Nancarrow's Drum Machines

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PILACREMUS, PERSPECTIVA INTERDISCIPLINARIA DEL LABORATORIO DE CREACIÓN 2020 No.3 Conlon Nancarrow

Nancarrow's Drum Machines: the story of his mechanical orchestra and *Piece For Tape*

SYNOPSIS

When Conlon Nancarrow began writing for the player piano he discovered the ideal tool with which to express his temporal imagination. Despite the apparent limitations of this homophonic instrument (or perhaps because of them), he uncovered a multitude of original and still unsurpassed ideas. However his initial vision of mechanical music was of an automated orchestra of pianos and percussion. The failure of this instrument is known, but Nancarrow managed to record enough of it to create a tape piece that reveals yet more inventive compositional techniques. A transcription of this tape piece is now making its way into the percussion canon while Trimpin has rebuilt the mechanical orchestra using contemporary engineering techniques. This article attempts to tell the full story of Nancarrow's unfinished experiments and proposes the relationship between the percussion orchestra and the tape piece. It includes an analysis of the intriguing compositional problems and solutions in Piece for Tape and suggests why this reinforces the idea of Nancarrow as a forebearer of electronic music.

KEYWORDS: NANCARROW, MURCOTT, TRIMPIN, PIECE FOR TAPE

INTRODUCTION

This article is both a historical detective story and an analysis of an inventive compositional technique. It charts the journey of an idea that Conlon Nancarrow had in the 1940s, developed then abandoned shortly afterwards, but has now entered

musical society in two separate formats. In the process it emerges that not only did Nancarrow create one of the earliest pieces of *musique concrète* but one that functions unlike any other of that period and reinforces the notion of him preempting the aesthetics of computer music.

Despite being famous for a collection of player piano compositions that explore simultaneous tempo relationships more thoroughly than any other composer, there exist a few pictures of Conlon Nancarrow (1912-1997) posing in his Mexico City studio in front of a fantastic wall of percussion and machinery taken sometime around 1950. Much to Nancarrow's chagrin, one was published on the inner sleeve of his Complete Studies For Player Piano Vol.3, released in 1981 on the Arch 1750 label. Writing to the producer Charles Amirkhanian he complains, "I hope by the time you get around to my next record you will have gotten over your hang-up with the drum pictures. I have become the drum composer" (Nancarrow 1981). The problem was that the contraption never functioned properly and was dismantled without producing any satisfactory music. Nancarrow did however manage to make a recording of some of the instruments and used this for a fascinating tape piece, more of which to come.

FIGURE 1: NANCARROW WITH HIS INCOMPLETE MECHANICAL PERCUSSION ORCHESTRA (COURTESY OF NANCARROW ESTATE)

BUILDING THE 'ORCHESTRION'

Nancarrow bought his first player piano in 1947 after reading Cowell's *New Musical Resources* which proposed manually punched rolls as a solution to multiple tempo problems. In truth he was already considering it "I had the idea of the player piano in my mind from way back, but Cowell's book reinforced it" (Nancarrow 1980). His interest in contrasting layers of musical time, or his own phrase *rhythmic dissonance* was already developing and the adoption of the player piano for the 35-year old composer was needed in Gann's words "..to satisfy an aesthetic already in place"(Gann 1995). A clue to sound world this machine was hopefully going to emulate can be found in a 1987 interview with William Duckworth. Here Nancarrow

states that while is Boston (circa 1932-35), he was “bowled over” by a recording of Indian music featuring 12 tuned tabla played “like a harpsichord” (Duckworth 40).

The exact date of the percussion photographs is unknown. In fact exact dates are a continuing problem for Nancarrow scholars as the composer began with little expectation of his works becoming well known, so took little interest in the accurate cataloging of his early works. Gann concludes that it is late forties, undoubtedly from discussion with Nancarrow himself (Gann 1997 p45). So what was this instrument? The caption under the photograph on the 1981 recording describes the instrument as an *Orchestrion*, a now disused term to describe any mechanical ensemble instrument (e.g. Amsterdam’s 1924 Busy Drone). The concept was to create a percussion and player piano orchestra that could be powered by the same mechanism as the player piano itself i.e. a motorised vacuum pump and controlled by holes punched in a paper roll. The roll passes over a tracker bar housing a hole for each note. With the tracker bar permanently ‘sucking’, a hole in the paper causes a momentary burst of air to move down a tube and activate a piano hammer. Fitting out a well-stocked workshop as part of his newly built home studio he was able to fabricate the majority of the structure himself.

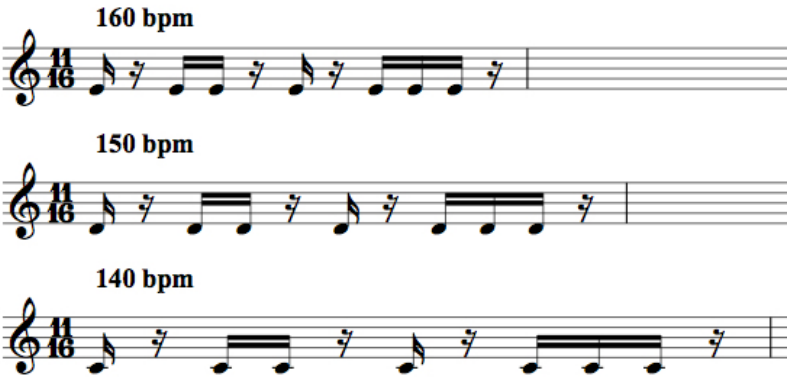
FIGURE 2: ONE OF NANCARROW'S SURVIVING HOMEMADE DRUMS (PHOTOGRAPH JAMES GREESON)

His stepson Louis Stephens, also remembers him making some of the actual drums by stretching goatskin over clay pots (Stephens n.d.). Assisted by his friend Bob Allen, previously a journalist who reported on the Spanish Civil War and had originally studied engineering at MIT (Annette Nancarrow in Hocker 2012, p104), he extended the player piano's pneumatic system to allow a drumstick or mallet to be activated instead of a piano hammer.

