

## THE MUSIC OF CSIRAC, SOME UNTOLD STORIES

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### Abstract

CSIRAC was probably the first computer in the world to play music, although that was never developed. The music was never recorded, but it has been reconstructed to a very high degree of authenticity. A book documenting this, *The Music of CSIRAC*, included interviews of several of the original personnel involved with CSIRAC and the music. This paper fills out some of the stories and background left out of the book.

**Keywords:** computer music history, CSIRAC, research methods, computing history

This paper provides some supplementary information to my book *The Music of CSIRAC*. There were reasons for omitting this information at the time the book was written, but the information is valuable now. The paper also investigates the research methods used to document and reconstruct the music, and this has been (surprisingly to me) something many readers have found valuable.

Computer music is the great musical adventure of the twentieth and twenty-first centuries, even if it has always been a rather poorly-defined concept. Obviously it has something to do with computers, and something to do with music. The question of why someone would want to use a computer to make music was first asked (in print) in 1959 by Lejaren Hiller. Now, the use of computers in music production and reproduction is ubiquitous, for artists and consumers, so many others must have asked that question. For artists, computer music may still retain the aura of a separate field of academic or artistic endeavour. For consumers, the use of computers in music is a daily fact of life.

The path that led to this usage is the result of many very small steps that were neither coordinated nor goal-oriented - steps that were not labeled as scientific, consumer-oriented, or artistic. The computer's use in timbre creation, experimentation, complex compositional systems, and musical instrument design, as well as the enthralling power of a computation machine, all contributed to a climate in which something that could be called 'computer music' began to be created.

Based on these ideas, an historical narrative could be produced, linking all of these activities in a compelling story of inevitable advances. Perhaps an equal-

ly viable narrative would be a chronicle of engineering achievements that accidentally became musically useful - digital computers are one example. In the case of CSIRAC, the hooter circuit could be added to this list, as having a loud-speaker driven by pulses allowed people with skill and imagination to experiment musically.

The technical challenges faced by all pioneers of computer music were enormous, and are difficult to comprehend today; surmounting these challenges was a contribution to what is now a dominant musical activity.

An artistic history might discount some of the initial 'buzzes and squawks' as musically irrelevant; however, a history cognisant of the current artistic, scientific and consumer-oriented reality should also take note of the early effort and dedication that now can be seen as a piece of the overall puzzle, part of the grand musical adventure of the twentieth century: the use of computers in music.

### The beginning

I was sitting in my office at the Royal Conservatory of Holland, reading *The Age* (newspaper) online, and came across the obituary of Trevor Pearcey, the designer of CSIRAC. As an undergraduate computer science student at the University of Melbourne I had been fascinated with stories of CSIRAC - it stored information in *liquid metal*! One fact in the obituary stood out to me, that CSIRAC played music in 1951. I *knew* this was wrong; I was working in one of the most prestigious computer music departments in the world (the Sonology Institute of the Royal Conservatory of Holland), and everyone knew that computer music started in 1957 at Bell Labs with the work of Max Matthews. Being an alumnus of the department, I sent an email pointing out the error in the obituary. To my great surprise the head of the department, Peter Thorne, said that he remembered me as a troublemaker and that the 1951 date was *correct* - people remember it, they were there! My colleagues, all highly decorated computer music types, were all either sceptical, or astonished. Apparently there were no recordings of the music, and the machine was no longer working, but the programs allegedly existed on paper tape, there were circuit diagrams for the machine, and several key personnel who worked with CSIRAC were still around.

This started the journey to reconstruct the music played by CSIRAC, as told in the book *The Music of CSIRAC*.

Along the way, several problems presented themselves which, naively, I had not expected. A brief summary of these problems are:

- How to reconstruct the music
- How to ensure that the music sounded authentic to the original played in 1951
- How to document that CSIRAC played music in 1951
- How to ensure that both the reconstruction of the music and the 1951 date was rigorously researched or documented, so that it would stand up to the inevitable scrutiny that revising history would attract

The book *The Music of CSIRAC* explains clearly the first two points above, and also covers point three; however the last point is not explicitly addressed in the book, except in an embodied way - that is, it becomes evident through the book that CSIRAC did, indeed, play music in 1951.

