**Conlon Nancarrow – Martin Schlumpf:**
**The Art of Tempo Canon**

Fourteen Canonic Studies for Player Piano by Conlon Nancarrow,
in MIDI arrangements by Martin Schlumpf

## Conlon Nancarrow

Conlon Nancarrow was born in Texarkana, Arkansas, on 27 October 1912. After beginning his music studies in Cincinnati he moved in 1932 to Boston, where he took private lessons in counterpoint from Roger Sessions and became personally acquainted with Walter Piston and Nicolas Slonimsky. He briefly joined the Communist Party and helped to organize a memorial concert in Boston Symphony Hall for the tenth anniversary of Lenin's death. In 1936 he made his first trip to Europe, travelling for a month as a trumpeter in a ship's band. The following year he volunteered for the Abraham Lincoln Brigade and fought against General Franco's fascist troops in the Spanish Civil War. When the Republic collapsed in 1939 he fled via France to the United States, where he became a victim of political discrimination and was not allowed to renew his passport. In consequence he emigrated to Mexico, where he became a citizen in the 1950s and remained until his death.

Over the next few decades, almost completely outside of public view, Nancarrow lived in a small house with studio in a suburb of Mexico City and created his *Studies for Player Piano*. Until the early 1980s his name was known only to a small number of cognoscenti, and even then hardly anyone had met him. This changed radically in 1982: first, at the recommendation of Gyˆrgy Ligeti, he received the richly endowed "Genius Award" from the MacArthur Foundation; then he was appointed "featured guest composer" at the Twentieth Cabrillo Festival in Aptos, California. In late October, after a long hiatus, Nancarrow again made a trip to Europe, during which his music was played (from pre-recorded tape) at a concert of the Cologne Kunstverein and at the Centre Pompidou in Paris, among other places. This marked the beginning of his emergence as a cult figure of contemporary music. Several concerts in Europe and the United States introduced him to a select audience. In 1988 all of his *Studies for Player Piano* were recorded for Wergo, and a seminar and concerts in his honor were finally held at the University of Mexico City in 1990. In 1994, while making his final trip to New York, he suffered a light stroke. Terminally ill,

his entire collection of papers was transferred to the Paul Sacher Foundation in spring 1997. He died in Mexico City on 10 August that same year.

**Music for Player Piano**

Asked how he came to write for the player piano, Nancarrow replied that he had always been interested in problems relating to tempo, and that he dreamed of being able to bypass the performer. This final remark surely reflects his frustration with performances of his works in the 1930s and 1940s. Evidently his decision to write exclusively for the player piano was heavily influenced by the disastrous premiËre of his *Septet* in New York (1940), when the musicians fell hopelessly apart. Another influence was his reading of Henry Cowell's *New Musical Resources*, where the author specifically recommends the player piano for the rendition of complex rhythms.

In 1947 Nancarrow, on the only trip he made to America between 1940 and 1981, paid a visit to New York to purchase his first player piano and a punching machine for the paper rolls. Later he bought a second instrument in Mexico and covered its hammers with leather and metal to obtain a more percussive attack. In this way, he created a distinctive and unmistakable instrumental medium for his series of *Studies for Player Piano* (for a long time he called them *Rhythm Studies*). Today some fifty of these studies, dating from 1948 to the early 1990s, have survived with Nancarrow's authorial sanction.

In many passages of his studies Nancarrow achieves a sort of hyper-virtuosity in which gravity seems to be suspended. The truly extraordinary thing about them, however, lies in their wholly unique way of handling musical time. Nancarrow took advantage of the mechanical precision of the automated piano to invent music whose metrical complexity and contrapuntal intricacy advanced into uncharted musical territory.

**Basic Comments on My Arrangements**

This is where my work begins, namely, with the question to how much, and with what means, Nancarrow's polymetric constructs can be made clearer to the unaided ear by expanding the range of available timbres. The original music was restricted to the sound of the piano and had to struggle with many technical shortcomings in performance. I wanted to augment the originals with arrangements that exploit the potential of modern audio

technology in general and use timbre in particular to present these works in a new acoustical "light." That this is only possible with the aid of a computer lies in the aforementioned basic metrical preconditions of Nancarrow's music, in which different voices are heard simultaneously at different speeds.

My first task, then, was to transfer the basic skeleton of the music – all its relevant rhythmic and melodic data – into the computer. I did this using two different sources: Nancarrow's autograph fair manuscripts, and his "punching scores " (see Digression 2).

Once I had received copies of Nancarrow's fair manuscripts for all his unpublished studies from Schott Musik International, it turned out that I could transfer most of the pieces to the computer from this material alone. For the others, which were written without time signature or codified rhythm, I had to consult the so-called "punching scores" preserved at the Paul Sacher Foundation. With the aid of this material, I was able to enter the voices into the computer time-independently using a special sequencer. This paved the way for the actual arrangement, the allocation of MIDI timbres. For this purpose my "Klangdeponie Studio" had it its disposal various sound expanders and a comprehensive library of samples. My goal was always to reinforce the special musical quality of each study through my choice of timbres, thereby opening up new ways of accessing this music with the unaided ear. I also had to place the voices in a stereo panorama and to deal with articulation, tempo, and dynamics.

The choice of tempo merits special attention. First, it is obvious that the metronome marks in Nancarrow's fair manuscripts differ, sometimes dramatically, from the tempos he used on the complete recording for Wergo. Second, these recordings reveal an increasing accelerando toward the end of each piece, especially in the longer ones. The process of acceleration is conditioned by the mechanics of the player piano: toward the end of the piece, when the paper roll is largely used up, it tends to revolve more rapidly as its weight decreases. The result, especially in lengthy studies, is a relatively large discrepancy in tempo. When choosing the basic tempo, I usually adhered to the metronome marks in Nancarrow's fair manuscripts. In three cases, however, I chose slower tempos close to those used on the Wergo recording (*Studies #34*, *#37*, and *#41B*). As far as the problem of accelerando is concerned, my arrangements thus

represent an alternative to the Wergo recording in that the tempo remains stable ñ as was probably Nancarrow's intention.

**What is a Tempo Canon?**

A tempo canon is a canon in which the voices move at different speeds. Except for *Study #26*, all of Nancarrow's canons fall into this category.

To make it easier to describe the examples below, here are a few basic technical terms for this kind of canon:

*Entrance succession*: We refer to the entrance of the first voice as "I", that of the next voice as "II", and so forth.

*Entrance register*: The lowest voice is called "A", the next-lowest voice "B", and so forth.

