RHYTHMS – DURATIONS – RHYTHMIC CELLS – GROUPS. CONCEPTS OF MICROLEVEL TIME-ORGANISATION IN SERIAL MUSIC AND THEIR CONSEQUENCES ON SHAPING TIME ON HIGHER STRUCTURAL LEVELS

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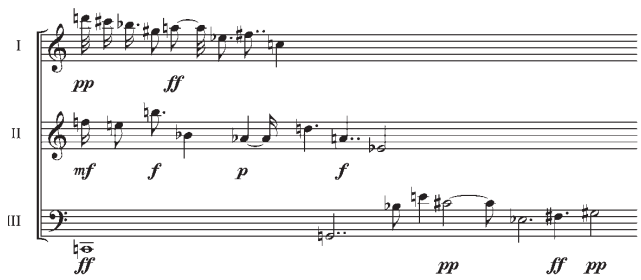
In his 1944 publication *Technique de mon langage musical*, Olivier Messiaen initially studied rhythm, then pitch. This seems to be an inversion of the usual approach in Western music theory since most theories until then were primarily based on considerations related to pitch-organization, be it melody, phrase-structure or harmony. For Messiaen, rhythm reached a degree of independence that allowed the consideration of this dimension on its own, even if in the first chapter, 'Charme des impossibilités et rapport des différentes matières', it is precisely the relationship between the dimensions of pitch and rhythm on which Messiaen focussed. Taking as examples two particularly interesting 'impossibilities', modes of limited transposition and non-retrogradable rhythms, he immediately stressed their analogies: 'les rythmes réalisent dans le sens horizontal (rétrogradation) ce que les modes réalisent dans le sens vertical (transposition)' (vol. 1, p. 5 — 'the rhythms realizing in the horizontal direction (retrogradation) what the modes realize in the vertical direction (transposition)', English translation, vol. 1, p. 13).

As shown by his first examples (taken from Igor Stravinsky's *The Rite of Spring* or the treatise on Hindu rhythms by Çârngadeva written in the thirteenth century), Messiaen is interested in *rhythms*, that is to say, in groups of durations with characteristic properties. (To avoid the usual vocabulary of motives and themes in the domain of rhythm, he sometimes uses the term *personnages rythmiques*.) These rhythms may undergo specific transformations such as more or less regular augmentations and diminutions (vol. 1, p. 10–11; vol. 2, p. 3–4), but also inner permutations (i.e. an exchange of the place of specific values in the rhythm) or subdivisions of specific durations (what Messiaen calls *monnayage*). All

these techniques are very prominent in the *Quatuor pour la Fin du Temps*: the text given there as a preface anticipates certain pages of his *Technique*.

In the 1948 solo-piano piece *Cantéyodjayâ* (first performed in 1954), Messiaen took a decisive step for mid-twentieth century music history, since at its sixth tempo-indication (p. 8 of the score, bars 64–101), *Modéré*, he presented a 'mode de durées, de hauteurs et d'intensités', combining three layers of eight pitches each with a different duration and a specific dynamic level.



Example 1

The harmonic structure of the first layer of this mode (all eight notes are given once each to begin with) only differs from the fourth mode of limited transpositions by a single note (B-flat instead of G), and while the *pp*-figure combining the first four notes evolves linearly in register by a continuous descending movement, the *ff*-figure grouping the four last notes alternates with downwards and upwards directed movements (the connection between both figures initially breaks the regularity of the descending movement). The second layer conforms completely with the fourthmode, but while the last two pairs express the structural tritone-relation explicitly (A-flat rising to D, A falling to E-flat), the two pairs are interlaced in the first segment of four notes (F/E/B/B-flat). The first D of this second layer has to be considered as an anticipation, its role is to emphasize (one octave lower than the initial D of the first layer) the structural tritone-

relation of the first segment of layer I as well as to connect both layers precisely through another tritone-relation. Here, the two occurences of theD on the one hand function as two members of the same pitch-class (the second revealing a harmonic relationship the first one does not express through melodic adjacency until bar 70 — see also bars 72 and 74), on the other hand these occurences manifest them as two different 'sound-objects' (since there is no other characteristic in common with them: *pp* becomes *p*, and the duration changes from a demisemiquaver to a dotted crotchet). The third layer, harmonically, also contains strong tritone-relations since it displays a second mode (i.e. an octatonic scale) with only one alteration (A-flat instead of A). The last note of this layer, the G-sharp, occurs only in bar 78, after a first repetition of the only clearly expressed tritone-relation (in succession as in register-repartition) of this layer; this tritone B-flat/E is often combined with the C-sharp in the same register, thus expressing prominently one of the ic3-cycles founding the octatonic scale.

The durations Messiaen considered them really as isolated values since he no longer used the word rhythm — evolve regularly by addition of the shortest value in the upper layers: in layer I, from a demisemiquaver to a crotchet, in layer II from a semiquaver to a minim (beginning with the second note, the F — see above). Layer III combines pairs of durations evolving 'from the extremes to the centre' with one supplementary permutation between the values 5 and 6. While layer I displays a regular repartition of the two used dynamic levels (*pp* and *ff*), layer II functions by pairs involving three complementary dynamics (*p*–*mf*–*f*); layer III refers only to the two extreme dynamics (*pp* and *ff*), but irregularly, the grouping densities restricting progressively (4–2–1–1), an eventual analogy to the 'from the extremes to the centre'-strategy in the domain of durations.