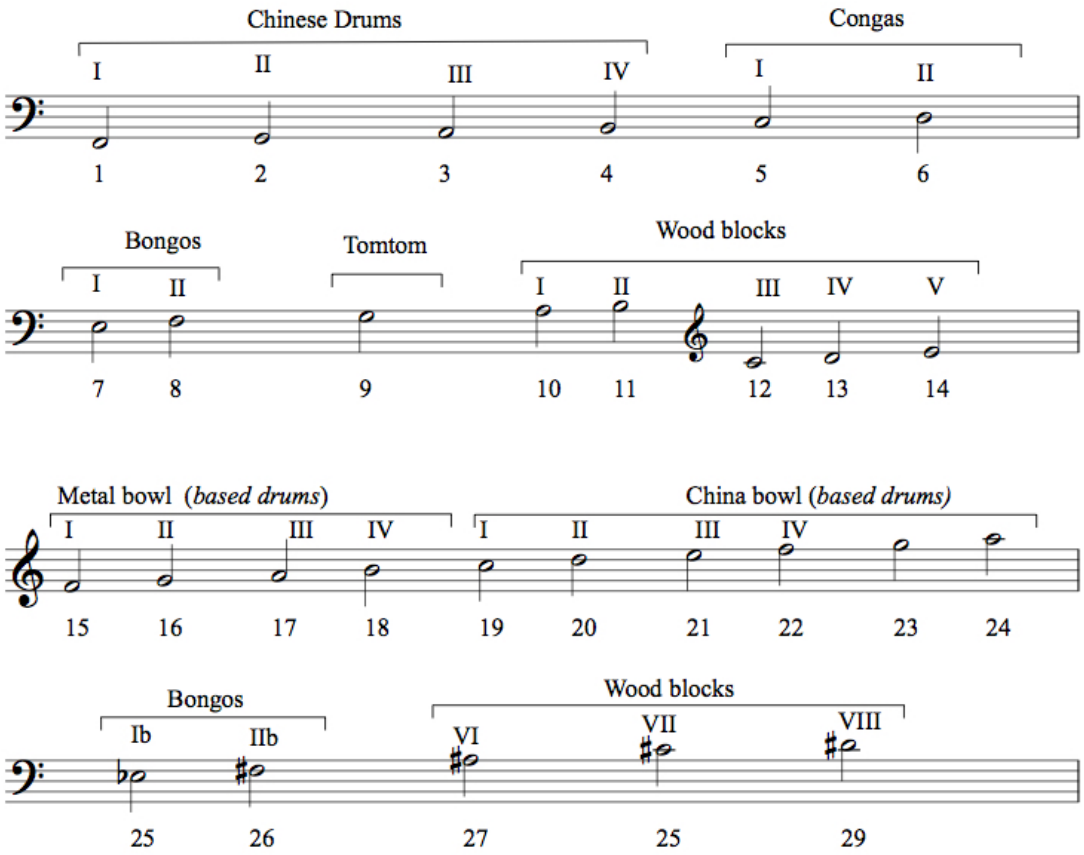
FIGURE 3: ONE OF NANCARROW'S HOMEMADE PNEUMATIC MALLETS (PHOTOGRAPH BY THE AUTHOR)

Unfortunately the energy required to play a finely balanced piano key is far less than that needed to move a mallet with a suitably rapid striking force and the results were disappointingly slow (Trimpin 7). In his own words: "The original project for the percussion orchestra was to include some fixed pitch instruments such as marimba, also the pianos were to be included. The reason I dropped the whole thing was that it never worked, and I got tired of trying. I wasted an enormous time on that." (Nancarrow 1985). From the same interview "That was a mistake of someone-taking a picture of the drums and publishing it everywhere. In fact, it's had the effect of some non-musicians hearing a recording of my player piano music and commenting of how interesting that percussion music is." (Duckworth 43).

Percussive attack was crucial to Nancarrow's aesthetic and he augmented the hammers of his pianos with metal to accentuate this (see Murcott 2014 and Hocker 2012) but given that he must have begun building the percussion orchestra soon after acquiring his first player piano we can assume that his original concept of mechanical music was multi-instrumental as well. Indeed he returns to a multi-timbral method briefly in Study #30 for prepared piano, then again for a late work with Trimpin's MIDI controlled prepared piano (Contraption IPP 71512 - see Leitman 2011). Although no recordings of the percussion orchestra survive, a number of unmarked piano rolls were discovered in his studio in the early 1990's that use a limited number of pitches with only rhythmic interest. Although Player Piano Study #20 uses a similar idea of single pitch voices in tempo canon, the relationship between the pitches is thematically important unlike these unmarked rolls. It must therefore be assumed that they are experiments for the percussion orchestra (Gann's conclusion also - Gann 1997 p45). One such example, labeled XX by Trimpin (who digitised the rolls) consist of three identical lines of a seven-note phrase, eleven notes in length including rests The three lines play exactly 14, 15 and 16 times over the same period, stopping at the first convergence point (see Gann P.21 for a description of this term). The tempi are therefore also in the ratio of 14:15:16 (see EXAMPLE. 1). A number of pages of notes, seemingly providing a key of instruments for the percussion orchestra survive today in the Sacher Foundation, Basel. The most complete one shows a total of 29 instruments notated as in EXAMPLE 2.