The actual *tempo ratio* between the voices is given in metronome numbers. The *tempo proportion* (TP) is the least whole-number ratio of these metronome numbers.

The point where two or more voices intersect in tempo and pitch is known as the *point of coincidence* (PC).

The *echo interval* is the length of time occurring between points of pitch intersection in two voices.

**Description of the *Studies***

*Study **#43*** (ID **1**) shows a two-voice tempo canon with a tempo proportion of 24:25. The canon is relatively easy to perceive with the unaided ear. IA, at tempo 120, is followed after some six seconds by IIB at tempo 125. When the time between entrances is this short the voices are fairly easy to follow, especially because II, the faster voice, constantly creeps up closer and closer to I. As a guide, I have chosen my instrumentation accordingly by using a percussion sound to emphasize the beginning of each new motif and assigning it a distinctive timbre. Shortly after 2'30" the two voices reach the first PC (gong stroke). Nancarrow allows II to continue at the quicker tempo so that it increasingly forges ahead of I. At 3'07" (cymbal crash after drum roll) he then interchanges the two tempos so that Voice I now gets closer and closer to II. At 3'42" (second gong stroke) we reach the second

PC. An avalanche of rapidly descending arpeggios leads into the final section, a free inversion of the opening section lasting almost a minute longer.

*Study #24* (ID **2**) introduces a variant of the tempo canon that is absolutely unique in Nancarrow's oeuvre. The entire three-voice piece consists of a total of twelve subcanons, each with a tempo proportion of 14:15:16. All the voices in each subcanon enter simultaneously – something that never happens in ordinary canons but proves to be a useful alternative in tempo canons. Further, the slowest and the fastest tempos are always assigned to the outside voices A and C in such a way that the two voices switch tempos at the middle of each subcanon. With the middle voice retaining its tempo, the voices thus move gradually farther apart after the opening of the subcanon until the moment when the tempos are interchanged, after which the echo interval becomes shorter and shorter until the next PC occurs. Besides the four synchronous openings, Nancarrow varies this schema slightly by placing short rests at the beginning of each subcanon or allowing the subcanon to re-enter shortly before the PC.

Another peculiarity of this study is Nancarrow's use of two levels of tempo at a ratio of 3:2. Besides the fast tempo ordinarily employed, only subcanons 1 and 11 make use of the slower tempo level, causing them to interrelate in a way that is also written out as an abbreviated reprise. If we compare the absolute durations of the subcanons, we note the follows proportions: 27-12-18-6-9-3-4-1-2-74-9-2, with 1 roughly equal to 1.26 seconds. This temporal conception is relatively easy to follow with the unaided ear, and it is noticeable that the longest subcanon (no. 10) enters immediately after a lengthy process of truncation to create a sort of development of the preceding events. Exactly in the middle we hear a passage where, briefly, all three voices not only have the same tempo as the middle voice, but all play in the same rhythm!

**Digression 1: The Relation Between Tempo and Time Grid**

How can we define the shortest unit allowing us to construct a basic time grid with the property that all rhythmic durations in all voices of a tempo canon always fall on points of the grid?

First, it should be noted that tempo indications (in MM) and grid units (in units of length) stand in inverse proportion to each other. In *Study #24*, a TP of 14:15:16 yields a grid proportion of 120:112:105. Further, we also have to determine the shortest rhythmic value

in all voices – in our case the sixteenth-note. In order for every sixteenth-note in every voice to fall on a point of the grid, the value "1 ÷ 16" must again be divided, e.g. by 112 in the middle voice, yielding a value of "1 ÷ 1792". The fastest tempo set down in the middle voice is dotted quarter = MM 240. The duration of that dotted quarter is "60 ÷ 240", or 0.25 seconds. Now we have to determine the factor x with which to multiply the reference value of a dotted quarter in order to obtain the value "1 ÷ 1792". Since one dotted quarter equals "3 ÷ 8", the factor x is "(8 · 1) ÷ (3 · 1792)" or, for short, "1 ÷ 672". The duration of the grid unit at the upper end of the tempo scale thus equals "(1 ÷ 672) · (60 ÷ 240)", which is equal to "1 ÷ 2688" or 0.000372 seconds. This micro-unit of 3.72 ten-thousandths of a second is, of course, absolutely imperceptible to our sensory faculties – and this for a relatively straightforward TP! This raises further questions.

1) To what extent is the human ear capable at all of deciding whether two musical events are simultaneous or displaced? Obviously none of us is capable of discerning minuscule grid displacements with the chronometrical unit defined above. In practical terms, however, this implies nothing less than a blurring of the theoretical distinction between "simultaneous" and "displaced." The extent to which it is blurred depends in turn on various factors in each individual case.

2) To what extent is the computer capable of accurately representing infinitesimal distinctions on the grid? The sequencer I used for my work – Studio Vision Pro 4.5 – divides a quarter-note into 480 ticks, i.e. a value of "1 ( 1920." In our case it is therefore just capable of positioning the values more or less accurately, though minimum rounding will be required in some passages.

3) But how on earth was it possible for Nancarrow to maintain an overview of such complex tempo processes and to translate them into music? We will have more to say about this in Digression 2.

With *Study **#13*** (ID **3**) and *Study **#19*** (ID **4**) we briefly enter the earliest creative phase of the canons on our CD. *Studies #13* through *#19* were originally combined under the title *Seven Canonic Studies* and were presented in 1962 at the only public concert that Nancarrow ever held in Mexico City. The most important points that *#13* and *#19* have in common are the tempo proportion among their three canonic voices (12:15:20) and a rhythmic ostinato figure "n-1 / n / n+1 / n". This ostinato figure occurs in four variants within each given voice: a) 3 + 4 + 5 + 4, b) 4 + 5 + 6 + 5, c) 5 + 6 + 7 + 6, and d) 6 + 7 + 8 + 7, where each number is represented by a short staccato note followed by a rest. They differ in the manner in which

they begin, their actual tempos, and their melodic writing.

In *Study #13*, variants c), a), and b) occur successively in voice IA (MM=96), followed by the two other voices IIB (MM=120) and IIIC (MM=160) with the same internal structure. Nancarrow then presents variant d) in the bass, again first in I, then in II, and finally in III, followed by a slightly abridged deconstruction in exactly the reverse order. In *Study #19*, in contrast, the four variants enter together in a given voice. The entrances of the voices (in tempos MM=144, 180, and 240) are conceived in such a way that the end is marked by the attainment of the first PC.

