and hand cut paper rolls in 1951, some 10 years, for example, before Penderecki's *Threnody*, or 9 years before Bernard Herrmann's *Psycho*. For those who persist in thinking of Grainger only as the composer of *Country Gardens*, I can highly recommend playing them this amazing recording. In fact, sketch though it may be, I've come to like this recording as my favourite Grainger piece ever. Also of note in these recordings is the fact that the roll is once more treated as a resource for music performance possibilities. Pulled by hand, variations in speed and direction are both used. A passage might be heard slightly faster in one direction, then slightly slower in the other direction. Grainger and his co-workers were quick to seize on the musical possibilities of their machines, and again, were not just using them as simple reproduction devices.

Immediately following their work with the reed box, Grainger and Cross began to work with a Codemaster oscillator, assembling devices to produce smooth glides with it. The drawing called "Oscillator-Playing Tone-Tool, 3rd Experiment (early Nov 1951)" shows the hills and dales paper graph from the reed box experiments adapted to playing the oscillator. (See Illustration 4) Some of the November 1951 "Oscillator Test" recordings may have been made with this machine. It was quickly superseded, though, by a two voice machine consisting of a solid paper roll with gliding patterns made with clothesline glued to the paper, and sliding devices moving controls for two oscillators up and down. (See Illustration 5). And this machine was superseded by the famous Kangaroo Pouch Machine which still sits today in the Grainger Museum. (See Illustration 6) In the current Museum installation, only the four paper rolls for pitch control are on the machine. The four narrower rolls which

would control the volume of each voice are missing. Cross and Grainger had three voices working when they made their December 1951 recordings on the machine. On the recording, at mid-point, Cross's voice can be heard saying, enthusiastically, "And now in the other direction!" They then reverse the hand cranked roll and play their test pattern in a perfect retrograde.

Shortly after these recordings were made, Grainger and Cross embarked on a much more ambitious project, The Electric Eye Tone Tool. This was to have been a seven voiced instrument, with seven sine wave oscillators controlled by variations in light on a series of 14 photocells. Patterns painted on a large plastic sheet pulled across the plate of the instrument caused the variations in light. In this way, Grainger's vision of a graphic notation for precise glides and intervallic leaps could be finally realised. (Illustration 7) They had completed three working voices on the machine, according to Cross in his article about the making of this machine⁴ and according to Richard Franko Goldman⁵, Grainger in 1955 was writing graphs for selected passages from Wagner (the opening of *Tristan*), Scriabin, Grieg and other composers. Whether these were ever recorded, or whether any of Grainger's own experimental rolls exploring his own ideas were recorded is unknown to me. As for the machine itself, it suffered a very cruel fate, of which I have heard three versions. It was either destroyed in transit to the Grainger Museum, or it was disassembled for repairs at the time of Grainger's death, and the parts were thrown out by mistake, or it was disposed of by Grainger's executors, who were not aware of its significance. Whichever of these stories turns out to be true, the sad fact is that this machine, the crowning achievement of Grainger and Cross's work, no longer exists. However, Cross left rather detailed plans for the instrument, and a number of people over the past few decades, such as Caroline Wilkins

and Rainer Linz, have expressed interest in rebuilding the machine from these plans. I, too, had toyed with this idea, but had never followed through on the idea until late 2003, when John Crawford of ABC Classic FM approached me with the idea of producing a show about Grainger's more radical thinking, as part of a Grainger Festival organised by the Adelaide Symphony Orchestra and ABC Classic FM. I proposed that he fund the reconstruction of the Electric Eye Tone Tool, and he eventually approved the idea, so that from August through October 2003, Paul Francis Perry, Malcolm Ellis, and myself built a new version. This version differs in some ways from the original. (See Illustration 8) It is shorter than the original, contemporary halogen lamps providing a better light source than their bulbs, and it is narrower. Grainger's machine was 1.5 meters wide, ours is about 1 meter. This is because the 1.5 meter wide plastic sheeting Grainger used is no longer available. Similarly, we decided to use modern IC circuitry instead of the single transistor oscillators they used, and we ended up using easily available Dick Smith solar cells instead of their now obsolete selenium photocells. We built an upper set of control slits as in the Cross-Grainger machine, but for the first few pieces made with our machine, we found them not to be necessary. However, we feel that we've gotten as close to the performance of the original machine as one can get using currently available technology, and we feel that Percy and Burnett would be pleased with our machine as a continuation of their research. (Since Grainger and Cross were continually modifying their machines, we felt that a kind of "original instrument" aesthetic would be out of place in our rebuilding of the instrument. We want to move on from their work, not to repeat it.)