EXAMPLE 1: THE XX PHRASE WITH INDICATIVE TEMPO MARKINGS



EXAMPLE 2: KEY OF NOTATION WHICH APPEARS TO BE FOR THE MECHANICAL PERCUSSION ORCHESTRA. TAKEN FROM NANCARROW'S OWN NOTES.

Imagining the octave in the XX MIDI file is correct then the three sounds will be woodblocks. AUDIO EXAMPLE 1 is version of the XX roll using these sounds at the tempo that the MIDI file proposed. Though a relatively simple example, if Nancarrow did manage to get this test to work, then he was able to hear an accurate version of phase shifting percussion that no one else had at that time. This was around fifteen years before Reich used multiple tape machines for elongated phasing effects.

AUDIO EXAMPLE 1

AUDIO EXAMPLE 1: AN AUDIO RECREATION OF THE XX UNMARKED ROLL

THE TRANSFER TO TAPE

Nancarrow had already shown an interest in recording devices. His stepson remembers him experimenting with a recording turntable prior to moving into his studio in 1947/48 (Stephens n.d.). In the late 1940's tape recorders appeared commercially for the first time, replacing relatively expensive and low quality wire recorders which were already available (see Greg Milner's book 'Perfecting Sound Forever' for a fascinating description of this story). At some point during this period, seemingly as a continuation of the percussion orchestra project and perhaps frustrated with its limitations, Nancarrow recorded some of the sounds of the instruments and created a piece that became known simply as Piece for Tape. Though shared with a number of his friends over the years, it only became publicly available in 2000 (Nancarrow, Lost Works, Last Works, Other Minds). In the liner notes for this release

Kyle Gann states “some phase-shifting occurs in tempo relationships we can only guess at”. In 2010 Felix Meyer, Director of the Paul Sacher Foundation in Basel, discovered a number of unmarked pages of an incomplete score of the work amongst Nancarrow’s archived documents. On hearing Piece for Tape in that same year, the present author became excited about the prospect of creating a solo percussion arrangement and undertook an analysis of the work.

While the recording stops after just over two minutes, the score continues for another 34 bars which would amount to an extra 30 seconds of music but nevertheless is still unfinished. Writing about it to Elliott Carter in 1970 Nancarrow says “It is incomplete, and I don’t know whether this was all I could find or I simply got tired of it and stopped. Probably the latter.” In 1981 he explains more thoroughly in a letter to Charles Amirkhanian:

> I recorded a collection of percussion sounds, then made copies of each one and cut them into little pieces for the rhythms I was going to use (a certain length for a sixteenth, double for an eighth, etc). Then I spliced them together for this piece. All that work for a nothing little piece, and such limited possibilities, so I went back to player piano, which I had barely started. Of course in these days there was no multiple track and all the other modern sophistications. If there had been I might have stuck with it, but by the time those things developed I was already deep into player piano. A few years ago I ran into the tape I had done. It was already falling apart (in those days tape was paper) so I had a copy made on good tape. Some of it is missing, and what you heard cut off is the amount that was left. I don’t remember how much of the original was lost.

There are a number of tapes still in Nancarrow's studio (2), which are either the original, or due to them being on plastic and not paper tape, copies of the source material.

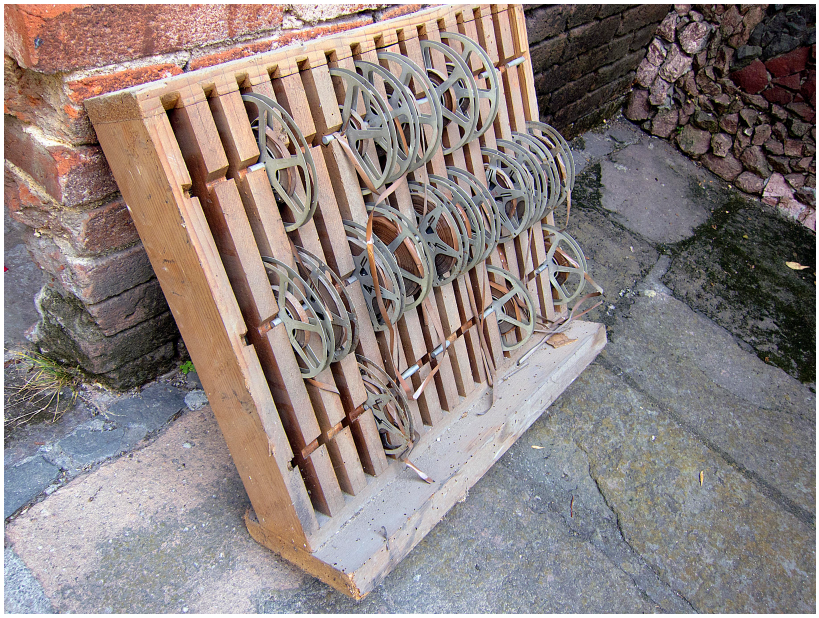
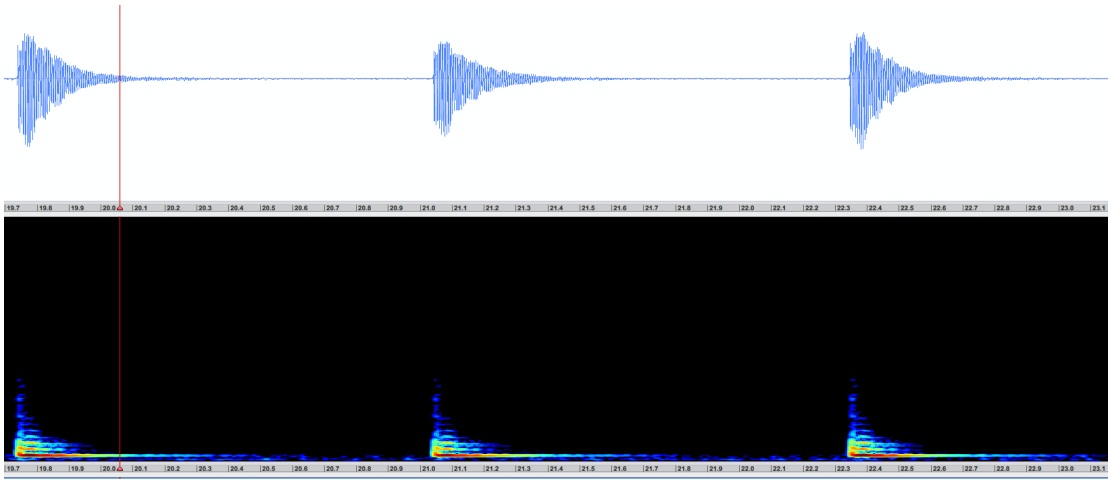