Thus, *Study #13* places the twelve separate "strands" into the foreground, whereas *Study #19* more strongly emphasizes the three-voice tempo canon. I reinforce this state of affairs in my arrangements: *#13* presents itself as a twelve-voice contrapuntal fabric of equivalent plucked and percussion instruments, while *#19* highlights the universal three-voice texture with three different pianos playing in four voices. To make the successive compression of the echo interval in *#19* easier to perceive, I have additionally used woodwind instruments to highlight analogous short motifs in all voices.

Finally, I should also mention that *Study #13* is actually nothing more than a rhythmic canon, for the melodic writing is merely imitative without being strictly canonic.

With *Study **#41B*** (ID **5**) we enter the realm of the "aggregate canon" – and the realm of metrical irrationality.

What we mean by an aggregate canon is best explained by listening to one. Here two canonic voices in a clearly two-voice texture appear in a dazzling array of sounds. Instead of melodically determined canonic lines we now hear breakneck arpeggios, pitch reiterations, dense chordal progressions, melodies hammered out in multiple octaves, and similar effects filling the full range of the instrument.

A glimpse at Nancarrow's instructions for the tempo proportion ("1 divided by the cube root of $\pi$ over the cube root of 13 divided by 16") makes it patently obvious that we are dealing with irrational numbers, i.e., numbers incapable of being represented as finite decimals. Voice IA is assigned

"cube root of 13 divided by 16," or 0.933127...; Voice IIB is assigned "1 divided by the cube root of π", or 0.682784... The resultant TP – the ratio between these two irrational numbers – approximately equals the whole-number ratio 30:41. In this case the tempo, rather than being defined in metronome marks in the usual way, is defined by determining the total duration of the longer voice IA, i.e. 6'10". The tempo I choose is slightly slower, being derived from the total duration found on the Wergo recordings: 6'29".

The formal design of this canon is very simple. At 1'08", IIB enters a major tenth higher at the faster tempo. It then intersects with IA at the sole PC after a large upward glissando and a brief common pause (4'16"). This is followed by a deconstruction shortened roughly by half and using some of the same motifs, with the faster top voice coming to a stop roughly 35" before IA. Particularly striking are the reiterated notes in the bass, which accelerate layer by layer in arithmetic succession, vanish in the middle, and return in reverse order to dominate the deconstruction.

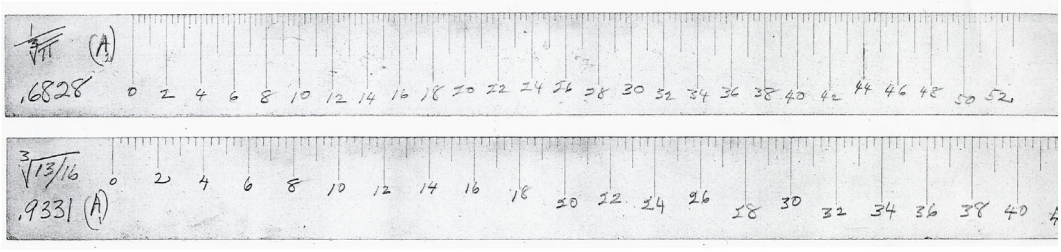
**Digression 2: Nancarrow's Working Methods**

How did Nancarrow implement irrational tempo ratios such as these in practical terms?

With the overall plan of a composition in his head, he first set out to elaborate the tempo proportions on a blank player-piano roll. He did this by means of so-called "master scales," strips of cardboard roughly 4 cm wide and 50 cm long, on which all the grid systems corresponding to his chosen tempos were drawn to scale.

*Ill. 1* shows the two strips he used for *Study #41B*: the top one for the faster tempo (factor: 0.6828), the bottom one for the slower tempo (factor: 0.9331). Having painstakingly drawn all the grids onto the blank piano roll at a specially equipped drawing board, he then transferred them to standard manuscript paper, on which he then worked out the entire composition in the manner of a continuity draft. Nancarrow referred to these manuscripts as "punching scores."