For the radio program, I decided that just playing Grainger's work would not be enough. I wanted contemporary composers to work with the machine. Accordingly, I

commissioned Wang Zheng-Ting, Tristram Cary and Catherine Schieve to make works involving the machine. In our haste to finish the machine in time for the program, we made some errors in power supply design. As a result, for this program, our machine had a 50 hz frequency modulated wobble on all seven of its oscillators. Fortunately, all three composers felt they could live with that (Tristram was indeed less than happy, but still decided to go with the timbre as it existed) and made works for the machine. Interestingly enough, all three of them made works for the machine and accompaniment. Ting's work was the first to be made. He is a calligrapher as well as a composer and sheng player, so I thought he might be interested in doing some sort of calligraphic score. But when he moved his hands between the lights and the photocells, and heard the various twitters and sweeps that resulted from that, he decided to simply multitrack several tracks of hand made gestures, and then played sheng along with these tracks to make his piece, *Future Four Seasons*. Tristram's approach was different. We used AudioMulch to make a backing track which indeed did have pure stable sine wave timbres and Graingerian glides. We then cut envelope shapes out of duct tape and placed them on the plastic sheet. These made a short series of gestures, changing pitch and loudness on differing numbers of oscillators. In live performance, we played back the recording of the AudioMulch sine waves, while Tristram hand cranked the machine back and forth, assembling, quite elegantly, a series of modulated warbles in real time over the sine wave base. Catherine's approach was different yet again. Her principal compositional interest has, for many years, been the application of graphic notational techniques to music. An accomplished painter as well as a composer, she found that titanium white paint produced very controllable and repeatable gestures, while different colours and densities of paper and other materials produced gestures that varied considerably

from performance to performance. Her piece, *Aviary*, also uses a backing track, made by recording the output of the machine while she was moving her paintbrush between the lights and the solar cells, and a live performance of a very colourful score, consisting of many different juxtaposed patterns of paper, ink and paint. (See Illustration 9) In performance, following the Cross-Grainger practice, the roll is used first in one direction and then in the other, with speed variations produced by hand cranking as an essential part of the performance. Since completing this piece, she has made a second piece using the machine, *Repentistas*, for Violin, Electric Eye Tone Tool Two, Piano, Organ, and Toy Piano. In this piece, she worked exclusively with titanium white paint, making repeatable gestures based on the inflections of the Brazilian folk singers referred to in the work's title. (See Illustration 10)

Future developments of the machine include not only re-designing of the power supply to provide more stable oscillators, and modifications to the ranges of the control knobs to provide a finer range of control over pitch and amplitude, but also to put the raw voltage output of the photocells themselves into a control voltage to midi converter, getting 14 midi continuous controller messages to apply to any desired set of synthesizer or sampler parameters. That these control patterns would then be able to be physically manipulated in real time by moving the roll back and forth is one of the ways that I feel the implications of the Cross-Grainger work will be developed. I would also like to commission other composers to work with the machine, and may even initiate a CD recording project of new pieces made for the revived Electric Eye Tone Tool. I would also be very interested in getting a commercial CD of the Grainger Free Music recordings released. In the appendix to this paper I have listed all the currently available recordings that I found in the collection of

the Grainger Museum.

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Appendix 1: Listing of Recordings of Percy Grainger Free Music (and other) recordings from the collection of the Grainger Museum. Transcribed and tentatively identified by Warren Burt, Oct. 03

