ISSN 1974-0042

18
2024

Musica / Tecnologia

Music / Technology

FIRENZE
UNIVERSITY
PRESS

Musica/Tecnologia
Music/Technology

RIVISTA DELLA FONDAZIONE EZIO FRANCESCHINI

18 • 2024

Firenze University Press

Musica/Tecnologia
Music/Technology
18 (2024)
Registrato al n. 5489 del 31/3/2006 presso il Tribunale di Firenze.
ISSN 1974-0042 (print)
ISSN 1974-0050 (online)
Versione on-line: http://www.fupress.com/mt

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Immagine di copertina: Dettaglio del quadro *Grüne Spitze* (1932) di Vasilij Kandinskij.

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Università degli Studi di Firenze – Firenze University Press – via Cittadella 7 – 50144 Firenze, Italy
web: www.fupress.com – mail: journals@fupress.com

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The Acousmatic Dimension

edited by Lelio Camilleri

Preface

Lelio Camilleri

Dedicating an issue of a journal to a reflection on acousmatic music might seem out of place and outdated, given that in recent years there has been debate about the post-acousmatic phase of electroacoustic music. However, I believe it is important at this moment to reflect on acousmatic music, its linguistic characteristics, and the structural elements that distinguish it from other experiences in electroacoustic music.

Another topic that this issue aims to explore concerns the examination of certain characteristics of acousmatic music from different perspectives. Two of these, form and space, though inherently linked, are addressed here, as far as possible, separately, in order to better focus on the distinctive traits and peculiarities of these two fundamental aspects for acousmatic music.

In his essay, John Young raises the issue of form and its relationship between its scale and the acousmatic sound project, mainly related to the typology of sounds used or shaped its form. If the relationship between sound discourse and material is one of the key elements of electroacoustic music (Emmerson 1986), it is specifically so for acousmatic music, especially in relation to the spectromorphology (Smalley 1997) of sound matter.

Annette Vande Gorne addresses another problem considered fundamental since the early experiences of electroacoustic music: that of space, one only needs to think of the early experiences with Schaeffer's space potentiometer (*potentiomètre d'espace*) or Stockhausen's "pentaphony" in *Gesang der Jünglinge* (1956). In addition to providing a precise and detailed taxonomy of spatial modes and behaviours, Vande Gorne highlights their characteristics and functions, framing them in the context of acousmatic music.

But does acousmatic music rely solely on sound fixation on a support (Chion 1991), or does it also extend into the relationship between acoustic and electroacoustic dimensions? The inclusion of one or more instrumental, acoustic sources might seem contradictory if one does not consider that the issue is not so much the use of instrumental identity in relation to sounds fixed on support, but the ways in which it is used at the discursive level and in sound manipulation. If we take, for example, a piece like Denis Smalley's *Clarinet Threads (*1985), for clarinet and tape, the clarinet

Musica/Tecnologia, 18 (2024), ISSN online 1974-0050, ISSN print 1974-0042, pp. 5-6
DOI: 10.36253/music_tec-15333 – http://www.fupress.com/mt
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is used as a sound producer to manipulate beyond its conventional characteristics. Similar considerations could be made for another piece involving interaction between fixed sounds and an instrument, such as Daniel Teruggi's *Crystal Mirage* (1997) for piano and tape.

It is precisely Daniel Teruggi's essay that addresses this theme, the extension of acousmatic music in relation to the instrument. A reflection that highlights how in this context the central element is always the methods by which sound is composed both as sound, but also through sound; sound is not only seen as material, but also as a carrier of syntactic and formal elements through its specific spectromorphology.

My contribution seeks to highlight some specific characteristics of acousmatic music, starting from different statements and considerations of François Bayle. My hypothesis, furthermore, is that one of his specific works, *Espaces Inhabitables* (1967), examined in the essay, draws a demarcation line between the experience of musique concrète and that of acousmatic music.

Returning to the initial question of whether it is appropriate today to seek to produce a series of reflections on the various facets of acousmatic music, I believe the answer lies in the variety of issues raised and examined in the essays of this journal issue.

In an essay from 1960, when the true acousmatic adventure had not yet begun, speaking of the acousmatic condition of musique concrète, the writer Peignot identifies two aspects that will become characteristic of music of this kind.

> «In 'acousmatic' music, composition is a struggle, a dance with matter.» (Peignot 1960)

A struggle and a dance with sounds and among sounds.