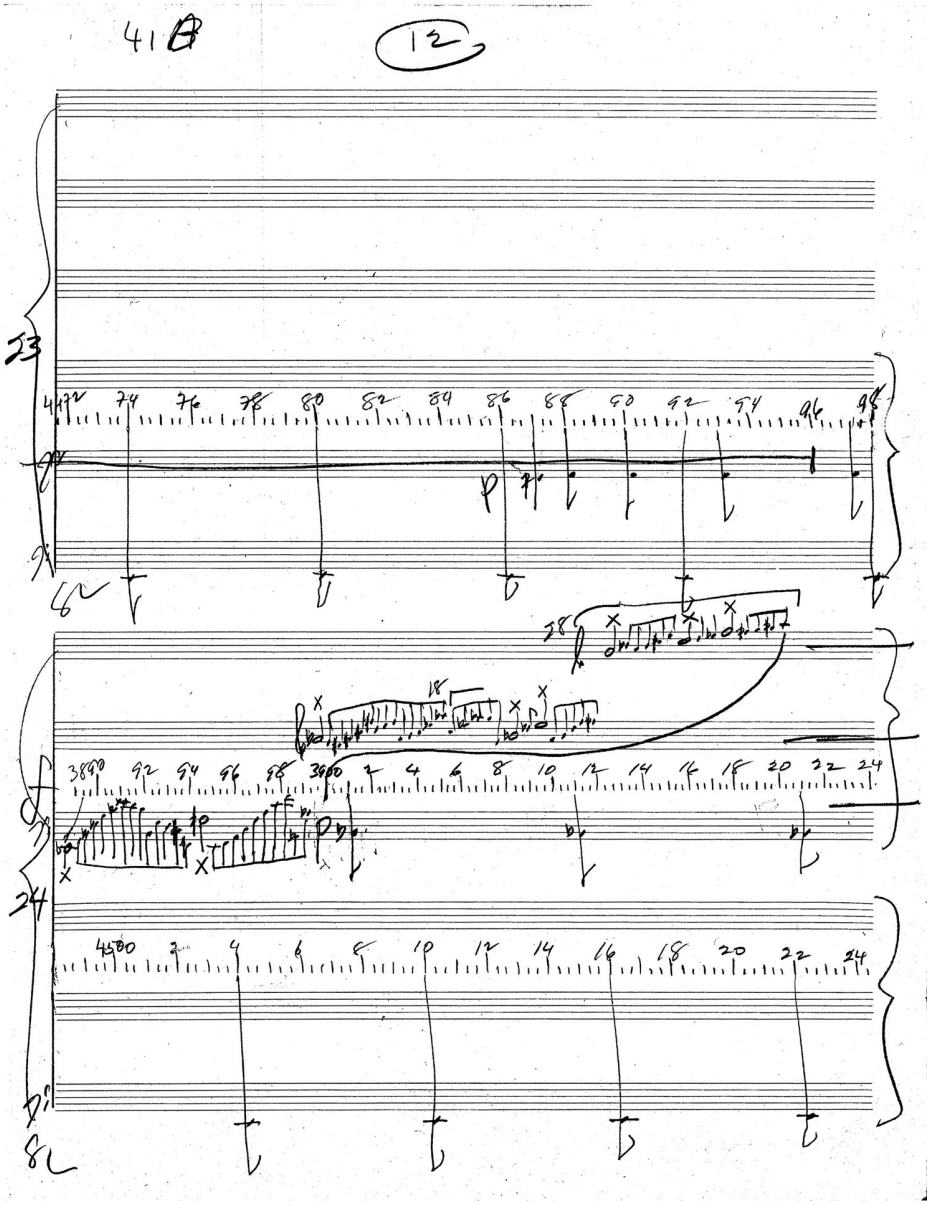
**1: Strips used for Study #41B**



*Ill. 2* is taken from the punching score for *Study #41B*. It shows the page where Voice IIB enters at the beginning of the bottom staff: somewhere around number 4500 in the lower voice, the upper voice enters two strokes before marker 3890 with the characteristic loud arpeggio from the opening ñ an arpeggio that lasts exactly until 3900. Thus, this punching score allows us to read the exact chronometrical placement of all the figures within a single voice. In contrast, the synchronization between the two voices has to be estimated visually (it is calculated backwards from the later PC). Once the punching score was complete, Nancarrow then set about the time-consuming labor of punching the player-piano rolls. A special punching machine enabled him to set the pitch-level, pitch-attack, and pitch-duration (a series of perforations) with remarkable accuracy.

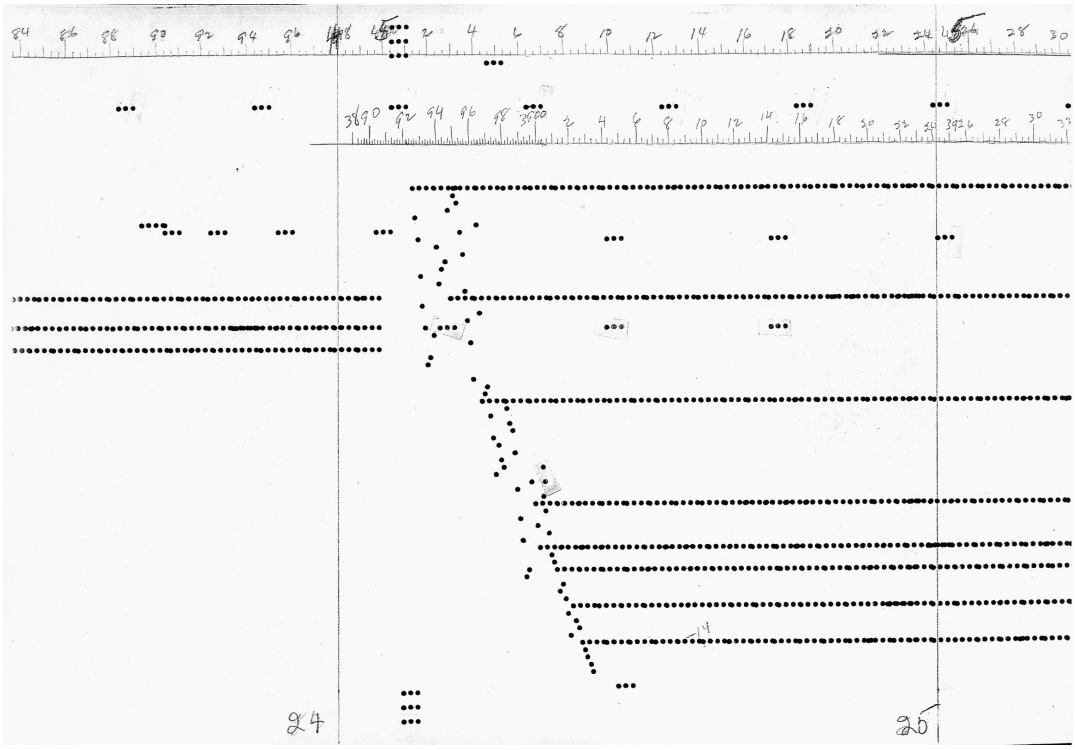
**2: Punching Score for Study #41B, page 12**



*Ill. 3* shows the analogous passage to Ill. 2 on the player-piano roll. At the top we can again discern the two grid rows with the markers 4500 and, just in front of it, 3890. The arpeggio at the opening of the second voice is now recognizable as a line of punched holes in rapid succession (low pitches are at the top, high pitches at the bottom). Some of these pitches are, as can be seen in the punching score, sustained to form a chord. At the very top we also see the even pulse of the contra E in IA. All in all, it is striking that every one of the entries has been shifted to the right compared to the punching score ñ a phenomenon produced by a special mechanical device on the punching machine. The final stage of the working process was to make a fair manuscript of the entire study, where the work is meticulously presented intact in standard staff notation. This stage sometimes took place after a long delay.