1. PG Butterfly Piano Introduction No. 1 (0:56)
2. PG Butterfly Piano Introduction No. 2 (0:46)
3. PG Butterfly Piano Introduction No. 3 (1:33)
4. Butterfly Piano Roll Complete First Recording (1:29)
5. Butterfly Piano Faster with PG Intro (0:44)
6. Butterfly Piano Faster and Slower (0:54)
7. Sea Song Player Piano Roll Cut 1923 (0:37)
8. Sea Song with Solovoxes and Intro by BC Feb 1950 (1:53)
9. Solovoxes and Reed Organ Early One Morning 1950 (3:01)
10. Lonely Desert Man 01 PG Intro and Marimba (1:41)
11. Lonely Desert Man 02 Reed Organ part only (1:01)
12. Lonely Desert Man 03 Reed Organ Record & Marimba (1:10)
13. Lonely Desert Man 04 PG & EG Sing with Marimba Record (1:36)
14. Lonely Desert Man 05 PG & EG Sing with Mba Record Take 2 (1:35)
15. Lonely Desert Man 05A PG & Engineer Speak (0:17)
16. Lonely Desert Man 06 Mix with Recorded Cello? (1:15)
17. Reed Box 01 Jan 29 1951 First Recording (2:41)
18. Reed Box 02 Jan 29 1951 Second Recording (1:45)
19. Reed Box 03 Jan 29 1951 Top and Bottom Ranks - THICK (2:05)
20. Reed Box 04 Jan 29 1951 Timbral Synthesis (2:10)
21. Reed Box 05 Jan 29 1951 BC Explains Previous Take (1:21)
22. Reed Box 06 First Gliding Chords Sept 1951 (1:10)
23. Reed Box 07 Sept 51 Second Recording Roll forward and Backward (1:36)
24. Reed Box 08 Glides No Talk - From Cassette given to WB by BC (1:01)
25. Reed Box 09 Forwards - 1988 Recording (1:03)
26. Reed Box 10 Backwards - 1988 Recording (1:31)
27. Oscillator Test - 1 Voice with Hills and Dales Nov 2 1951 (1:29)
28. Oscillator Test - Two Parts (0:42)
29. Oscillator Test - Four Parts (1:19)
30. Oscillator Test - AM Oscillator - From Leonardo Music Journal CD (0:50)
31. Kangaroo Pouch Machine Dec 1951 BC Voice (1:22)
32. Free Music Number 1 - Les Craythorn Realization?? Only 3 voices (1:47)
33. Free Music Number 1 - Les Craythorn Realization 4 Voices - From BC Cass (1:47)
34. Free Music Number 2 - Conyngham realization - Move LP (1:12)
35. PG Sings and Plays Rufford Park Poachers (4:27)
36. PG Sings and Plays Lord Melbourne (3:12)
37. Various Introductions spoken 1988 by BC (7:29)

Footnotes:

1. Glinsky, Albert, *Theremin: Ether Music and Espionage*, Urbana and Chicago, University of Illinois Press, 2000.
2. Cross, Burnett, "Collaborating with Percy Grainger." *NMA* 7, pp. 3-4, Melbourne, NMA Publications, 1989.
3. CD Companion, *Leonardo Music Journal No. 6*, Cambridge, MA, MIT Press for International Society for the Arts, Sciences and Technology, 1996.
4. Cross, Burnett, "Grainger Free Music Machine" in *A Source Guide to the Music of Percy Grainger*, Thomas P. Lewis, ed., pp. 158-162, New York, Pro/Am Music Resources, Inc. 1991.
5. Goldman, Richard Franko, "Percy Grainger's Free Music" *The Julliard Review II/3*, pp. 6-11, New York, Fall 1955.

Grainger Illustrations:

Illustration 1: Sea Song Solovox and Player Piano Rig

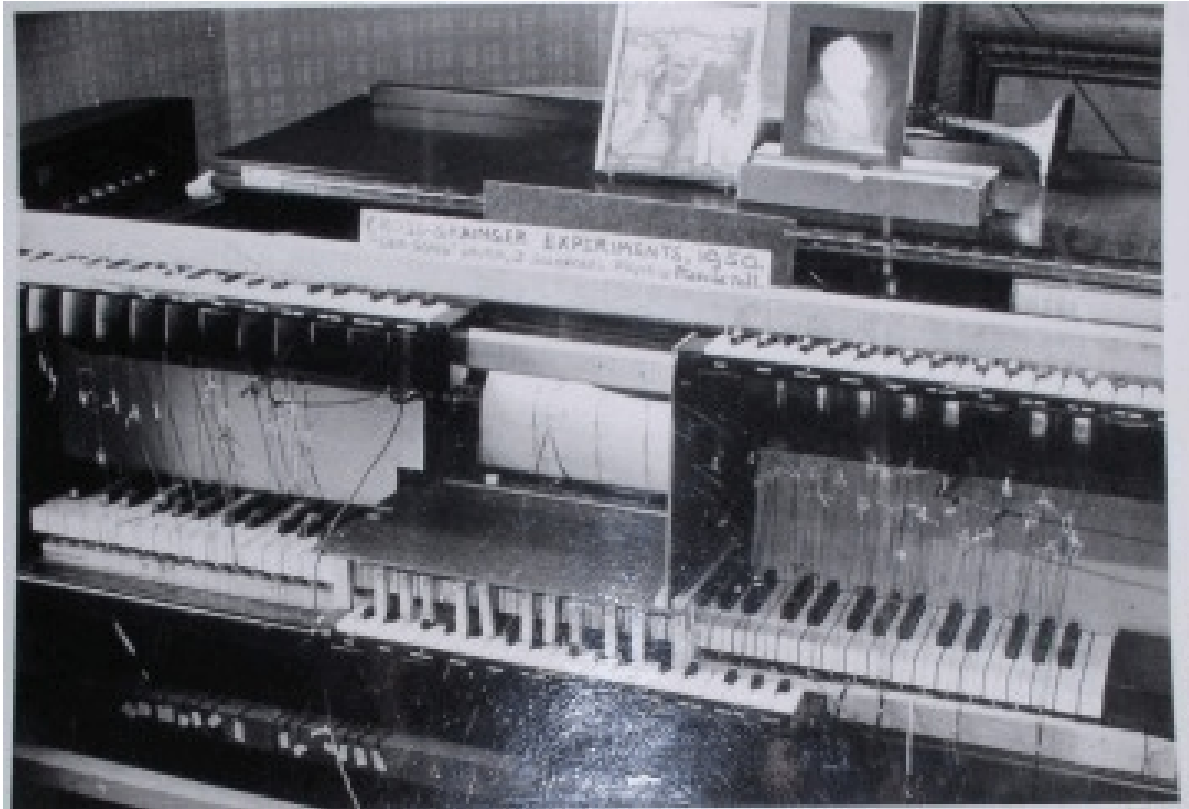


Illustration 2: Butterfly Piano



Illustration 4: Oscillator Control, 3rd Experiment