This passage clearly anticipated the piece that has gained celebrity in music history as one of the essential precursors of integral serialism, that is the *Mode de valeurs et d'intensités*, composed in Darmstadt in 1949, where Réné Leibowitz was present for the second time to lecture on Arnold Schoenberg's Viennese School (his book *Schoenberg et son école* had been published in French in 1947 and translated into English as early as 1949). The preface to

the *Mode* is probably far better known than the composition itself, as Messiaen explained there the work's modal strategy by separating the acoustic dimensions: twelve values for articulation (attack); seven values for dynamics; three divisions of twelve chromatic durations each, beginning respectively with a demisemiquaver, a semiquaver and aquaver; and, finally, three pitch divisions each exploring the chromatic pc-reservoir. Two remarks need to be made here. 1) The reason why Messiaen combined the durations into a complete sequence of twenty four values has never been convincing to me, since *hierarchally* the crotchet as the eighth value of division I, the fourth value of division II and the second value of division III, *is not* the same duration, especially as all dimensions are connected in a stable way throughout the composition. 2) All three pitch-divisions are presented as irregular progressions from high to low, each division contained in a specific bandwidth, while the duration-progression is regular. Furthermore, this presentation suggests a specific acoustic awareness by Messiaen (a perspective, the young Pierre Boulez will continue to connect only with Varèse) since by 'verticalising' each division a structure results in which the lowest values are the longest and the highest the shortest, a clear analogy to the sound-spectrum of an harmonic sound. — 1948 was also the year of the first presentation of the initial realisations of musique concrète by Pierre Schaeffer.

The following considerations are not intended as an analysis of the *Mode* but as an attempt to clarify why Boulez was interested in the first pitch-division as starting point for his *Structures*-project beyond the anecdotal homage to his teacher. Indeed, as Robert Piencikowski showed more than twenty years ago, division I is structured by tritone-relations: the first two pitches (E-flat/D) are immediately transposed a tritone down (A/A-flat); this same relationship can be observed for the next three pitches (G/F-sharp/E become C-sharp/C/B-flat) as well as for the last pair (F becomes B). Similar pecularities appear in division III: the first three pitches are a transposition two octaves down of the beginning of division I; other tritones appear here in strict succession (in the mode, which does not imply that it will necessarily be so in the music), F-sharp/C, F/B, E/B-flat. Messiaen used precisely his

modal technique (where he was not constrained by a specific order as would have been the case in a theme-based or serial organization) to emphasize more or less these relationships, whether they are 'hidden' as in division I or explicit as in division III.

Let us take the beginning of the composition: in bars 1–3, Messiaen gives the listener the characteristic highest 'motive' completely, that is to say the four first pitches in the order of the mode, the successive intervals being (in interval-classes) 1–5–1. The subjacent relationships by the tritone (between E-flat/A and D/A-flat) are not translated into an immediate succession at the foreground-level: this harmonic connection remains in the 'middleground'. But in bar 2, Messiaen juxtaposes E and B-flat in the upper part, immediately echoed by the inversion B-flat to E in the middle part (i.e. division II, where tritones, as far as I can see, do not have the same structural function). Shortly after, at bars 8–10, the lower part emphasizes *ff* the pitch-classes E-flat, D and A-flat, highlighting a tritone separated by an octave and completing (from the point of view of pitch-class-relationships) the reduced beginning of the initial motive of division I that appears in the next bar. At the first appearance of the low C-sharp (the lowest note of the composition, whose occurences in a certain sense punctuate the whole composition) in bar 28, there is a very interesting treatment of the tritones in division I. At first (bars 29–30), there is a modal succession restricted to ic1 and ic4 relations (each pitch considered as a pc): the characteristic beginning reduced to two notes, E-flat and D, followed by B and B-flat. In bars 31–33 a kind of repetition of this figure occurs, enlarged by interpolated tritone relationships: D followed by A-flat, B followed by F before B-flat is finally played.

In Messiaen's modal universe, highlighting one or the other harmonic relationship is rather easy, since the composer has a total freedom with relation to the order of succession of the elements. His freedom was here even enhanced since the *Mode* is based on single objects with an all-parametric identity, and since Messiaen considered the other dimensions (duration, dynamic and attack) apparently not designed to build specific relationships. Since Messiaen left aside his former rhythms, his way of composing changed here profoundly: it really became the handling of prede-

fined 'sound-objects', which were no longer at the disposal of the composer for contextual adaptation through modification (altering of duration, register etc.). The restrictions Messiaen imposed on himself were even stronger here than Schaeffer's submission to the recorded sounds in his first noise-studies.

The problem of revealing at the surface more or less hidden but structurally important features is much more problematic in serial music. The two solutions are either to leave the serial ordering aside at certain moments (and then it is legitimate to ask why even adopt the serial technique?), or to reflect on the system's impact on the surface and to find some kind of equilibrium between both these levels (or at least one or the other even exceptional situation where the reciprocal determination of structure and surface can be made obvious to an attentive listener).