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Scaling Form

John Young

It is self-evident that composers find it necessary to realise musical designs on varying scales or durations. What we might judge as a long, short or medium length musical work is to a certain extent relative. It is not necessarily connected to any value-driven notion of profundity, nor can profundity be linked to genre: there is no reason why a three-minute popular song cannot encapsulate or stir in us a deeper reflection on life than a 45-minute symphony. Similarly, duration as measured by the clock does not correspond linearly with psychological time. How musical contexts are created and what the listening imagination is offered in the materials of a work shape the way it is experienced, but so does the mind and cultural frame of the listener. This article examines the notion of scale in acousmatic forms, to locate ways in which we can find satisfaction in forms of different lengths and to locate some of the conditions by which material and its organisation necessitate or determine formal scale. In doing so, I am interested in how we sense the way a durational scale arises from the nature of the materials to hand and musical design processes. A key point of contention is whether acousmatic working methods lead composers to inherently lengthening the timescales of their materials. If so, this may be to do with how we use tools. An elemental sound processing method such as sample rate conversion-based transposition is often taught as a starting point – repositioning upper partials of sound as richer, slower evolving midrange sonority can be an appealing prospect. The naturally reverberant effect of granular time stretching can be accepted by the ear as an engaging state of spectral slow motion. These openings-up of spectral and temporal space tend toward expansiveness. A short-form work may have to take these tendencies into account. Has enough time been given to allow a satisfying sense of movement through time to be established or a sense of character to be conveyed by the music? Use of recognisable sounds, say from field recording, can require little time to establish an image in the mind of the listener, but embodying that in a form that involves sound transformations and abstractions has consequences for scale and balance of elements. These thoughts raise questions that we encounter in any compositional project. Many sounds created following different lines of thought that may not be yet connected … how do I conceive a coherent form with them? Is my material and my approach to it going to lead me toward a particular scale of form, and what are the consequences?

Musica/Tecnologia, 18 (2024), ISSN online 1974-0050, ISSN print 1974-0042, pp. 7-33
DOI: 10.36253/music_tec-15334 – http://www.fupress.com/mt
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What do we mean by form?

Bonds (1991: 13) shows that the term 'form' is applied in music with two distinct meanings. Firstly, as a 'conformational' principle, where structural patterns can be observed across numerous works (such that we might refer to ternary or sonata form) and, secondly, as a generative principle in which the elements of a composition give it a unique shape (in the sense that no two sonata forms are exactly alike). While these two meanings have different implications, Bonds emphasises that both perspectives are nevertheless important to developing a full picture of the experience of musical form. Yet in the generative sense, the 'elements' of a form cannot be reduced to an accumulation of material. We often ascribe value to the way *elemental materials* are stated, shaped and reshaped over time in the construction of a musical design as evidence of craft and imagination. So, compositional practice negotiates time to offer an experience in which traces of the technical apparatus of compositional practice may assume identities as forces acting on sound. For instance, in acousmatic terms actions such as filtering, shredding, time stretching, spectral blurring, spatial motion and envelope substitution might serve as generic kinds of sound-shaping that can be recognised as agencies in their own terms, independent of an underlying sonic substance. How such experiences emerge and are interpreted as form is subject to conjecture. Levinson (1997) argues for a 'concatenationist' view of musical experience which is to say that music is apprehended as a series of moments rather than being grasped as a single architectonically coherent entity: '… it seems that one cannot *perceive* the form of such a [large scale] musical composition as a whole, one can only conceive it (or perhaps *imagine* it, in a non perceptual way).' (Levinson, 1997: 20). Turning to the question of whether this makes a narrative approach to musical form relevant, Levinson puts forward two parallel frames – a kinetic-dynamic one and a spatial-architectonic one. The former we might characterise as resting on anticipation aroused by implication-realisation and the latter the broad sense of journey from beginning to end. These two frames are not limited to musical experiences, they relate to ways we respond to literature, fine art, sport, and to life as whole. Rather than negating the value of a large-scale musical form, Levinson allows us to take a perspective on it – for there should be nothing inherently negative in an imaginative conception of an entire extended form. The stirring of reflective imagination after the fact is one of music's powerful effects – questions about the nature of object and our encounter with it arise – and the same is true of any meaningful aesthetic experience. A work that leaves us with an incomplete image of its architecture may call us back to resolve or re-live the questions it poses. Figuring out a relationship between the kinetic-dynamic and the spatial-architectonic is relevant not only to a listener but, from the outset, to the creator – composing is seldom a process of starting at the beginning and finishing at the end and typically involves rotating processes of action and reflection, taking into account relationships between the parts and some phantom or emergent conception of the whole. Composers also live in the moment: in acousmatic music one easily becomes absorbed in the kinetic-dynamic dimension with decisions about shaping, connecting, interrupting or extrapolating elements in a network of musical material,