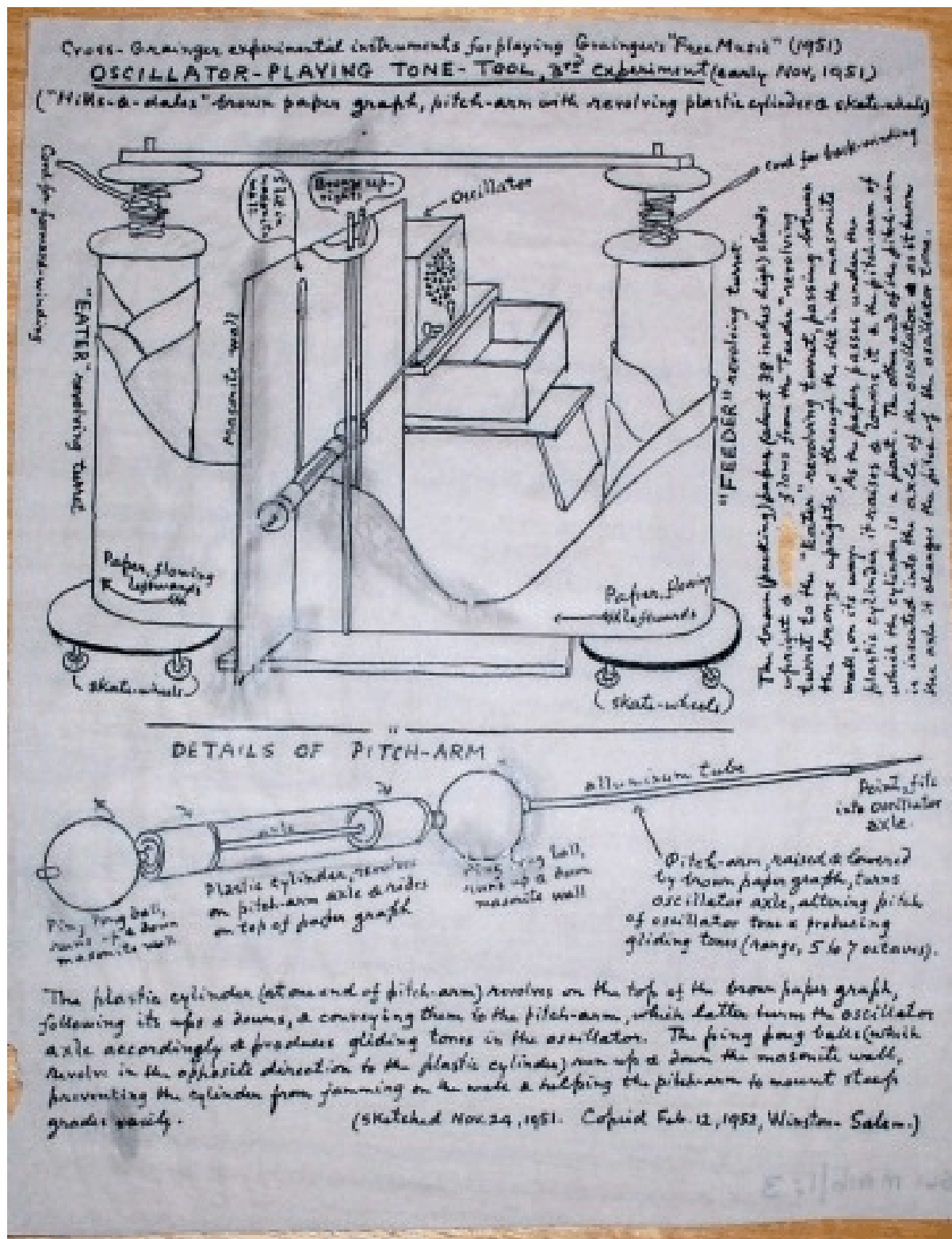


Illustration 5: Clothesline Controller

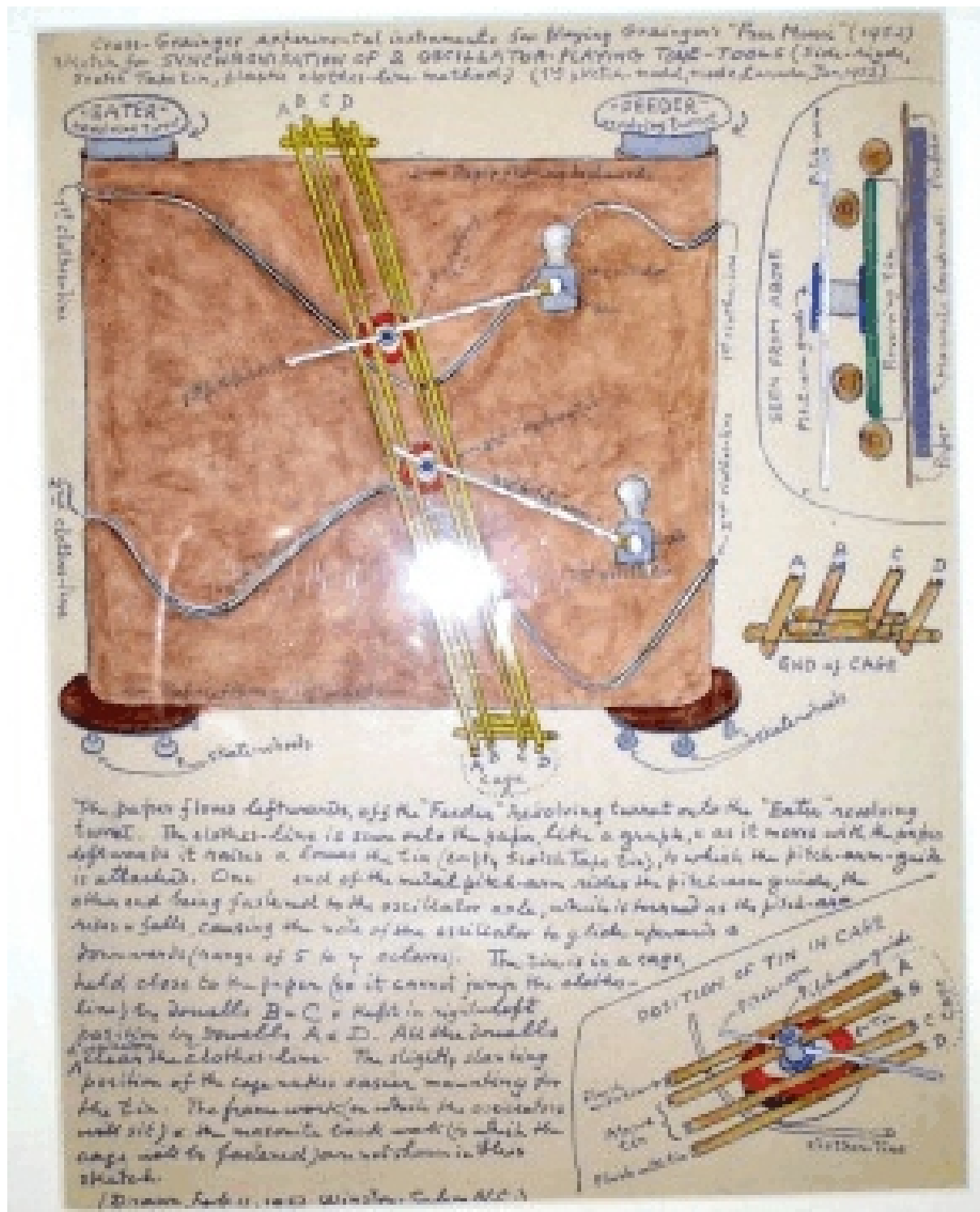


Illustration 6: Kangaroo Pouch Machine, October 2003