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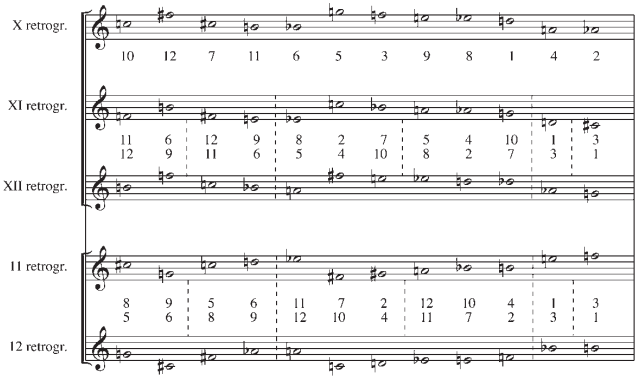
It was also in 1948 that Boulez published his first article, 'Propositions'. He identified two strains in the music of the first half of the century (they later became the major axes for most of the historiography concerning this period): Schoenberg, for his research in the realm of pitch, and Stravinsky, for his explorations in the domain of rhythm (the latter was extended by Messiaen). Boulez chose atonality as the basic reference point and considered the dodecaphonic perspective of Schoenberg as being the point of departure for a really new musical language. Since he wanted to transgress the contradictions of the music of the first half of the century by an original synthesis, he concluded his article by advocating the necessity for an 'atonal rhythm' to combine with the principle of the series (which Schoenberg invented, but did not — according to Boulez — understand its full implications). In 1949, John Cage was in Paris, and a profound exchange began between the two composers who were subsequently considered as the two poles of contemporary music. At that time, they obviously shared many ideas, and Boulez discovered in Cage's music a way of constructing relationships between the micro- and macro-level for which there was no example in European music so far. Furthermore, there seemed to be a strange parallelism between Messiaen's thoughts on independent sound-dimensions and

Cage's compositional method since the thirties. (The separation of acoustic dimensions was also the basis for the first electric instruments that had been built since the late twenties, different technical means being responsible for each of these aspects in the resulting sound.) It took Boulez a few years to come to the synthesis to which he aspired and which he fully realized in his *Structures*-project.

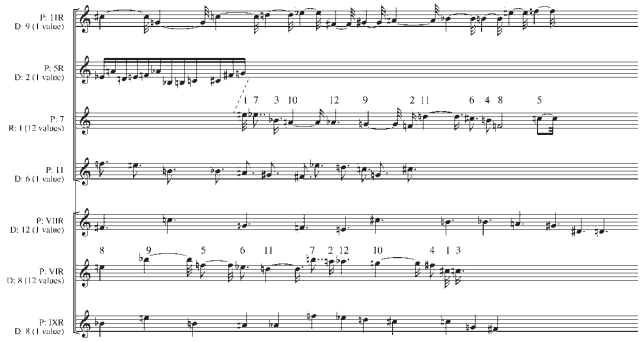
It is well known, that the point of departure of what will become the first book of *Structures* is the division I of Messiaen's *Mode*. Boulez transformed this given structure into a row and developed a fully serial project on this basis. At first, he was concerned with systematising the pitch-dimension. Indeed, in the scores of the composers of the Viennese School, there did not seem to be a need to relate the basic row itself and its treatment on larger scales, beginning with the order of succession of the row's transpositions. So Boulez, as explained in 'Eventuellement …' (1952), organized his row-table by transposing the basic series according to its own hierarchy: the second form begins its transposition on pitch two of the row; the third form on pitch three etc. (According to a recent, private report by Michel Fano, this also seems to be the way Messiaen presented the row table in his analysis of Alban Berg's *Lyric Suite* in his teaching.) The complete row-table shows peculiarities already identified by Piencikowski: complementarities between adjacent row-forms around the structuring tritones. Boulez exploits these complementarities at the foreground level of *Structure Ia* in the first section of the second part. As shown by Piencikowski, the pitch-rows as well as the duration-rows are in parallel tritone relations: this is the reason why at certain places in this section, the tritone E-flat/A is played as a simultaneous event (as in the harp's part of Anton Webern's *Symphony* op. 21, beginning of the first movement) in both piano parts. [example 2] Since each pitch-row-form is linked to a duration-row-form (which always uses all twelve chromatic duration-values), there is a strict synchronisation of the beginnings and endings of all the rows in these two dimensions. Dynamics and articulation are used to unify the different objects of one row-strain as shown already in late fifties in the piece's first analyses (by György Ligeti and Marc Wilkinson both published in 1958 — it is probable that Karlheinz

Stockhausen also analysed it this way in his Darmstadt seminars in 1957).



Example 2

In *Structure Ic*, the next movement of the cycle from the point of view of compositional chronology (completed after Boulez's experiments in Schaeffer's studio at the Paris radio station), Boulez began to introduce flexibility in the relationship between pitch-rows and duration-rows, since the latter could either consist in a complete sequence of the twelve chromatic duration-values or in a periodic presentation of the successive pitches of a row according to the first value only of the selected duration-row. The practical result is that the different pitch-rows are played at variable speeds, distinguishing furthermore between regular and statistical (i.e. serial) repartition of the events of one row-strain. At the beginning of the movement, this is immediately obvious [example 3]: in Piano I, Boulez graphically displays one row-form by linking all its notes, each playing a semiquaver (bars 1–3); the two other voices also evolve in regular steps, but slower (by steps of 6 and 9 demisemiquavers). The fourth row-form to appear (middle voice from bar 4 onward) presents a different duration for each. In Piano II, the situation is similar (12 and 8 demisemiquaversas regular steps for the outer voices while the middle voice displays all chromatic values).



Example 3

The situation becomes far more complicated in *Structure Ib*, where Boulez constantly invents new strategies to translate numbers and number-groupings into specific *rhythmic groups*. These rhythmic groups are not identical to Messiaen's rhythms (even if the latter consisted of grouped durations): in Boulez's *Structure Ib*, the grouping structure is revealed by strong identities, whether in the form of regular rhythmic subdivisions or in the form of a sequence of pitches linked together through an identical intensity- or articulation-level. A simple look at the score is sufficient to understand the flexibility (and thus the freedom) Boulez has gained in his serial approach.