such that an architectonic 'solution' can feel a remote goal, a mirage even, but one that allows composers to directly engage with material at every stage in the compositional process – even at points when things might appear conceptually vague – as an inhabited ecology of sound.[1] McAdams and Battier (2005) ran an experiment on the comprehensibility of large-scale musical form in collaboration with composer Roger Reynolds. An extended composition for large ensemble and electroacoustics *The Angel of Death* (2001) was conceived by Reynolds (Reynolds, 2004) with the aim of gathering audience responses in studio and in live concert settings. Two versions of the work's materials were realised, a sectional (S) version and a domain (D) version, with the S version combining types of material such that clear boundaries between them could be discerned, and the D version taking a more organic approach by interweaving these same elements. From this study a useful observation is made by Philippe Lalitte that an audience might, in the first hearing of a work, develop an image of a protoform: 'a minimal representation based mainly on surface features, which the listeners may or may not remember in their correct order, but from which they will nevertheless build up a succession of emotional states, believing that these were intended by the composer. … If a work cannot generate a protoform, the listener will lose interest very rapidly. In the strictest sense of the word, the composition remains "formless" for the listener, in spite of the composer's intentions.' While it is unlikely that we could regard any music as being truly formless – musical form is most importantly an experience that is aroused by a given stimulus structure in the mind of the listener – the consequences are perhaps more related to the finding of meaning or insight through aesthetic affinity (see also footnote 2 below). Recognition that there are numerous types of listening behaviours of particular relevance to electroacoustic music has had significant effect on theoretical research in the field. (Marty, 2019).

Working with sound

Important to acousmatic music is the notion of taking a given sound and working compositionally from its inherent properties. But a general characterisation of the materials in the genre is problematic. In it we find anything from coherent field recordings sourced from nature or culture, through carefully crafted sound-shapes derived

[1] Such a sentiment might be related to Boulez's (2018:142-3) statement: 'We wanted to explore mobile forms out of a desire to escape the empty shell of teleological form, and to offer the performer the power to select from several pathways, several solutions.' In describing his incomplete Third Piano Sonata (1955-57, 1963 –) as '… a maze, a spiral in time' (Boulez, 1986) a concept of form is enshrined in the very notion of variability: the form is the journey and its guided manifestations of pathways through the material. Lalitte (in McAdams and Battier, 2005) takes a different view: 'To believe that an aleatoric assemblage of the sections, without regard for their sense of direction in time, will produce the same effect as the composition proper, is to deny the existence of form.' https://mpcl.music.mcgill.ca/angel/3.5.1.html [accessed 18.10.23]. Levinson shapes this more contextually, stressing capacity for tacit knowledge, with a view of the comprehending listener: 'Being musically literate is being sensitive to differences, departures, and digressions, relative to internalized norms of style, genre, and form. (Levinson, 1990:25).

from a studio *séquence-jeu* session (Reibel, 2000) to the most seemingly immaterial shreds of sound which challenge perception of pitch and timbre. Sound manipulation techniques can render original materials unrecognisable, or function as datasets to transform other materials. Schaeffer's (2017) mapping of sound typology marked a serious attempt to grapple with the enormity of the electroacoustic sound world, summarised in a 6 x 5 table (Schaeffer, 2017: 351). There we find expressions of the relationship between a sound object's mass as 'occupation of the pitch field' (2017: 318), the nature of the sustaining energy (based on models of impulse, iteration, continuity) and its duration, converging in the centre of the table on the phenomenon of the impulse. Sound typology in this sense recognises that every sound – sound object – has its own form in time, distinct from the way we might recognise it as comprised of 'matter.' (2017: 216). Significantly, Schaeffer took into account the effects of duration and variability in mass. At the core of the typology table are 'balanced objects' – the zone of traditional stable note-forms of normative duration, while extended durations with high levels of variation in mass being found at the extremes of the typological framework and characterised as over-original. Schaeffer placed varying degrees of musical utility in these typological regions. In his terms, for musical purposes, sound objects should have a degree of stability with some variation in construction (as facture). If overly prolonged in duration sound objects risk banality and redundancy through insufficient change over time. Eccentric sounds, characterised by extreme forms of change in the structure of a sound produce in Schaeffer's terms 'an excess of originality' which he warned against for musical purposes '… the dynamic and melodic profiles will be tortuous, confused. The excess of information generally makes people say of these sounds that they are formless' (2017: 360). Similarly the outer extremes of the typological table take into account and marginalise irregular accumulations of iterative energies. As is doubtlessly obvious, these 'constraints' though perfectly rational in characterising aspects of ecological listening strategies have become the stuff of much electroacoustic music, for instance through extreme forms of time-stretching or the micro editing into amalgamated energy profiles of disparate sound sources in concatenative synthesis.[2] Similarly, Schaeffer's phenomenological focus, which aimed to define the sound object without regard to source recognition has not been followed by probably the majority of composers working in the field, leading Chion (2016) to