Illustration 7: Burnett Cross Drawing, Electric Eye Tone Tool

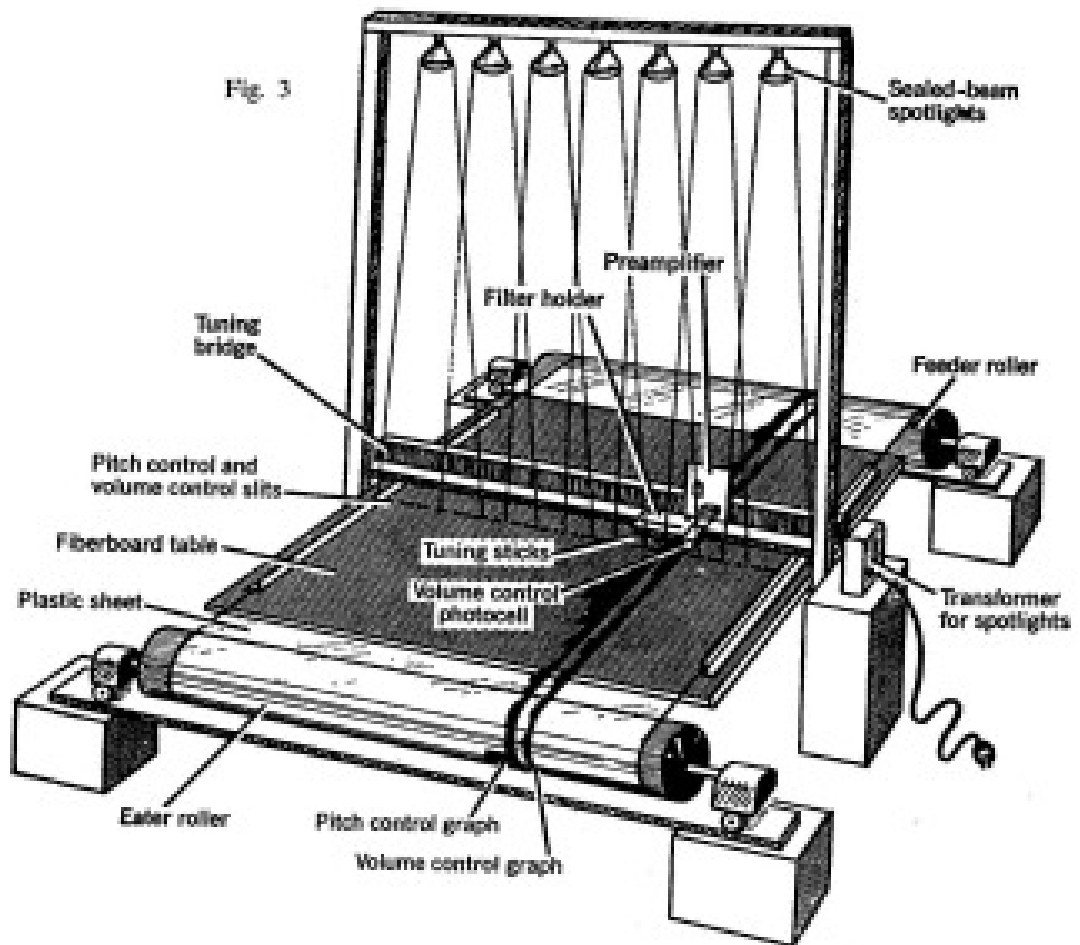


Illustration 8: Burt-Perry-Ellis reconstruction: Electric Eye Tone Tool Two