Le Marteau sans maître is known for its organization according to three interwoven cycles, each cycle being based on a different serial technique, a different way of constructing hierarchies starting from the same basic-row. These techniques were explained by Boulez as early as 1954 in his article '… auprès et au loin.'. Three of the four serial techniques Boulez revealed (the first one concerns *Structures*, the other three *Marteau*) focus so strongly on pitch problems (transposition of a basic-row in terms of pitch-classes; creation of harmonic entities through 'sound multiplication'; vertical control through serial means), that the question of rhythm was approached only incidentally. As for the third technique, Boulez stressed immediately the close relationship between the dimensions of pitch and rhythm and gave the latter even a

structural priority. Let us consider two examples showing divergent strategies and different listening perspectives — such a polarisation being stressed by Boulez himself in his analysis of Stravinsky's *The Rite* written between 1951 and 1953 ('Stravinsky demeure'): the opposition between subdivided global values ('Introduction' of *The Rite*) and additive rhythms ('Danse sacrale').

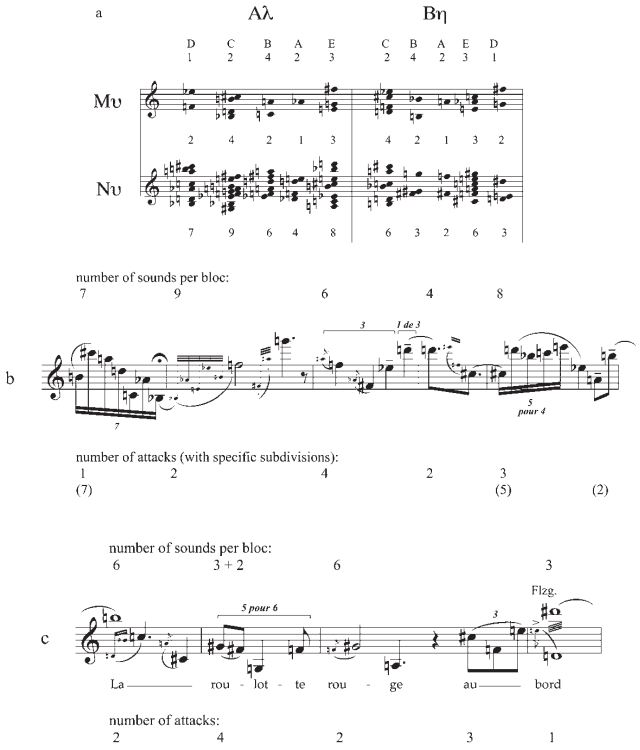
In the cycle 'L'Artisanat furieux', Boulez used 'sound blocs' with variable density and with non-oriented development of their constituents (that is to say no preestablished ordering of the pitches composing a complex in the case of their horizontal presentation, for example, by a solo-instrument such as the flute in the third movement). The rhythmic equivalent of these sound blocs, as suggested already in the former article 'Eventuellement …' (1952), are *rhythmic cells* of variable density. The choice of the term 'cell' instead of Messiaen's 'rhythm' is to be understood on the basis of a certain degree of abstraction whereas Messiaen's rhythms were concrete entities: from Boulez's perspective, a cell is defined only by the number of principal attacks (here: from one to four), not by specific durational relationships between the values of a cell nor by the relationship between total cell-durations from one to the other. There is no given first rhythm, no basic *personnage*. From the point of view of coherence in Boulez's serial system, this is not only sufficient (there is a strong relationship between the densities of the rhythmic cells and the grouping of pitches on the level of the basic row for the derivation of the sound blocs) but also necessary, since he is looking for a maximum degree of flexibility through which the composer would be able to express himself freely on a globally controlled canvas. And this flexibility has to exist on all levels, each level operating in its own universe. The following example is relatively simple but allows on the one hand to understand the basis of Boulez's approach in this cycle, and contains on the other hand sufficient ad hoc-solutions to demonstrate the flexibility the composer was looking for.

In the introductory sequence of movement III, played by the flute [example 4b], five sound blocs are melodically developed in time according to five rhythmic cells (each cell giving rise to a bar). The compositional problem Boulez has to negotiate constantly is the relationship between the density of the blocs (here:

7–9–6–4–8) and the number of attacks in a cell (here: 1–2–4–2–3). Since, taken as one to one relationships, the bloc-densities are always superior to the cell-densities, there is no need for a local arrangement and the question for Boulez was how to develop the sound-blocs in time so as to assure his aesthetic aspiration of flexibility to also determine the musical surface and thus the perception of his music. Flexibility was translated in terms of 'no perceptible tempo' but only constantly and irregularly fluctuating movement. On an initial level, Boulez chose values for the successive cells that constantly alter the reference duration (dotted crotchet, minim, crotchet triplet, dotted quaver, crotchet) and thus the 'felt tempo'; on a second level, he adopted two distinct solutions to distribute the 'exceeding' pitches on the attacks he has at his disposal: 1) the regular subdivision of an attack (semiquaver septuplet in bar 1, semiquaver quintuplet on the first beat and two quavers on the last beat of bar 5 — this technique corresponds to Messiaen's *monnayage*); 2) the irregular distribution of groups of 'little notes' (appogiaturas) preceeding a principal attack of a cell (5[4]–2–1–1–0–0–2 in bars 2–4). In this case, the distribution of the two solutions suggests a symmetric arrangement, but this suggestion is purely graphic: by listening to a performance of the piece, it is impossible to decide exactly which notation had been used, nor does it seem desirable to ask performers to translate the different notations into two differentiated classes of figuration. What is clearly heard finally is an absence of pulse, or a constantly changing pulse (in bar 3 for example, there is a slight chance of hearing the pulse since the first of the four values is not altered by a ligatura and the single little notes at the beginning of the two first attacks are not strong perturbations). Furthermore, there are groups of sounds that are played so fast, that they merge into a single complex entity. From this point of view, we could come to a more convincing description of a perceptible (even if incomplete) symmetry of compounded sound phenomena in terms of attack (with variable density) and sustain, since the perceived density of the attacks evolves as follows: 6–4–2–1–1–2–4.