FIGURE 4: NANCARROW'S HOMEMADE BOX WITH SOURCE MATERIAL FOR PIECE FOR TAPE (PHOTOGRAPH BY THE AUTHOR)

Each tape contain repetitive strikes of a single percussion sound. The timing of the strikes is entirely mechanical and three of them examined are at regular 92 bpm which suggests that they were played mechanically. Sonogram analysis supports this, showing an almost, but not identical sonic signature for each strike. This regularity but not exact uniformity also suggests that they were played by one functioning mallet from the percussion orchestra rather than created by a tape loop.



EXAMPLE 3: SONOGRAM OF ONE OF THE TAPES OF RAW MATERIAL. THE UNIFORM, BUT NOT QUITE IDENTICAL PATTERNS ARE CONSISTENT WITH A MECHANICAL STRIKE.

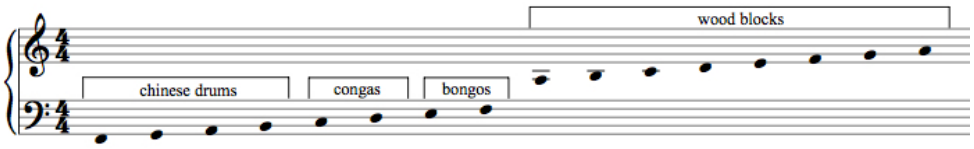
The recording of Piece For Tape consists of very rapid drum sounds, changing to rapid woodblock type sounds some point after halfway. With times referring to the recording, the overall structure from the score could be expressed as:

0'00" THEME (drums)
0'07" TRANSITION
0'12" THEME (HALF SPEED)
0'26" DEVELOPMENT
1'14" THEME (SHORTENED) (woodblocks)
1'18" TRANSITION
1'23" THEME (SHORTENED)
1'26" DEVELOPMENT
2'03" (recording ends)
START OF NEW INCOMPLETE MATERIAL

EXAMPLE 4: STRUCTURE OF PIECE FOR TAPE FROM SCORE WITH TIME REFERENCES TO THE RECORDING

The piece is scored for eight drum sounds and eight woodblock sounds, and while there is no key to which line of the score is which, analysis of the recording shows

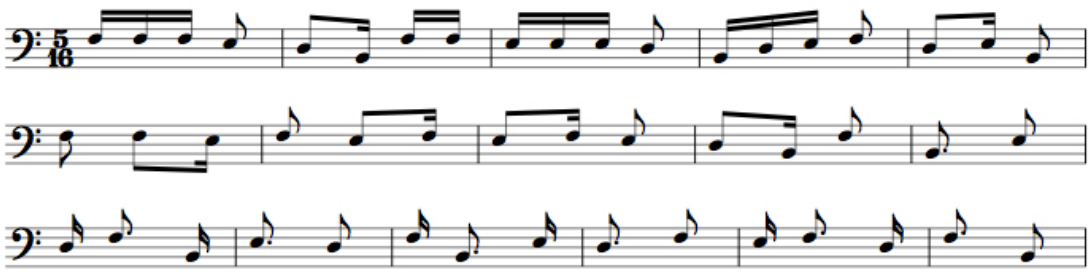
that it corresponds sonically to the instruments in EXAMPLE 5, which itself corresponds to the score. This is very close to the key for the percussion orchestra previously mentioned which reinforces the notion that Nancarrow flowed directly from percussion orchestra ideas to tape music ideas.



EXAMPLE 5: THE INSTRUMENTS USED IN PIECE FOR TAPE DERIVED FROM THE AUDIO RECORDING AND SCORE

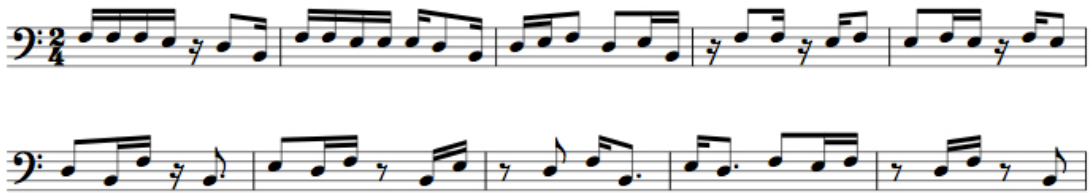
The primary limitation here is that with a single monophonic tape machine and recordings of single sounds, the only possible outcome was a monophonic piece. For a composer whose *raison d'être* was the layering of different tempi this would seem at first to be an insurmountable challenge. However Nancarrow thrived on such limitations and using a combination of high speed and structural exploration he gives the impression of polyphony.