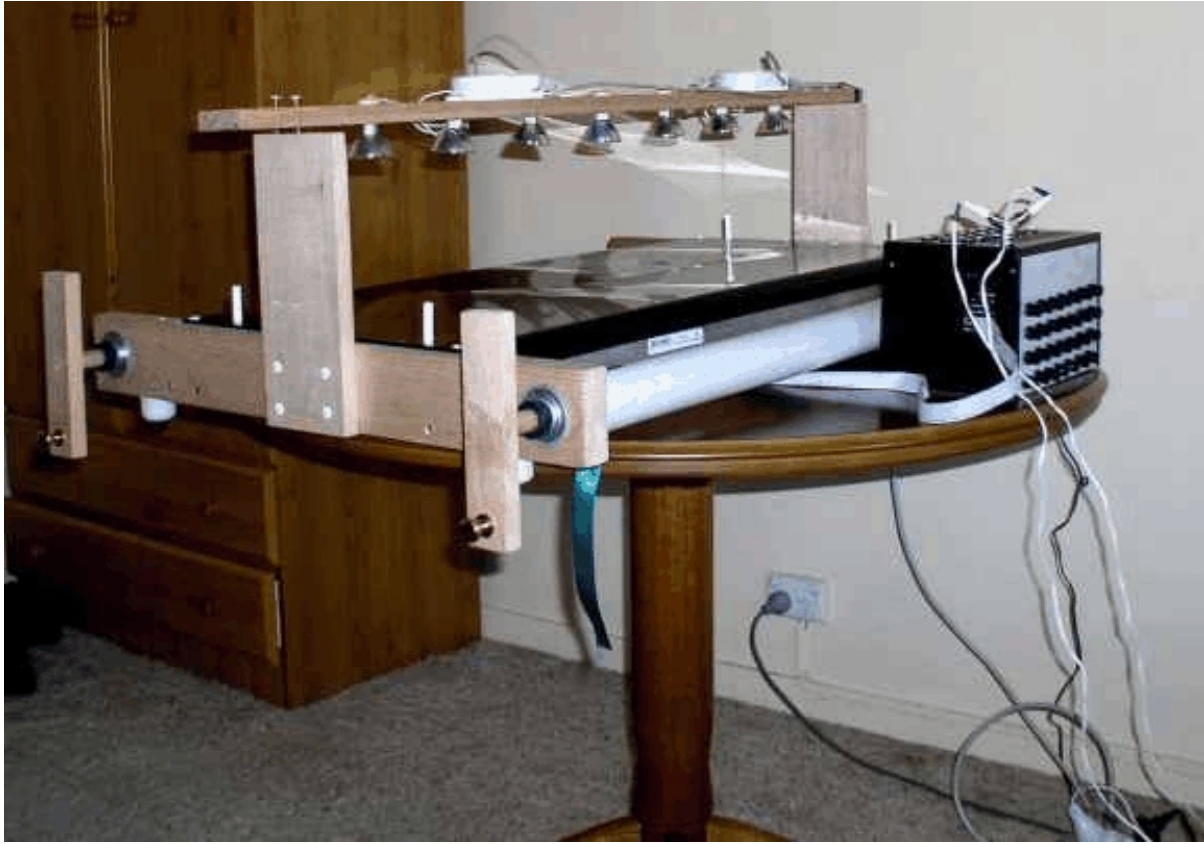


Illustration 9: Catherine Schieve score for *Aviary* (detail)



Illustration 10: Catherine Schieve score for EETT2 part for *Repentistas* (detail)