The only way I could think of to address this issue was to go to primary sources and research the question of when CSIRAC played music. Luckily, there was a video of Trevor Pearcey saying that they played music in 1949 or 1950. I searched for newspaper reports, but there was nothing. This initially surprised me, but I later found out that the music was not an authorised activity, but something of a 'parlour trick', not publicly acknowledged by the CSIR (the Council for Scientific and Industrial Research, the precursor to the CSIRO), and thus not allowed to be reported.

My best option appeared to be to find the people who remembered CSIRAC playing music, interview them, and document the interviews; this body of evidence would hopefully convince the world, even the sceptics, that CSIRAC did play music in 1951 and possibly earlier. I was still partially a sceptic myself at this time, such is the power of a well-documented 'history' to further a common belief regarding an historical practice.

The stories are largely documented in the book *The Music of CSIRAC*; however, many interesting anecdotes did not make it into the book, as I wished it to be rigorous and to-the-point. In hindsight, I think these untold stories add to the evidence of CSIRAC playing music from around 1949, and this paper documents them for the first time.

### Pearcey's story:

Trevor Pearcey was one of the designers of the CSIR Mk1 (later known as

CSIRAC), along with Maston Beard, for the Council for the CSIR. Pearcey was not a musician; none of the CSIR Mk1 personnel were really; however, he understood something of the power of music. Dr. ‘Taffy’ Bowen, a world-renowned radar expert, ran the CSIR Radiophysics division. Among Dr. Bowen’s interests were advanced radar systems, radio astronomy, and cloud-seeding as a way to improve Australian agriculture. The CSIR Mk 1 was always intended as a prototype for a more capable machine, and after attempts to commercialise it failed, its future was in doubt; thus a campaign was started by the CSIR Mk1 team to popularise the computer. There would be no better way to do so than to make it famous for playing music; Pearcey wanted to have the music played on 2BL radio station, but Dr. Bowen would not allow it; Pearcey says, “... Dr. Bowen, who was then chief, did not think this was good enough. I think he didn’t realise the intellectual skill and effort that had gone into actually getting the machine to play specific musical sequences. This was in 1950 or ’51, I cannot give a precise date. It was certainly a very early programming exercise. We played it at the conference.” In this interview you can hear Pearcey’s disappointment, bitterness and resentment. The conference mentioned was the Conference of Automatic Computing Machines, Australia’s first computing conference, 7-9 August 1951.

The campaign to popularise the computer continued. According to one report [1], the piece *Bonnie Banks* was programmed, in an attempt to try and interest the then Prime Minister of Australia, Sir Robert Menzies, who was of Scottish descent. This did not seem to work, as Dr. Bowen ordered a review of the computing project in the early 1950s, by a board consisting of one American and two English computing specialists. They recommended that Australia leave computation to England and America, that digital computing had no future because analogue computing was the way forward, and that Australia should concentrate on primary industry. While the decision to close the CSIR Mk1 project was probably justified, the decision to abandon computing altogether is most lamentable.

### Hill family stories:

Geoff Hill, the first programmer of the CSIR Mk1 and Australia’s first software engineer, first programmed the CSIR Mk1 to play music. Geoff came from a

musical family; his mother and sister were music teachers and he, like his mother, had perfect pitch.

This was a crucial and fortuitous development. The speaker on the CSIR Mk1 was electrically connected to the main computing buss, and it was used to indicate where the program was - raw pulses from the computer buss were sent to the speaker to make a sound, and these ‘blurts’ were used to indicate the end, or a particular stage, of a program. Geoff Hill, as a mathematician from a musical family, would have easily realised that if pulses could be sent to the speaker with a regular period, then a steady tone could be produced. After achieving this (no easy feat with variable memory access timing), the next logical step would be to make a scale.

Geoff Hill’s widow, Eileen Hill, was able to relay several interesting stories about Geoff and the music [2]. When Geoff was first working on making the CSIR Mk1 produce a scale, he called his mother one night around 9:30 or 10 pm. Mrs. Hill relates the story from Geoff’s mother as follows, “It was very late for those times, and I had Geoff’s dinner in the oven. He called and asked me to listen to something. I told him to stop messing around with a piece of paper and a comb and to come home!” Geoff Hill had put the telephone receiver to the speaker on the CSIR Mk1 to ask his mother if the scale was in tune; she thought that he was playing games with a piece of paper and a comb.