Moving at a blistering 340 eighth-notes per minute, the opening theme appears to be a through-composed idea in 5/16 (EXAMPLE 6).



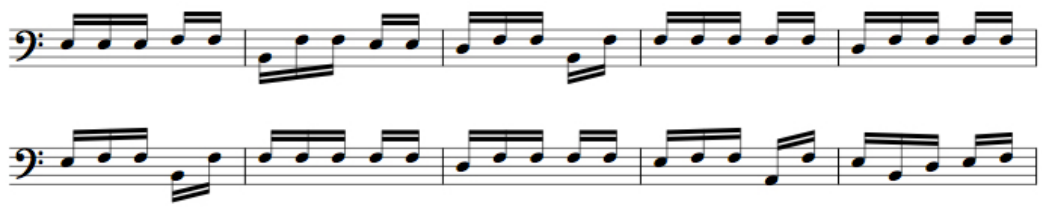
EXAMPLE 6: THE OPENING THEME OF PIECE FOR TAPE FROM NANCARROW'S SCORE

The phrasing of the theme however suggests 2/4 and if re-barred as such it fits perfectly over 10 bars (EXAMPLE 7). There is a suggestion therefore that it was conceived in 2/4 and made ten bars long to ensure completed bars when the 5/16 time signature was imposed over it.



EXAMPLE 7: THE OPENING THEME OF PIECE FOR TAPE RE-BARRED

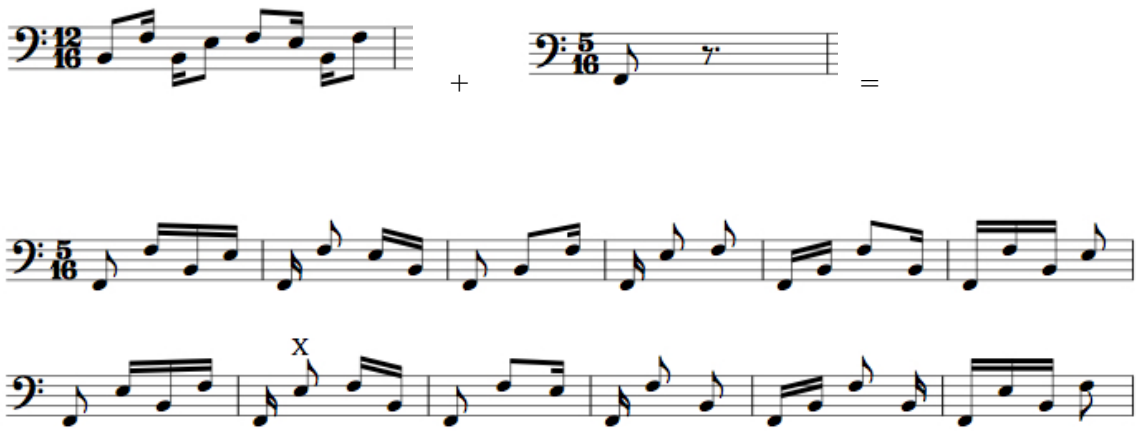
There follows a short transition establishing the sense of a 5/16 meter (EXAMPLE 8) before the theme is restated on lower drums at half speed.



EXAMPLE 8: TRANSITION AFTER OPENING THEME

It is in the development that follows where the intrigue truly occurs. Throughout this complex section the listener is aware that there are patterns and movements that dissolve and progress before they can be resolved into a clear sense of pulse. Furthermore there is a palpable increase in excitement as the rising motifs direct the texture towards a point of greatest density on the highest instrument. To achieve this Nancarrow uses his beloved combining of overlapping time streams but creates a system to manage the monophonic limitation.

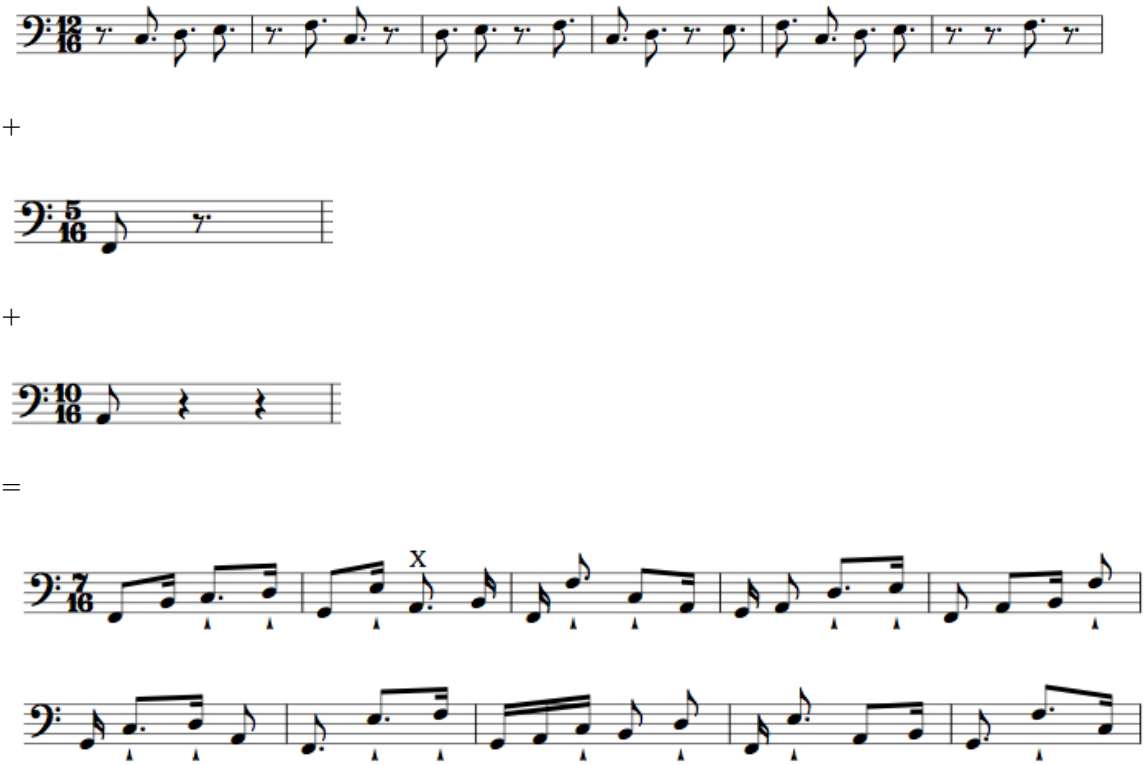
To begin with, a repeated phrase in 12/16 is combined with an interrupting pulse in 5/16. Using what might be termed *hierarchical superimposition,* they are layered one on top of the other for 12 bars. Where two notes coincide the 12/16 note is dropped in favour of the 5/16 (EXAMPLE 9).