The first vocal line [example 4c] allows us to focus on another issue. The bloc-densities (6–3–2–6–3) present a problem when connected to the cell-densities (2–4–2–3–1) since the second bloc

contains only three pitches, which is insufficient to realize the required four attacks. Since, furthermore, there is a common pitch between the blocs 2 and 3, Boulez unifies both blocs into one single unit and splits the following fourth bloc (six pitches) to realise the next two cells (a total of five attacks), and thus to redress synchronicity between the two determinations. In the rhythmic realisation itself, Boulez left the context of periodicity inside the cells since from this second section on, irregular proportions between cell-durations occur beside the initial regularity, thus increasing through a supplementary means the fluidity of time.



Example 4

By contrast, the cycle 'Bourreaux de solitude' is clearly pulsatory. While the changes of tempo-feeling were fluid in 'L'Artisanat furieux', Boulez juxtaposed here sections with identifiable tempi changing by discrete steps from one section to another. The determinations for durations and dynamics conform to the former stage of *Structures*, that is to say, multiplication of a basic unit by values from 1 to 12 and 12 discrete degrees of intensity (six dynamic-pairs internally differentiated by means of articulation). These two levels and a grid of twelve entrance-points were connected by Boulez to determine the basic structure of this cycle. As he wrote in '… auprès et au loin.', the pitch domain served now to vary this horizontal regularity by constantly changing vertical densities at each entrance-point. The specific serial technique of deriving the pitch-structures resulted in a 12x12 table, where horizontally and vertically, each box indicated a specific density, varying irregularly from 0 to 4. Empty boxes were realised through interventions of the untuned percussion instruments, so that the lack is only relative to pitch but not to rhythm.

In the first bar of movement VI, the basic unit is a semiquaver. On each semiquaver of the bar a sound-event occurs, be it a percussion-sound or one or more variously sustained pitches: only the attacks determine the perception of the basic pulse, whereas the variable duration has effects on the inner transformation of the more global sound-texture. At the beginning of bar 2, the felt tempo changes to half the tempo, since the unit regulating the entrance-points changes suddenly to an quaver. The beginning of the third row-form is slightly anticipated: instead of beginning at bar 4, Boulez fused both row-forms by the common pair B-flat/D (vibraphone and guitar belong to the second row-form while xylorimba and viola belong to the third one, as does the supplementary anticipation of the A in the flute). The felt-tempo is again the initial one, with the semiquaver as the pulse. This structure of three grouped rows ends with a 'resonance-bar' of 5/16. The latter duration is simply the result of the remaining durations to be completed, since at bar 6 a new group of three rows begins, now alternating quaver triplets and quavers as the basic pulse. The temporal strategy here is thus a clear pulse-feeling changing from section to section with measured (but not pulsating) resonances at the end of a structure grouping a certain number of row-forms.

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Stockhausen's theory of musical time as formulated around 1955 has often been reduced to the question of the chromatic scale of tempi. Even if this issue was important enough to be highlighted, its full meaning is significant only in the context of the instrumental pieces that Stockhausen began at the same time as *Gesang der Jünglinge*, that is to say, *Zeitmaße* and *Gruppen*. So what were the reasons for developing such a tool, and was it more than a goal in itself?

To begin, we must briefly recapitulate the necessity for Stockhausen of his chosen solution in the wider context of serial thinking. As Stockhausen demonstrated in '… wie die Zeit vergeht …' (1957), considering a series in terms of proportions (intervals) instead of simply regarding it as a sequence of objects, implies a reconsideration of the formerly adopted solutions for chromaticism in the domain of durations. The only solution is to work with variable speeds — a possibility technically already suggested by the *phonogène* in Schaeffer's studio in Paris. But what is needed to *perceive* tempi relations? A tempo is expressed through metric relations, not through durational relations. That is why Stockhausen connected the idea of chromatic tempi with group-structures, so that the basic pulse of a corresponding tempo might be perceived through repetition. Stockhausen thus had to reflect on periodicity, a feature stylistically considered as problematic in serial music (this questions was, for example, very prominent in the correspondence between Boulez and Henri Pousseur around 1952, the latter considering every kind of regularity and periodicity as a submission under the former laws of tonality).

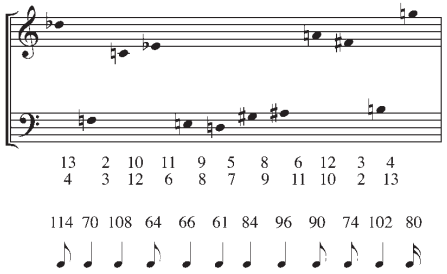
The reason to enlarge the conception of serial music to encompass periodicity was given by the starting points of *Gesang der Jünglinge* as well as of *Gruppen*. In both cases, Stockhausen wanted to include sounds like the sung voice in *Gesang* and the orchestral instruments with definite pitch in *Gruppen*. Now the sung voice and these instruments, according to the knowledge of acoustics at the middle of the twentieth century, are precisely characterised by harmonic timbres, and the composer has no possibility of modifying such data. The use of sounds with periodic micro-level-char-