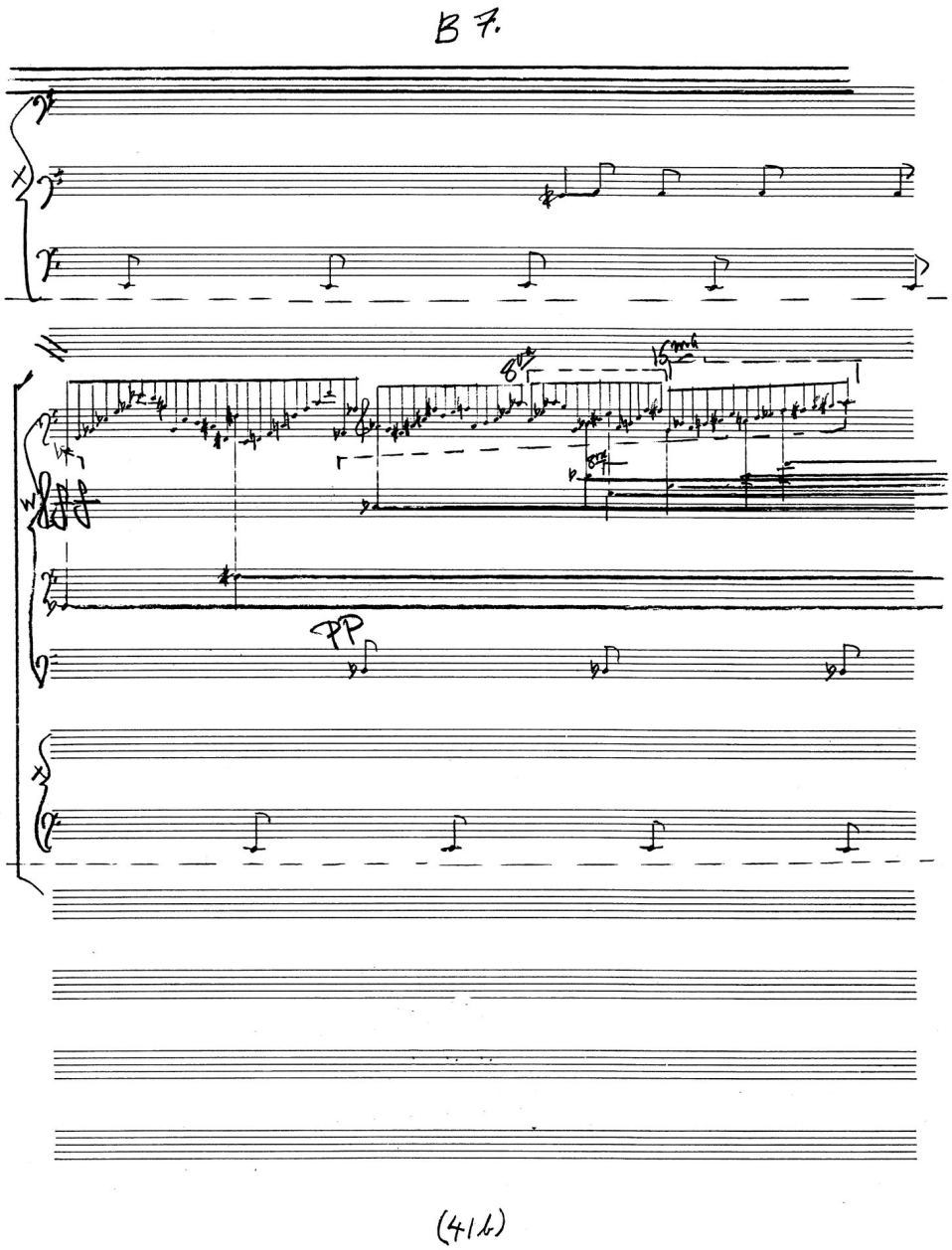
**3: Player-Piano Roll, Study #41B**



Finally, *Ill. 4* shows the same passage from our study once again, but now written out as a fair manuscript in straightforward staff notation, though without time signature, rhythmic indications, or grid marks.

**4: Fair Manuscript Study #41B**




With *Study #32* (ID **6**) we encounter, for the first time, a four-voice canon with the relatively simple tempo proportions of 5:6:7:8 (and grid proportions of 168:140:120:105). The voices enter as in *Study #19*, namely, from bottom to top, staggered in such a way that they all converge on the same PC at the end, the moment when the final sustained notes all break off. Unlike *Study #41B*, every voice here is written in a melodic monophony and

the study is relatively short. Is it therefore nothing more than a simple canon? Our ear quickly lets us know that it is not simple in the least. Why?

Besides the four-voice texture, two factors are perhaps mainly responsible for the complex and convoluted sound of this study. The first is the fact that the melody in each voice leaps from register to register at relatively short intervals of time, thereby undermining the impression of a contiguous line (this is easy to hear in the monophonic opening). The second factor is my technique of instrumentation: I have assigned a particular instrument to each characteristic motif (e.g. the descending opening triad, all semitone intervals, the frequent ascending minor third, and so forth), thereby reinforcing the impression of heterogeneity within each voice. At times we might wonder whether we are dealing with a rigorous canon at all; we lose sight of which motifs have come before and which will come later.... Only toward the end, as we approach the PC, does the canonic structure constantly gain in clarity.

With *Study #22* (ID **7**) we again enter *terra incognita*, in this case what is known as "time-stretching." We can already sense this on the title page of the fair manuscript, where Nancarrow has written "Canon – 1% / 11/2% / 21/4%." What do percent signs have to do with music?

The answer, once again, comes when we listen more closely to the study: the rates of acceleration in the subtle accelerando processes of the opening are directly related to the specified percentages. A one-percent accelerando (this is how IA opens) means that, within a series of metric units, the speed increases from one unit to the next at a ratio of 100% to 101%, which corresponds to a coefficient of acceleration amounting to 1.01. Each tempo number is multiplied by this factor to define the next tempo number. A gradated ascending sequence of tempo numbers of this sort is known as a geometric accelerando.

In the first section of *Study #22* the following tempo process occurs: Voice IA enters with its first pitch at tempo MM=45 and slowly accelerates at a rate of 1 percent. After roughly 17 seconds IIC (the highest voice) enters at the same opening tempo as Voice I, and is thus momentarily slower than Voice I, but it accelerates at a rate of 1.5 percent. After a relatively brief period of time these two voices are approximately equal in speed. At this point (shortly before 33") the third voice IIIB enters, once again at the same

opening tempo of MM=45, and is thus the slowest voice in the piece at this moment. However, since it has the fastest rate of acceleration (2.25%), it catches up with the other two voices fairly quickly, passes them, and is roughly twice as fast as IIC and four times as fast as IA at their common PC (after 1'25"). Taken altogether, we therefore have a three-voice tempo constellation that is by no means easy to follow, first because we can never be sure which voice is the fastest, the slowest, or the middle one, and second because a geometric process, rather than proceeding linearly, gradually becomes asymptotically "madcap" (this is best heard in Voice IIIB). In the middle section Nancarrow then interchanges the rates of acceleration between the low and middle voices: now it is the lowest voice that has the greatest potential for accelerando and the middle voice that has the least potential. In more or less solo sequences of pitches that barely overlap, the voices accelerate to a tempo climax at 2'06", after which the entire process heard up to this point proceeds backwards, in the manner of a palindrome, with corresponding processes of ritardando. The third section accordingly begins with a PC, after which the voices slowly calm down and peter out in the same way that they began. Not only are the temporal processes retrograde, the melody too proceeds in strict cancrizans, which means, among other things, that all directions of motion are inverted.