[2] A recent example is Romain Perrot's [2023] *Muro di Rumore.* Perrot writes that the work is 'composed from multilayers of free form noise, to induce spectral individual sounds which will appear differently to each listener.' In one sense this can be exhilarating – within the work's 10 minutes and 59 seconds of high-density noise, detail and flux in the spectrum are available to the ear, but maintaining focus with a level of attention that can consistently enable discernment of sonic detail becomes more an act of will than engagement with the sound world. Works of this kind take us into a confrontation with the phases and modes of listening, but inviting us into that experience also potentially risks oversaturating capacity for attention. Yet, because there is no essential dynamic change in the course of the work, it does concede the possibility of listening at different fixed levels, as a way to interact with the ear's inherent variations in frequency sensitivity. *Muro di Rumore* was composed specifically for the 2023 Prix Russolo which stipulates a maximum duration of 11 minutes, which therefore presumably determined the work's final duration.

propose the alternative term *auditum*.[3] But a key point about Schaeffer's work in this regard is that he recognised a distinction between time as measured chronometrically and as psychological time, in which sense he referred to the way a 'listening journey' (2017: 196) can evoke varying conceptions of the passage of time. An example of a piano note heard as recorded or reversed served this example:

> … whether the sound played backward appears longer or shorter … produces very varied, and sometimes contradictory, answers. For some the "suspense" makes the time feel long; for others it fills and shortens it. The important thing is the observation that the listening *journey* [originally '*trajet* de l'écoute', italics in original] is neither of the same length nor of the same type in sound played backward or forward. (Schaeffer, 2017: 196).

Richness of musical content is not necessarily the same as density of information, say in spectral or rhythmic complexity. In an initial sound object these may provide the composer with models out of which many new materials may be derived and developed, while simple initial materials may afford clarity of content from which more elaborate designs can be forged. (Young, 2016). But how might the nature of materials afford or influence the kind of timescale on which a composer can build a work? Truax (2014) pointed to the fact that social contexts have a very real impact on the way we think about musical duration. In terms of continuous duration, the most extended of Bruckner's symphonic movements at 25-30 minutes are considered 'long', while a 35 second prelude by Scriabin is clearly 'short', with consequently different social, artistic and programming implications. A musical experience may be of short duration but have stature and depth as a statement.[4] To draw from Schaeffer, beyond the listening journey of a single sound object, a musical journey can be projected on a slender timescale: simply, as in Chopin's A major Prelude or with some complexity as in one the fugues in Bach's *Das wohltemperierte Klavier*. Recall that, in relation to his *Bagatelles for String Quartet* (1911-13), Webern (1963: 51) wrote: 'Here I had the feeling, "When all twelve notes have gone by, the piece is over."' Although this is not what transpired in the finished work, some of the seeds of his later more extended structures are found there (Chrisman, 1979). Webern's evident sensitivity to the colour and quality of each sound, blends and registral placement and, perhaps most importantly, the sense of line and phrase that defines each of the movements invests in each a distinctly audible overall design. Coming down to very basic elements of musical content, Hindemith (1952:68) expressed the view that 'single tones ... are mere acoustical facts which do not evoke any genuine musical reaction. No musical effect

[3] 'Unlike Schaeffer's sound object, the *auditum is subject to all modes of listening* – reduced, causal, figurative, semantic, which make up different, at once linked and independent, levels of apprehension – knowing that it is helpful to distinguish among these modes of listening that take aim at the *auditum* and for which it is the foundation.' (Chion, 2016: 193) italics in original.