acteristics necessarily led to consequences concerning the way of considering these projects as a whole. During his experiments in the electronic studio (but also in Meyer-Eppler's teaching at Bonn University) Stockhausen was confronted with the idea of the physical time continuum, which is divided into specific areas (duration, pitch, timbre) only by our perception. Stockhausen's serial conception led him to translate the qualities he could observe in his material on certain levels to other ones, which no longer were given by the material itself but decisions of the composer relative to his compositional method. The coherence of the aesthetic project thus resulted not from a simple transfer of a certain logic deduced from one dimension to the others, but from taking into account all combined basic constraints. In Stockhausen's time continuum, timbre and pitch are two adjacent domains. Timbre is considered as given 'by nature' and conforms to the criterion of periodicity, harmonicity; pitch-organization, on the other hand, was fully chromatic (a feature inherited by Webern). To create a specific sense of coherence, he transferred the characteristics of this domain-couple (vertically harmonic, horizontally chromatic) towards the other time-domains that are immediately perceptible: duration, meter (understood as grouping of durations) and different levels of form-building. This gives rise to the following subdivision of collective characteristics:

overall group relations — formal plan	group relations (relative duration)	meter	duration	pitch	timbre
overall *chromaticism* of the group-relations	harmonic proportions between successive groups	chromatic tempi	harmonic time spectra	*chromaticism*	harmonic sound-spectra of the instruments
12 successive 12-tone-rows governing the overall form	durations of the groups in terms of harmonic proportions	a 12-tone-row governs the time-relations	structuration of a basic duration through layers of entire subdivisions	stylistic serial constraint	physical constraint

Example 5: Relations of the couple harmonicism-chromatism over the complete time continuum

The first realisation of this new conception was in the final part of *Zeitmaße* (a composition Stockhausen coincidentally began in August 1955). Indeed, in the sketches of *Gruppen*, besides the search for specific proportionalities for the time-plan of the orchestra piece, one registered twelve-tone-row enlarged by harmonic proportions occurs between the successive pitches as well as tempo-indications. This row is revealed to be the basis of the final part of *Zeitmaße*, consisting of twelve sections (one for each pitch of the row) differentiated by their tempi, their total duration and a variable treatment of vertical density (the density being controlled through a series of modulo 5, since there are five instruments involved in this composition). To relate this sketch [example 6] to the score, three modifications need to be taken into account: 1) the tempi differ slightly from the scale published by Stockhausen in his article and which he also adopted for the published score; 2) the tempo-indications of 66 and 80 have been exchanged (without any consequences on the other levels) to emphasize the global gesture of extinction at the end of the composition; 3) the metric unit has been doubled.



Example 6

The tempi reflect the chromatic organisation of the row; the pitches' registration has consequences for the basic-duration (i.e. the metric unit), here with a repartition on three different time-octaves (crotchet, quaver, semiquaver for the final g); the harmonic proportions are translated into the global duration of each section, the number of metric units — their grouping — resulting

from the denominators of the proportions (except for the first section, the duration of which is deduced from the numerator since this section is not linked to a former event by such a proportion). Since the employed row is symmetrical, this reading of the proportions results in a double occurence of numeral 13 while numeral 5 is omitted. That is why Stockhausen realised a certain interaction between these two numerals in the final section: its global duration is of fourteen units (the slight stretching is to avoid the last sound to be played on a down-beat, which would usually result in a stress, and would be completely against the present gesture of a progressive 'fade-out') and only the first five basic-durations continue to be determined by the above mentioned density-modification. After this serially coherent group of five values follow four 'adieux' each consisting of a sustained tone preceded by respectively 2–3–1–0 appogiaturas.

In *Gruppen*, besides the extension of a group which is, like in *Zeitmaße*, deduced from the interval-proportions between successive units, the maximal number of layers for the harmonic subdivision of a basic-duration ('time-spectrum') is also determined by these numerals. The horizontal and vertical dimensions are thus interdependent: the longer a group, the finer the subdivision of the basic durational unit. The inner repartition is again serial, fluctuating irregularly between the minimum of one single rhythmic harmonic subdivision to the maximum given the group's extension. Furthermore, since the orchestra is subdivided into three independent parts, each under a specific conductor, it was now possible to give to both terms of the proportion a significance relevant for the time-shaping of the composition. Indeed, Stockhausen worked here with two distinct time-determinations, the first being the interval of entrance ('Einsatzabstand') between successive events (derived from the numerator of the proportion), the second the proper duration of each event (derived from the denominator). If a numerator is inferior to the denominator of the preceeding proportion, the orchestras will overlap; if the numerator is superior, there will be a silence between two adjacent structures. (Further details are evident from the examples 16 and 17 given by Misch, 1998, showing the time-organization for the beginning of the composition.)

While in *Zeitmaße* the vertical density depended on the number of instruments and the basic-durations limited to the mid-range, the expansion of the time-scale in *Gruppen* had other specific implications. For obvious practical reasons, Stockhausen limited the shortest playable value to about 1/16th of a second (the coincidence with the threshold between rhythm- and pitch-perception is certainly significant). The consequence of this further 'material constraint', was that for certain long groups with short basic-durations, all the harmonic layers might not be playable if maintained according to the primary logic of time-spectra.