As in the preceding study, the instrumentation of the first and third sections is closely related to the motivic structure: three groups of timbres ("solo brass," "solo woodwind," and "string tutti") are used to highlight brief pitch sequences in every voice, a technique patterned after Anton Webern's orchestration of the six-voice *Ricercar* from Bach's *Musical Offering*.

In *Study **#33*** (ID **8**) we once again encounter an irrational tempo proportion: "2 to the square root of 2" or, expressed in integers, roughly 7:5. This time, however, the form includes five highly contrasting subcanons.

Subcanons 1, 3, and 5 follow the pattern of placing the PC at the beginning and the end while interchanging the tempos in the middle (much the same as in *Study #24*). Subcanons 2 and 4 each begin with Voice A, followed later by B. Subcanon 2 has the PC exactly in the middle, while Subcanon 4 concludes with the PC at the end. What all five subcanons have in common is that the lower voice, A, always begins at the slower tempo. However, the durations differ widely: measured in seconds, they produce the series 46 /

37 / 64 / 23 / 205. The final subcanon is thus longer than all the others combined. The special role that thereby attaches to Subcanon 5 is reinforced by a rhythmic observation. If we look at the rhythmic values used in the first four subcanons, we notice that Subcanon 1 is made up exclusively of whole notes and, more rarely, half-notes, whereas Subcanon 2 consists entirely of half-notes. Subcanon 3 presents half-notes and quarter-notes up to the point of the tempo exchange, after which it proceeds in quarters and eighths (the tempo exchange is made audible by the occurrence of short low notes). Subcanon 4 is the first to present sixteenth-notes in addition to eighths. Up to this point there has therefore been a clear incremental increase from long to very short note-values. In contrast, Subcanon 5 contains a mixture of all the note-values used previously in the piece. Here a sort of manipulation of previously stated material occurs in various episodes, with the relation to Subcanon 3 being especially worthy of mention. In this development section the two-voice Subcanon 3 appears solely in Voice B; later, with the addition of Voice A, it is expanded into a four-voice canon (with four tempos!) and varied. Toward the end of the study the recurrence of material from Subcanon 1 (multi-note dissonant chords) creates a bridge to the opening. This tendency toward formal closure is one of Nancarrow's special predilections, and one that he presents time and time again in manifold variants. The surprisingly brief reminiscence of Subcanon 3 (gently interspersed scraps of melody) may perhaps recall similarly surprising endings in Ives's music. Thereafter, however, the energetic Nancarrow brings his piece to its appointed conclusion with a loud and affirmative gesture in the final PC.

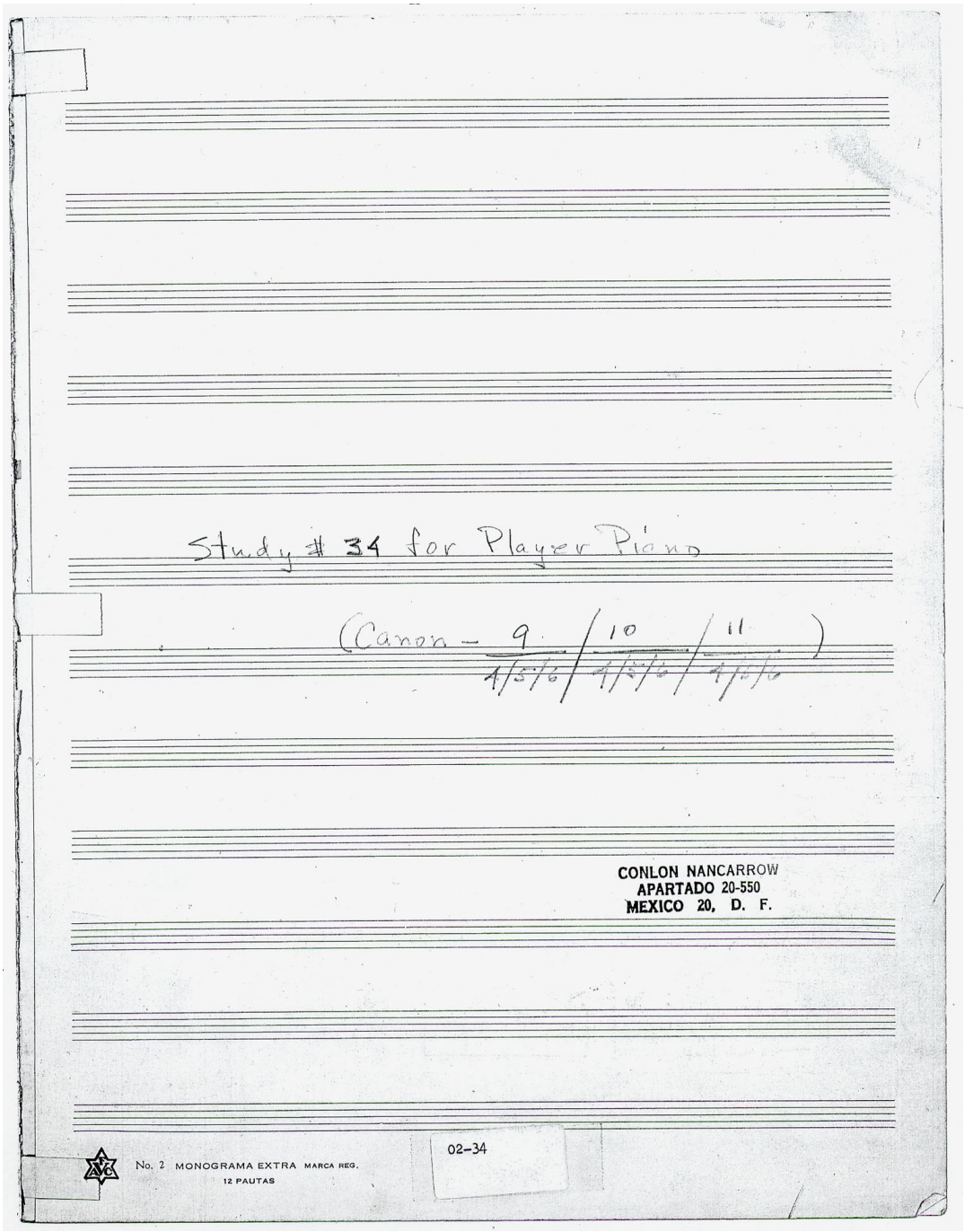
*Study **#34*** (ID **9**) represents another unique instance in our history of the tempo canon. At first hearing it should be obvious that we are dealing with a chain-rondo. A main theme (refrain) appearing in increasingly fast variant tempos (I have given it entirely to pianos in my instrumentation) is contrasted with various interludes (couplets) which I have assigned to harps, marimbas, and pizzicato strings. Finally, after a brief but forceful concluding ritardando, it winds up in a final chord that serves as the piece's only PC. How are these processes of accelerando and ritardando coordinated?