EXAMPLE 9: THE FIRST PHRASE OF THE DEVELOPMENT PRECEDED BY THE TWO OVERLAPPING FRAGMENTS (THE NOTE MARKED WITH AN X

IS PROBABLY A MISTAKE IN NANCARROW'S SCORE AND SHOULD BE A B)

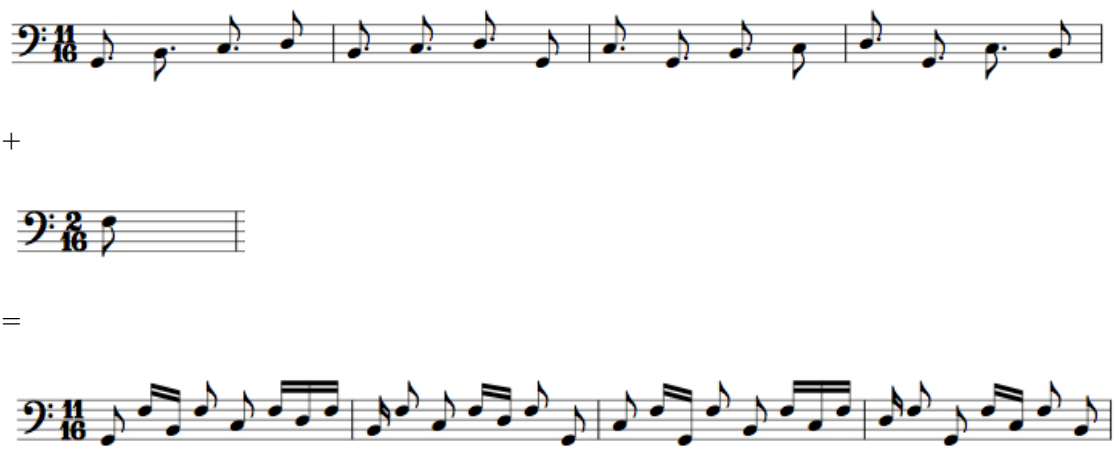
At the next time signature change the method is developed with two additional elements: the first is that three levels are now superimposed with the hierarchy being in the order 7:10:12. The second is that a 12/16 idea of four rising tones are used isorhythmically and allowed to complete their sequence before repeating, regardless of rests (EXAMPLE 10). There is also an additional element of tones on the B line which the present author can find no system for. They may have been added freely to maintain the density and continue the tone from the previous material.



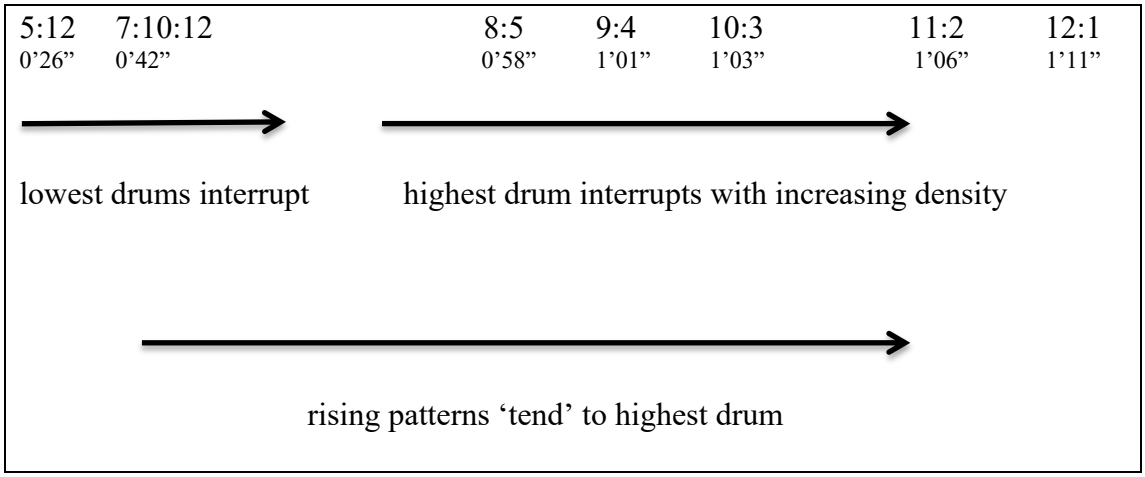
EXAMPLE 10: THE SECOND SUPERIMPOSITION. THE ACCENTS HAVE BEEN ADDED TO INDICATE THE OCCURRENCE OF THE 12/16 MATERIAL

(THERE IS A PROBABLE MISTAKE AT THE X, WHICH SHOULD BE AN EIGHTH-NOTE PLUS A SIXTEENTH)

Five further superimpositions follow, this time with the composed phrases being hierarchically dominant. To achieve structural momentum these phrases gradually expand while the interruptions gradually contract. Being on the highest drums the interruptions enhance a sense of rising timbres and impending climax as they increase in density until they fill all spaces within the composed phrases at a ratio of 12:1. EXAMPLE 11 shows the penultimate superimposition while EXAMPLE 12 is a diagrammatical representation of the complete development section.