[4] Expressions of the value in succinctness are found in Shakespeare (Polonius) 'brevity is the soul of wit' to Pascal (2012) in *Provincial Letters* 'The present letter is a very long one, simply because I had no leisure to make it shorter'.

can be obtained unless tension between at least two different single tones has been perceived.' Deryck Cooke (1989:27) challenged this with the example of the trumpet note at the opening of Wagner's overture to *Rienzi* which, he contended, is capable of evoking an emotional response: 'beautiful, mysterious, thrilling ...' Of course it is not a completely detached event – it does not die into silence as Cooke suggests[5] which renders inaccurate the image he uses on the title page of his book. Still, that image of the single tone, with its dynamic rise and fall followed by a question mark is a telling one. If we were to hear it so isolated, the question mark is precisely an expression of our tendency to allow even the simplest sound-form to lead us somewhere: and it is the dynamic profile, the implication that the tone, having emerged from silence will recede back into silence that is most responsible for that mysterious thrill rather than the phenomenon of the single note itself. In that sense, sound, rather than existing in relation to another sound becomes relational with silence. A remark that perhaps brings these views into perspective, by neatly separating the idea of material from organising concepts, is from Elisabeth Lutyens, who related an aphorism of one of her most talented students: 'the first note is a sound, the second note is a decision.'[6] Acousmatic and spectralist thinking of course regard the 'note' as a sound object, as an event whose interior construction affords a world of possible material, but which still necessitates an approach toward concepts for extrapolation into a form – identification of what the spectral interior of a note might afford requires a suitable form of analysis and a 'decision'. From the opposite end, if we take a composer's initial visualisation of global design, such as those Kaija Saariaho considered for the large-scale work *Verblendungen* (Saariaho, 1987:106) we might agree that what is represented in these ways could imply virtually any duration or scale. What is critical in practice is the relative state of each of the images along its path. Departing from that idea, a set of underlying dynamic profiles show Saariaho's thinking beyond the imagery with independently developed parametric layers, necessarily expanding the timescale on which the work evolves. Certain kinds of ideas do necessitate extended treatment. In acousmatic music we find this in Francis Dhomont's *Cycle des profondeurs* of themed large scale works *Sous le regard d'un soleil noir* (1979-81, rev. 1983), *Forêt profonde* (1994-96) , *Le cri du Choucas* (2014, rev. 2015) and in Trevor Wishart's *Red Bird* (1973-77), all projecting deeply interwoven layers of narrative.[7] As a means of contextualising an

[5] Each of its three statements overlap successively with: the same note in low strings an octave lower; a short woodwind chorale and; a unison G in low strings.

[6] Interview extract included in BBC *Woman's Hour* 25/05/2012, https://www.bbc.co.uk/sounds/play/b01hxt5l [15:54, accessed 14.11.23]

[7] Early pieces from the acousmatic canon frame and collage the colour and character of sound objects on modest scales, such as Pierre Schaeffer's *Cinque études de bruits* (1948), with more extended suites of pieces emerging as more expansive statements as in Pierre Henry's *Le microphone bien tempéré* (1950-51), and larger forms based on interconnected shorter units or movements, notably François Bayle's grand cycles commencing with *L'Expérience Acoustique* (1969-72) comprising fourteen subtitled pieces, ranging from almost 25 minutes to 35 seconds in duration grouped into five chapters and Bernard Parmegiani's *De natura sonorum* (1974,75) and *La création du monde* (1982-84). Annette Vande Gorne's and Werner Lambersy's electroacoustic opera *Yawar Fiesta* (2006-12) marks an important achievement as a full-scale acousmatic opera.

approach to long-form storytelling and connecting different perspectives on wartime experiences I have deployed a 'funnel' form in which content is progressively narrowed toward revelation of a key event or thought. (Young, 2018). For the purposes of this article, I am treating anything beyond 12 minutes of continuous duration as 'long' and around three minutes or less as 'short.'[8]

Form in practice

Curtis Roads suggests three pathways to a musical macroform: top down, bottom up and multiscale planning. The latter, he proposes:

> …encourages an interplay between inductive and deductive thinking, that is, from the specific to the general, and from the general to the specific. We use induction when we start working with a specific fragment and then see how many fragments can fit together within a larger framework. We use deduction when we conclude that a detail is inconsistent with the work as a whole. (Roads, 2015:298).