The title page of the fair manuscript (see Ill. 5) contains fractions with strange series of denominators. These numbers, once decrypted, reveal that the fundamental TP among the three canonic voices from bottom to

top is 9:10:11. Within each of these voices, however, there are five tempo levels and their multiples by a factor of two, so that the tempos used in the main theme are paired with the ratio 4:5:6. Thus, ten tempo levels are theoretically available in each voice. In actuality, however, only the 4:5:6 ratio is rigorously applied to a given voice, and Nancarrow sometimes jumps to tempos from other voices in the couplets.

**5: Title Page of the Fair Manuscript Study #34**



To take an example, the tempo matrix in the bass voice contains the following MM numbers: 60 / 72 / 90 / 96 / 108 and their multiples by a factor of 2. This corresponds to a lower TP of 10:12:15:16:18:(20), which is identical in every voice and harbors the ratios 2:3:4, 3:4:5, and, of course, 4:5:6. Projected onto all three voices, this results in some thirty tempo numbers, of which two are identical. However, since all of the temporal processes, being strictly organized, are staggered in accordance with the principles of canonic writing, the tempo proportions among the voices constantly vary. (For example, when Voice 3 enters the tempo proportion is A=90, B=80, and C=88, corresponding to a TP of 40:44:45.) The result is an overall impression of extreme metrical complexity.

In other words, here Nancarrow has implemented the accelerando/ritardando idea in a manner completely different from that in *Study #22*, so that the processes appear less "teleological": every now and then a voice in the first section returns to a slower tempo before jumping to a higher level.

Finally, it remains to be said that the tempos called for in the fair manuscript differ markedly from those used on the Wergo recording. The tempo I have chosen for my arrangement approaches the one used on the Wergo recording and stands in a ratio of 3:4 to the fair manuscript.

*Study **#36*** (ID **10**) is a four-voice canon with a tempo proportion of 17:18:19:20, which yields 3420:3230:3060:2907 as a grid ratio!

In formal terms, all the voices enter successively from bottom to top. Each occupies a tonal space one 10th higher than the last, with the four opening pitches, taken together, producing a major 7th chord on C. The only PC appears almost exactly in the middle of the piece (at 2'31"), where it can be identified by a brief rest followed by maximum density of movement. Thus, the basic metrical structure is identical to that in *Study #41B*.

Shortly after this PC we hear staccato repeated notes followed by a continuous figuration racing from top to bottom. Nancarrow produces this figuration by adding a particular arpeggio figure precisely at the momentary echo interval. As a result, with the addition of the canonic voices, we seem to hear a single continuous voice, implying that the strict part-writing necessary to canonic texture appears to be temporarily suspended. This

and similar examples of "suspended" canonic technique occur fairly frequently in Nancarrow's music.

Another peculiarity of many Nancarrow studies is his exhaustive exploitation of the full tonal compass of the piano. This feature is plain to hear in our study. The ambitus of the lowest voice extends from subcontra B to small B-flat, and that of the highest voice from one-line B-flat to four-line A (in one passage there is also a very fast arpeggio that enters an octave higher). In terms of my MIDI arrangements, the outside voices were thus often problematical: apart from piano-like instruments, there is not a large range of options for timbres that sound halfway presentable in these extreme registers. For this reason I repeatedly used piccolo and contrabassoon (or tuba) in various studies for the highest and lowest pitches, respectively.

It would burst the bounds of my essay to itemize all the peculiarities of *Study #37* (ID **11**), the longest study of them all. I will content myself here by presenting its key features.

The canon is in twelve voices and uses twelve tempos: 150 / 160 5/7 / 168 3/4 / 180 / 187 1/2 / 200 / 210 / 225 / 240 / 250 / 262 1/2 / 281 1/4. The proportions among the tempos correspond to the integral proportions used (by Cowell) for the eleven intervals capable of being formed from the twelve notes of the chromatic scale. For example, the tempo ratio of 150:200 corresponds to a TP of 3:4, which is equivalent to a 4th, or the distance between the first and sixth semitones in the chromatic scale.

The entire piece further consists of twelve subcanons falling into three groups according to their orientation on points of coincidence. Subcanons 1, 2, and 7 proceed from a PC at the opening; Subcanons 3 and 12 aim toward a PC at the end; the other subcanons lack a PC altogether.

As far as tempo is concerned, the voices in Subcanons 1 through 7 enter "chromatically," that is, in the order in which their tempos are listed above. Subcanons 8 through 10 follow the pattern of a chromatically shifted diminished seventh chord (tempos 1-4-7-10 etc.); Subcanon 11 follows the pattern of a chromatically shifted major triad (tempos 12-9-5 etc.); and Subcanon 12 returns to "chromaticism."

The entrance registers – i.e. the intervallic distance between adjacent voices – is organized in a similar fashion. A regular sequence (ascending or descending) dominates Subcanons 1-4 and 7. Subcanons 5, 8, and 10 are completely irregular, always following a twelve-tone series. Subcanons 6 and 9 present the model of a diminished seventh chord transposed in 4ths, Subcanon 11 that of a transposed augmented triad. Finally, Subcanon 12 presents the major 7th chord on B three times in succession, each time an octave higher, as a sort of secondary dominant to the final chord, a major 7th chord on C.

The lengths of the subcanons do not vary as widely in this study as in some of the others. The durations (in seconds) amount to 19 / 18 / 18 / 47 / 73 / 48 / 47 / 74 / 45 / 35 / 37 / 147. Here, too, they fall into groups: nos. 1 through 3 (approx. 18"); nos. 4, 6, 7, and 9 (approx. 47"), which are grouped exactly symmetrically around the major point of articulation after Subcanon 6 (at 3'43"); nos. 5 and 8 (approx. 73"), which are likewise symmetrical; and finally nos. 10 and 11 (approx. 36"). Strikingly, each subsequent number in the series 18, 36, 73, and 147 (the duration of Subcanon 12) is two times its predecessor.