EXAMPLE 11: THE PENULTIMATE PHRASE OF THE DEVELOPMENT WITH THE 11/16 MATERIAL HIERARCHICALLY DOMINANT



EXAMPLE 12: A DIAGRAMMATICAL REPRESENTATION OF THE DEVELOPMENT. TIMES ARE TAKEN FROM RECORDING

Though Piece for Tape can be described as musique concrète by the virtue of it's manipulation of recordings from the real world, it shares none of that movement's original philosophy. On Pierre Schaeffer, the originator of the term, Emmerson states *"At heart his insistence of reduced listening means that musique concrète* was *intended to refine and accelerate the development of a primarily timbral discourse which already had a long history in western music".* (Emmerson 6). Almost every early tape work focuses on the medium's potential to manipulate timbre in previously unheard ways. Interviewed about electronic music in 1977 Nancarrow comments on how he has not heard a single work in that medium whose primary interest is temporal (Nancarrow 2000). Despite (or perhaps because of) a lack of dissemination at the time, Nancarrow's piece stands alone as being a purely rhythmical exercise.

The monophonic restriction necessitated a linear inventiveness and there are some striking sonic predictions. The jazz drummers of the post be-bop era began to move beyond the coincidence of bass drum, snare, drum and hi-hat combinations towards a syncopation that was increasingly informed by linear ideas where feet and hands avoid striking together. Audio example 2 demonstrates the noticeable similarity between 15 seconds of the development from Piece for Tape, followed by 15 seconds of drumming by Ed Blackwell on the track Next to The Quiet Stream from the 1977 record Old and New Dreams.

Audio example2.

AUDIO EXAMPLE 2: AN EXTRACT FROM PIECE FOR TAPE FOLLOWED BY AN EXTRACT OF ED BLACKWELL TAKEN FROM NEXT TO THE QUIET STREAM BY OLD AND NEW DREAMS, 1977.

Nancarrow's mathematically informed linear superimpositions are also reflected in a key aspect of many computer musicians' approach to rhythmic programming. Audio example 3 is taken from the track Flashforward by the Venetian Snares from 2008. A core stream of material jumps rapidly from sonic idea to sonic idea with superhuman accuracy but neo-human irregularity. While this is, on the face of it, no more than a rapid version of any orchestration technique, the ability of each element to retain its own virtual space with any reverberation stopping abruptly with the material, can only be achieved electronically. Similarly, each drum sound in Piece for Tape is not affected by the sympathetic vibrations that would occur in a live setup giving the recording an unnatural ambience which we have grown to value. The rhythmic

tension in Flashforward is similarly enhanced by limiting the amount of elements that coincide and restricting the times when the pulse is reinforced.

Audio example 3.

AUDIO EXAMPLE 3: FLASHWFORWARD BY THE VENETIAN SNARES, 2008.

TWO NEW VERSIONS

Nancarrow's decision to use mechanical means of generating his music was based in part on his inability to engage performers in the 1940's to invest suitable energy in the preparation of his music. Not only have performers attitudes to his music warmed in the intervening years, but skill levels have increased and a virtuosic body of works for solo percussion has appeared. In 2010, recognising the possibility of Piece for Tape being performed live, the present author made an arrangement of the work for UK percussionist Joby Burgess which was premiered in the Cheltenham Festival then recorded and released on the Signum Label in 2012. The arrangement reduces the drums from eight to six (three bongos, three tom toms), ensuring playability without compromising the sense of contrasting pulses, and adds an ending using a purposefully non-Nancarrow-esque ritardando by repeating the last five bars of the written score on drums. For classical percussionists the use of drums, bongos and wood blocks in linear fashion fits well within the framework of contemporary multi-percussion performance. There are a number of often-played works that use variations of this idea, Ferneyhough's Bone Alphabet from 1991 and Donnacha Dennehy's Paddy from 2003 are two fine examples. The arrangement of Piece for Tape has now been performed many times in Europe and the US including by the London

Sinfonietta, and over 25 times by Joby himself. Joby chooses to play it under the tempo of the tape piece to allow the polyrhythms to articulate more clearly, while in the US, Chris Froh has a developed a version that is even faster than the tape and operates at the edge of rhythmic comprehension.

After lying in Nancarrow's studio for 60 years, many of the original drums were gathered by Trimpin, an artist whose practice combines kinetic sculpture and composition, for a reimagining of the original orchestra. Presented at the Berkeley Art Museum in 2012 as part of the Other Minds centenary celebration of Nancarrow's birth, it was simply named the Nancarrow Percussion Orchestra or NPO. Powered by electric servos and controlled by MIDI, the engineering problems of 1950 were overcome with considerable ease. Reflecting Trimpin's interest in Nancarrow's forays into prepared piano as much as the original percussion orchestra, the first version of the work featured three dismembered pianos interspersed with a collection of original and new percussion instruments. The pianos strings are played with a combination of plucking/scraping devices and electromagnetic drivers similar to the ebow. Imbued with Trimpin's characteristic visual charm, we can finally hear how Nancarrow's orchestra might have sounded live. Trimpin's own description of the project is helpful (Trimpin 2012) and the authors own video of the piece provides a flavor of the work (Nancarrow/Trimpin 2012).