Stockhausen thus used a 'time-filter'-device according to which the requested thirteen subdivisions per basic-duration will be accessible only for basic-durations superior or equal to a whole note; for a minim, the subdivisions will be restricted to a maximum of 12; for a crotchet, to 8; for a quaver, to 4; and finally for a semiquaver to 2. The loss of harmonic subdivisions nevertheless does not affect the vertical density, since the filtering-device does not simply 'cut-off' the values which are too short but acts by simplifying them to possible ones. Two short examples [example 7]. In group 12 in orchestra II, the reference proportion of 5:12 should result in a global duration of 12 quarters and the basic duration should be subdivided into a maximum of twelve layers (this is shown in example 7a). But since the filter-device restricts the possible values for a basic-duration of a quarter to a maximum of 8 levels, Stockhausen modified the subdivisions by adopting a simplification criterion that seems to be 'division by 2 or 3' (12 becomes a supplementary layer of 6, 10 of 5, 9 of 3 — 11 as prime-number is simplified into a second layer of 7); since layer 8 had to appear only once according to the initial determination, Stockhausen filtered this value as well (see example 7b). In group 36 in orchestra II, the situation is even more complex since the basic-duration is a semiquaver, and thus all the playable values will be either semiquavers or demisemiquavers. The corresponding sketch by Stockhausen can be reconstructed as a sequence of different stages. Example 7c shows the basic version, wherein Stockhausen replaced the numeral 5 by 6 (such changes occur systematically in the sketches for all series with an odd density); example 7d shows the repartition once the filter-device is applied;

group 12

12	8	1	10	9	11	5	3	4	7	2	6
12	12		12	12	12	12			12		12
11	11		11	11	11						
10	10		10	10	10	10		10	10		10
9	9		9	9	9	9	9	9	9	9	9
8											
7					7						
6	6	6	6	6	6	6	6	6	6	6	6
5			5		5						
4	4		4	4	4				4		4
3			3	3	3						
2	2		2	2	2				2		
1	1		1	1	1	1	1	1	1		1

a

12	8	1	10	9	11	5	3	4	7	2	6
7^2					7^2						
6^2	6^3	6	6^2	6^2	6^2	6^3	6^2	6^2	6^3	6^2	6^3
5^2			5^2		5^2						
4^2	4		4	4^2	4				4		4^2
3^2			3^2	3^2	3^2						
2	2^2		2	2	2				2^2		
1	1^2		1^2	1^2	1	1^2	1	1^2	1		1

b

groupe 36

4	6	3	1	2
6	6			
4	4	4	4	4
3	3	3		3
	2			
1	1	1		

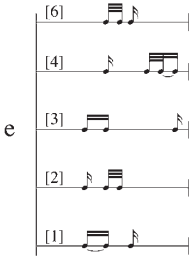
c

4	6	3	1	2
	2^3			2
1^4	1^2	1^3		1

d

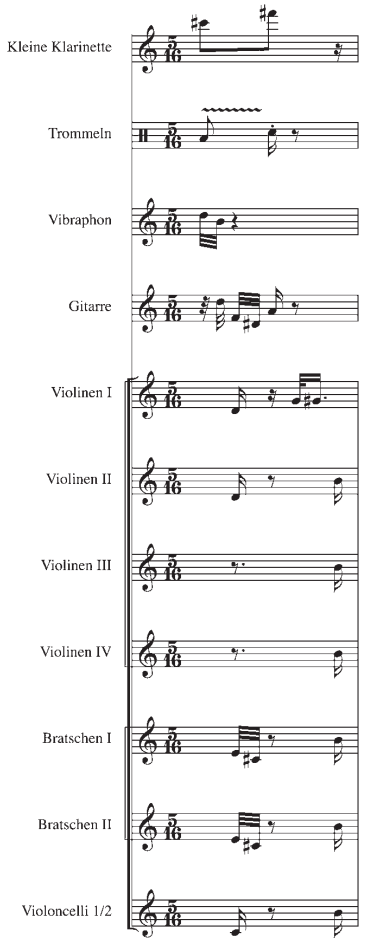
example 7e shows the rhythmic repartition adopted in the sketches while 7f transcribes the score. Two exceptional features need further comment. From the first to the second basic-duration, the four expressed basic-durations were expected to be prolonged onto the second basic-duration, resulting in four quavers. In the score, only two such values appear: in the piccolo-clarinet (which is an 'out of structure'-addition linked to another criterion of the piece, i.e. the repartition of specific harmonic fields whose predominant interval is always announced by this instrument) and in the drums, while vibraphone and guitar display a subdivision into two 32nd notes (which can be explained due to the overlapping with group 35 whose pitch-bandwith is also taken over for this first basic duration). The second and third basic-durations conform to the rhythmical sketch and express the specific bandwith in the pitch domain. The second exception occurs on the fourth basic-duration: indeed, Stockhausen's sketch does not show

how to reduce the numeral 4; an interpretation might be that he adopts the subdivision 2 (demisemiquavers) and that he writes an exceptional rhythm (demisemiquaverfollowed by dotted semiquaver, i.e. 1+3 demisemiquavers) to refer to the numeral 4 that should have been the value continuously present throughout this group.