Further, it is surely worthy of mention that here Nancarrow succeeds in designing a twelve-voice canon that makes room for soft passages of chamber-music delicacy alongside loud passages of static, block-like sonorities and sections capable of complex climaxes.

Finally, here too something should be said about the choice of tempo in performance. The tempos called for in the score and those that Nancarrow used on the Wergo recording are worlds apart: the Wergo recording is almost half as fast as required by the tempo indications in the score. Here, too, I have largely followed the version presented on the Wergo recording (my tempo is slightly faster) and reduced the slowest tempo from 150 to 96.

With *Study **#40A*** (ID **12**) we again encounter a two-voice "aggregate canon" with an irrational TP comparable to that in *Study #41B*.

These two studies have another point in common: both can be realized in two versions. They can be played either as separate canons, as I present them here, or as a double canon for two player pianos. In *Study #41C* two different canons, *#41A* and *#41B*, are played simultaneously. *Study #40B*,

in contrast, results from playing *#40A* simultaneously at two slightly different speeds in such a way that the two versions are directed toward a concluding PC.

The prescribed TP is "e:π" (thus Nancarrow's chosen orthography). Expressed in decimals, this is equivalent to "2.71828... : 3.14159...", which can be rounded off to an integral ratio of 13:15. Here, too, the exact point at which the second voice enters must be defined from the sole PC, which forms the end of the piece.

**Digression 3: Rounding Off Irrational TPs**

Thus, two of Nancarrow's precompositional definitions are incapable of being realized precisely. This implies that his working method (mathematical calculation, visual estimate, and drawing with master scales) has allowed minor deviations to infiltrate the ideal form of his intended tempo process. These "errors" must now be corrected. The two predefinitions are 1) the given TP and 2) the position marked in the punching score to indicate the entrance of the second voice. If we first proceed from the TP and allow the second voice to be played by the computer at the calculated speed (although the computer cannot handle tempo marks with more than two decimal positions), the entrance point is slightly displaced. This would produce a crucial alteration in the music: everything intended to be synchronous would now be displaced. It goes without saying that this option cannot be tolerated. I therefore altered the speed of the second voice empirically until the voice began as closely as possible to the entrance point marked in the score. Admittedly this necessitated a minor modification of the TP, which, instead of e:π, is now "almost like e:π." But who is capable of checking discrepancy?!

If we look more closely at the musical material that Nancarrow used in the canonic voices, we find the following features: chromatic glissandi at maximum speed / various trill figures, including trills at larger intervals (up to one octave) in addition to standard trills on the major or minor second / double trills in 3rds, 6ths, and other intervals / pitch and especially octave repetitions, usually in motivic form (these are plain to hear shortly after the opening) / sustained individual pitches or major triads / short and very fast grace-note figures. This list clearly reveals Nancarrow's predilection for rapid and at times highly virtuoso forms of execution, which he then juxtaposes in ever-new combinations and levels of density. It is a compositional technique that thrives not so much on narrowly conceived pitch relations as on an unbridled joy in performance: Nancarrow the jazz musician, Nancarrow the dauntless pioneer ...

Before proceeding to our grand finale, let us take a breather by interpolating the short *Study **#31*** (ID **13**).

Once again we have a sharply defined three-voice canon with a TP of 21:24:25 (and a grid proportion of 200:175:168). The novelty here is that this ratio, for the first time, is not "balanced": the entrance of the second voice comes roughly at 12" and that of the third about 4" later. The two voices, IIB and IIIC, thus form a relatively tight-knit "intertwined" couple, preceded at a proper distance by IA. As this canon, too, converges on a concluding PC, this ratio is heard at increasingly shorter intervals. The conclusion thus comes as a surprise: the voices break off just before the appointed PC actually occurs!

Three sections in the canon can be clearly discerned. In the first section, a principal pitch is embellished in various combinations of legato and staccato eighths, and the three voices are located a 5th apart in a relatively high register. In the second section, which elides with the first (the natural upshot of the "unbalanced" TP), the entrance register has expanded by an octave to a 12th; the tempo is half as fast and the dynamic level is piano, but we at least sense a relation to the melodic writing of section 1 in the head motif. In the third section, where the melodies appear doubled at the octave, we first notice an obvious sense of recapitulation: a principal pitch is embellished in a very similar manner, once again in *forte* eighths, but this time with highly distinct and discontinuous neighbor-notes and, as a subtle compositional nuance, an entrance register that is itself "unbalanced" (the distance from I to II is a 12th, that from II to III a 5th!).

*Study **#48C*** (ID **14**) brings us to our grand finale.

With this study Nancarrow produces a double canon formed from two independent canons, *#48A* and *#48B*. Both these canons build on a tempo proportion of 60:61. This takes us to the borderlines of Nancarrow's canonic universe, where he reaches the most minuscule difference in speed between two voices. To put it another way, with this sort of canon it is not easy to tell for certain that we are dealing with a tempo canon at all – quite apart from the fact that it is not at all easy to identify distinct voices in the dense tissue of figures spread out before us.

How should we select the tempos for the four voices of the double canon? The punching score reveals that canons *#48A* and *#48B* both have exactly the same number of metrical units! In other words, they are equal in length. Since *#48B* starts later, it is obvious that it has to have a faster basic tempo than *#48A*. The exact ratio can be calculated from the synchronization instructions in the punching score.

To define the basic tempo of the entire double canon, Nancarrow marks a particular stretch of the fair manuscript (2.95 cm) and assigns it the tempo 120. Further, the total length of *#48C* in the Wergo recording is, of course, also available for purposes of comparison. My choice of tempo results in an overall length wholly identical to that on the Wergo recording and somewhat slower than that indicated by the scales in the fair manuscript.

*Study #48C* is also noteworthy for two elements that we have not yet encountered in our history of the tempo canon. One of them is related to the musical language, the other to compositional technique.

The first element is a Spanish tinge – a frequent use of the Phrygian mode and the flamenco scale – that recurs time and time again throughout the piece in a very wide range of variations and lends the work its underlying flavor. Whether these represent delayed after-effects of Nancarrow's experiences in the Spanish Civil War is impossible for me to say.

The second element, here developed by Nancarrow to consummate mastery, is the technique of achieving a fascinating and ever-changing spatial depth through a frequent alteration of dynamic gradations, registral distributions, and degrees of density. Not only the obvious echo effects, especially toward the end of the piece, but particularly the multi-level penetration of various degrees of presence (an effect made possible above all by the use of two pianos) give the music a luminosity not found to the same degree in his earlier studies.

(translated: Bradford J. Robinson)