Later versions of the NPO have been created, and on 3rd December 2017, approximately 67 years after the original was abandoned, Trimpin presented a smaller version in Nancarrow's studio. To an audience of around 40, the NPO played new compositions by a group who had worked under Trimpin's guidance plus a version of Piece For Tape.

FIGURE 5: THE FIRST ITERATION OF TRIMPIN'S NANCARROW PERCUSSION ORCHESTRA, 2012 (PHOTOGRAPH BY THE AUTHOR)

FIGURE 6: A SMALLER VERSION OF THE NPO READY FOR PERFORMANCE IN NACARROW'S STUDIO, 2017 (PHOTOGRAPH BY TRIMPIN)

Nancarrow's relative isolation meant that his work was not widely disseminated until he was in his 70's. Despite this, the dramatic and almost entirely unique nature of the player piano works ensured that they became rapidly influential on other artists, a process that we can trace back to Elliot Carter's First String Quartet, completed in 1951 which quotes Nancarrow's Player Piano Study #1. Neither the failed percussion orchestra, nor the abandoned Piece For Tape are likely to have been influential in the composer's lifetime but both are gaining reputations in their new guises as time goes on.

A TEMPORAL WINDOW

Once the percussion orchestra was dismantled and the pieces of it stored in the corridors surrounding Nancarrow's studio, along with the frame full of tapes of single percussion strikes, Nancarrow wrote solely for the player piano for over 30 years. The failure of the mechanical orchestra was due to engineering limitations, and his vision for tape music was hindered by a lack of studio facilities. However his thinking was so advanced in both respects that it would be many years before the tools that make such works so achievable today would be invented. Having missed this 'temporal window' his adoption of the player piano was perfectly timed. Although player piano production had ceased after the Wall Street crash 20 years earlier, the machines themselves were still available in reasonable abundance when he bought his first in

1947. There were still specialists who could maintain the machinery and producers making high quality blank rolls. If Nancarrow had the first ever home studio, it would be 1985 before home computers and MIDI (3) became ubiquitous in musician's homes. This pre-MIDI period allowed Nancarrow ample time to undertake his temporal music quest in the knowledge that his antiquated system was still the only viable option. It may be precisely because of the slow nature of punching piano rolls that he was able to obsess about issues in a way that was unique when he began and remains rare today.

The date of the creation of Piece For Tape provides a curious footnote to the story:

Numerous sources date the percussion orchestra to the late 1940s though all of these are from conversations with Nancarrow many years later. Carter makes no mention of it in a 1951 letter to Aaron Copland reporting a trip to the studio in January that year. This reinforces the idea that it had been dismantled by that date as its imposing presence would have been entirely noteworthy. Assuming that the source material for Piece For Tape was recorded before the machinery was entirely dismantled this means that it may have been recorded as early as the 1949, the date that Hocker suggests for Piece For Tape (Hocker, 2002). It is known that the first player piano works Nancarrow wrote, starting in 1947, were the ones that he later collected together as the five movements of Study #3. Writing to Carter in 1970 Nancarrow says "I just sent you some tapes. I dumped those old pieces you wanted into #3, which I had discarded, in order to give them an identity. I also found a tape piece from the same period." He goes on, as already noted, to state that the tape itself was falling apart as it was made of paper in those days. The first commercially available tape

machines were called SoundMirrors by a Cleveland company called Brush, starting in 1946 with the BK 401 (Brush Industries n.d.). Brush also supplied paper backed tape (Milner 2009) to use with them until it was replaced by plastic backed tape around 1950. Costing around $400, the quality of these machines was relatively poor and was not well received by sound professionals (Leslie and Snyder 2010). It was not until the introduction of the superior Ampex Model 200A in 1948 that the music industry became interested (Milner 2009). Costing upwards of $4,000 it would explain why Nancarrow complained to Elliott Carter in 1951 that he could not afford a very good tape recorder (Meyer and Shreffler 2008). There exists a single tantalizing photograph of Nancarrow with a tape machine. As much as it would be convenient to say this is a picture of Piece For Tape being created, the machine is a SoundMirror BK414 released in 1952. To the right of the machine is a cardboard box with a dowel pushed through it, presumably to hold a few reels of tape. There is a tape in the process of being edited on the machine. There is neither evidence of the case with the collection of tapes with source material, nor the very fine splicing needed for Piece for Tape. Hocker dates this picture as 1955, and while it is not possible to verify this date it is more likely to show a recording of one of the studies being edited.

In Paris Pierre Schaeffer, replaced his recording turntables with a tape machine in 1950 (Emmerson 2007p26) and Luening and Ussachevsky receive their first tape machine at Colombia University in 1951 (Holmes 2002 p105). An educated guess would date Piece For Tape between 1949 and 1952 based on correspondence, interviews and other materials. If it was created in 1952 then it remains one of the earlier pieces of tape music. If it was created in 1949 then it might be the earliest!

"..even before this (*the player piano*) I was thinking of electronic music, what might have been electronic music.." (Conlon Nancarrow: Lost Works, Last Works. 2000)

FIGURE 7: NANCARROW EDITING A TAPE IN THE WORKSHOP OUTSIDE HIS SOUNDPROOFED STUDIO. (COURTESY OF THE NANCARROW ESTATE).

NOTES

(1) I am indebted to Yoko Nancarrow for granting permission for the use of the photographs of Nancarrow, and to James Greeson for his support in preparing this paper.

(2) The inclusion of MIDI ports in the Atari ST computer was the tipping point.

(3) Hocker (Hocker, Encounters With Conlon Nancarrow 2012) refers to two works: Piece for Tape (circa 1949) plus an untitled *musique concrète* work (circa 1948). These are almost certainly references to the same work.

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