Another time, Mrs. Hill related the story of when she first heard of Geoff. As a new student at Sydney University in about 1950, she was a resident in Sancta Sophia College. One night, at the dinner table, another young lady named Mary Thurling said, “Did you hear that Geoff Hill has that machine playing music?” Mrs. Hill continued, “I remember because I said, ‘Who is Geoff Hill?’ and of course I married him later.” It takes little extension to suggest that this young software engineer, having programmed a computer to play music for the first time, was inviting young ladies to come into the lab and hear it ...

### Other stories:

Dick McGee was a scientist who started working with CSIR Radiophysics in April 1951; during our interview [3], he remembered hearing the CSIR Mk1 play music soon after. While Mr. McGee did not attend much of the computing conference in 1951, he clearly remembered other attendees talking about CSIRAC

playing music afterwards, and how astonished everyone was by the computer playing music. What I found most interesting here was that Mr. McGee mentioned in passing that the CSIR Mk1 had run the calculations to find the centre of the galaxy. Apparently Mr. McGee and a colleague were working in radio astronomy, mapping the southern sky’s radio sources, and they had found the centre of the galaxy in 1953; this was ratified internationally a few years later.

Whilst interviewing Peter Thorne I said that it was a pity that no composers had been involved with CSIRAC (the name was changed from the CSIR Mk1 to CSIRAC when the machine moved to Melbourne), particularly Percy Grainger, who was known for his advanced musical thinking. I was astonished when Peter Thorne said, “I can remember Percy Grainger walking past the Computation Laboratory at the time CSIRAC was running. Actually walking down the alleyway between what would have been the cyclotron and Physics; the others in the laboratory pointed out of the window and said, “There’s Percy Grainger.” He was going towards the Grainger Museum. He was that close. It must have been in about 1959. Grainger was at the University when CSIRAC was operating.”

All someone had to do was to step out of the Computation Laboratory and invite Percy Grainger in; to think that we were a few physical steps away from advanced musical developments such as microtonality, arbitrary rhythmic and tonality possibilities, and so on with CSIRAC is particularly telling; it underlines that the musical output of CSIRAC was not seen as having any practical or significant application. It was obviously being used for computational and engineering problems, and the imagination of what it could, or should, be used for did not extend much further.

### A final note

The imagination of what might be possible seems to be the missing ingredient for CSIRAC to have made an impact on music; this is an ingredient that Max Mathews had at Bell Labs in the late 1950s.

CSIRAC was, I think, the first computer in the world to play music. It was followed not long after by a Ferranti Mark I machine in England, which played *God Save the Queen*. These early developments used the computer as a musical sequencer, to play standard and popular tunes of the day; this is not surprising given that it was engineers pro-

gramming the computer to play something.

At Bell Labs in the later 1950s, Max Mathews had a digital-to-analogue converter to work with the beginnings of arbitrary waveform synthesis. He made some very insightful decisions while developing his Music N software; unit generators and table oscillators are two of the most outstanding. I would also rank high amongst them the decision to ask composers to be involved with the development of music on computers; perhaps it took the particular genius of Max Mathews to realise that computer programmers were not the best people to determine what was needed from computers in order to advance the art of music.

This does not diminish the achievement of CSIRAC playing music in 1950 or 1951. That was a leap of imagination in itself, and the effort involved and the programming complexities were enormous; this was one of those small, uncoordinated steps which have led to the richness and adventure that we now know as computer music. When I discussed the CSIRAC project with Max Mathews [5] he said, “Yes, we heard about these sorts of things in the early days. What was the memory architecture of this machine?” He *immediately* understood the complexities involved with the programming. Who is to say which of these small and uncoordinated steps triggered another? It is possible to postulate that without CSIRAC, the Ferranti Mark I, or some other machine that Max Mathews may have heard about, playing music, then the developments at Bell Labs might not have happened; perhaps it was the initial ‘buzzes and squawks’ that helped to trigger the developments at Bell Labs which, in turn, went on to define computer music.

### References

1. Interview with Peter Thorne, conducted by the author, 16 February 2000.
2. Interview with Eileen Hill, conducted by the author, 2 March 2000.
3. Interview with Dick McGee, conducted by the author, 20 May 2000.
4. Paul Doornbusch, *The Music of CSIRAC* (Melbourne, Australia: Common Ground, 2005)
5. Interview with Max Matthews, conducted by the author, at ICMC 2000, September 2000, Berlin.