Example 7

Other exceptional features attest how Stockhausen progressively expanded his rhythmic considerations beyond the chromaticism of the twelve tempi distributed over approximately 6 octaves. In the groups 157 (orchestra II) to 167, which constitute section XII of Stockhausen's overall plan for the 'character-repartition', the basic-durations are expressed by only one harmonic subdivision at a time. This allows a kind of 'finer modulation ' of the discrete steps of the chromatic tempi-scale and tends to a dissolution of these discrete elements in a quasi continuum. Such a continuum becomes then the major time-shaping-feature in the three soli Stockhausen inserted into this structural framework, each solo concluding one structural section by emphasizing once more the predominant timbre-characterisations of the former section. The reference tempo in the inserted soli is 60 or a multiple of it, and the continuous sliding between different register positions of this reference tempo (either by change of the proper tempo-indication, for instance, from 60 per unit to 120 for this same unit, or by change of the unit's duration, for instance, from crotchet to quaver) joins all the chromatic steps into a tempo-continuum which



is equivalent to the glissando in the pitch-domain. This latter characteristic is almost non-existent in this score, but in at least one place, in group 6, it reflects precisely Stockhausen's intention also to transgress the limitations of chromaticism in the domain of

pitch. To fully understand the significance of the glissandi in group 6, one has to go back to the first manuscript full-score of *Gruppen*. At this point in the composition's genesis, the score was intended for three 'double' orchestras: three orchestras playing on stage and three other ones being prerecorded and 'adjusted' in the studio. There was a double purpose. On the one hand, Stockhausen had in mind the confrontation between fixed tempi and mobile tempi — something he had worked out on a smaller level in *Zeitmaße* with the parts added to the score between January and June 1956 (since a first version of the piece had been recorded and broadcasted on Cologne Radio in January 1956). *Gruppen* was planned as being the *summa summarum* of all Stockhausen's research, and in the sketches there are suggestions which even appear to integrate possibilities of aleatoric succession of predetermined sections into this project, which would have been a continuation of *Klavierstück XI,* composed in the summer of 1956. On the other hand, each group was (beyond all the rhythmic features that have been described here) individualised by a specific pitch-treatment, since Stockhausen determined for each group a frequency-bandwith, within which a group had to operate and to display statistically more or less clearly oriented movements (ascending or descending tendency according to the reference-pitch of the next group, in order to have an inner articulation that would compensate for the non-existing transitions between the groups). For group 6, the pitch-structure gave the indication of a minor third as bandwith: in his first full-score, Stockhausen attributed this group to one of the prerecorded orchestras, and composed a microtonal cluster of twelve steps within this boundary of the minor third. After cancelling the idea of the prerecorded orchestras, he had to redesign this group for the orchestra on stage and chose the glissandi as symbols for the finer scales also in the domain of pitch.

To conclude this panorama, one last observation on *Gruppen* and *Zeitmaße*. Up to now, my description was limited to the temporal framework of the time-spectra. But Stockhausen really 'sculpted' these spectra in terms of specific evolutions in time, alluding to the shape of a sound in time with its characteristic parts of attack, sustain and decay. That is why, for instance, the first group of the composition (which is preceeded by a cluster

enunciating precisely the frequency bandwith that will be displayed 'stretched' through the time during all the ten basic-durations of group 1) begins progressively (the two last subdivisions of each rhythmic harmonic symbolising the attack from longer to shorter values), and suddenly stops on basic-duration 2 with a clear cut-off of all harmonics before a melodic resonance on basic-duration 3 with the solo-violin, to begin a new three-units-long texture with progressive entries from long to short values and an extinction in basic-duration 6 which filters from the extremities to the centre, before the last four basic-durations display a final growth and descent of this sound in time. In this group, all the values of subdivision of the harmonics are expressed, the missing elements being subjected precisely to the global evolution in time with attacks and decays. From the middle of group 4 on, Stockhausen used tied values, the basic periodicity of an harmonic being slightly altered but not yet becoming imperceptible. In the center of group 7 (which is a filled-in silence, the structural groups being number 6 and number 9), silences of irregular value take the place of the tied values, and finally (beginning with group 11 in orchestra III), the horizontal articulation of each present rhythmic harmonic subdivision becomes completely statistic (i.e. that all grouping values from 1 to a maximum are used but in a statistic (non-ordered) repartition. The notion of statistic is furthermore of great importance, since it is the link towards noise — which is generally described as statistic repartition of frequencies). This last effect which brings the horizontal rhythmic articulation closest to 'noise' is controlled by means of the series, this tool enabling the composer to avoid perceptible repetitions (this is very clear in the parts of piccolo-clarinet and solo-violin I,1 in group 12). Clearly, Stockhausen had in mind the scale of his orchestral timbres with sustained sound of definite pitch, percussion (and thus more or less staccato) sounds with definite pitch and finally percussion sounds of indefinite pitch. This spectral richness had to be translated also to the slower time-domains, and the horizontal articulation of each rhythmic harmonic seemed to the composer an appropriate solution.

Let us from this point of the reflection now switch to the inserted parts of *Zeitmaße*, where the different instruments evolve

independently one from the other: certain instruments playing more or less fixed tempi (either a certain metronomic indication or suggestions like 'as slow/fast as possible') while others have to accelerate or decelerate very quickly — according to a ratio of 1:4 between the beginning and the end of a given passage. These continuous time-curves have the effect, since the different instruments play harmonic subdivisions of basic-units, of enlarging the reference-system by a new specificity, which is a non regular reference-pulse for the harmonic subdivisions. Retranslated according to the sound-model that is at the basis of Stockhausen's compositional thinking at that moment of his carreer, this implies a further step on the scale of irregularities inside a domain until expressed by a more or less recognisable pulse.

Even if the composer did not imagine such a solution at the moment when he started his project and defined its basic structural laws, this new, 'discovered' situation appears clearly as an unexpected but nevertheless coherent expansion of the basic system more than as a withdrawal of the former strictness to celebrate subjective freedom. If there is subjective freedom in serial music (and there is!), it is rooted in the open-minded attitude of these composers. A categorical contrast between strict and free composition does not exist any more in this music than in the music of the Viennese classic period (see Schenker). Contrast is too simple a concept to conform to serial thinking, whose major device has always been 'mediation'.

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