In acousmatic practice, the process of making and shaping sounds can easily be separated from any immediate musical intent. Signal processing routines frequently operate at rates faster than sound itself and generating many variants of the same formula is easily accomplished. A composer might have a concept of a possible concrete outcome from signal processing, or not. So, with a creative goal, surrounded by many sounds and aiming to make some coherent sense of them, a pertinent question is whether different sounds, phrases, accumulations or sections of musical material with varying surface qualities might overlap in their capacity to influence formal functionality – which is to say: can we make the same kinds of musical meanings with different materials? A perspective on this can be taken from Lakoff (2006) who articulates a hypothesis that cognitive primitives (or 'cogs') influence perception of form in (he exemplifies) visual art. Cogs are hypothesised as 'secondary' neural circuits that structure primary perceptions and motor actions as well as imagined instances of them to evoke schemas. A key idea is that they connect physically embodied experience of doing and acting in the world with language and are generalisable across actions and concepts – such as in schemas that articulate or express motions like grasping or stroking, incorporating associated phases of movement and identification of a target object. Through metaphor these can valorise language – to either 'hurl' or 'inject' an insult reflects embodied meaning but have different qualities in the metaphorical action. An example from visual art offered in Lakoff (2006:164) demonstrates how this can inflect meaning in form by summarising Arnheim's (1969) comparison of Jean-Baptiste-Camille Corot's painting *Mother and Child on the Beach* (ca. 1860) and Henry Moore's wooden sculpture *Two Forms* (1934). In the painting we see a mother reaching with tender gesture toward her child while in the sculpture we feel that same

[8] Barrett (1997:72) expresses a sense of difficulty with durations over 15 minutes.

caring, protective gesture, as the larger form inclines toward the smaller one. Central to this embodiment-based interpretation is that in both works the smaller 'child' figures are upright and apparently static, perhaps implying a vulnerability to which the larger figure responds. Lakoff explains that that 'cogs', as secondary structures ignore specific details of perception '… at once embodied, since they are part of the sensory motor system, and abstract since they do not include details.'

Discussion of acousmatic music also frequently draws on the embodied nature of metaphor. Wishart's (1996: 182ff) sketch of complex sound archetypes takes phases of generalised physical phenomena to characterise sound-energy relationships, and applies similar thinking to group and streaming phenomena. What Wishart refers to as the 'Dunlin effect' – murmuration of flocking birds – also characterises a container schema (outlined in Lakoff, 2006): although not contained within a solid receptacle the boundaries of spatial occupancy at any moment can be registered as containment. In sonic terms, granular clouds project this schema with capacity for form-building processes of change – pathways, expansions, contractions.[9] Smalley's (1997) motion and growth processes, seven characteristic motions, behaviour types and representations of spatial forms and settings also exemplify an embodied schematic approach, describing states of material and capacity for interactions. Materiality and embodiment also are at the heart of an earlier writing by Smalley (1992) making more overt links to the physicality, 'object-ness' and 'thing-ness' transmitted by sound. More recently Smalley (2010) has offered reflective insight into the values and pitfalls of devising descriptive terminology for sound. This includes recognition of changes in the conceptual potency of terms when translated, as well as an admission of an incorrectly designated term in Smalley (1986). In educational settings it has been my experience to find students resisting schemes such as Schaeffer's categorisations and Smalley's spectromorphological terminology as being too prescriptive – an imposition on the listening and creative experience. But grounded characterisations of the materials of acousmatic music from these perspectives are helpful, because they stand independent of any particular sonic material and indicate possible ways of connecting and valorising content.

First and last impressions: what to open and how to close?

We can get a clear impression of the possible scale of an acousmatic work by the way material is assembled in its initial stages. My hypothesis is that a generalised model for analysing the implications of 'opening' is that of entering a 'space'. Space is used here as a metaphor for the volumes, distances and material associations that a listener might infer from the nature of sound, the timing and style of their presentation. As metaphors for opening, I suggest that we might think of an initial musical space as *formed*, or in the process of *forming* – a reflection, perhaps, of the fact that *form* is both

[9] Smalley's (1986:79) acknowledges the challenges in sustaining 'musical coherence' in works nearing 15 minutes in duration.

noun and verb. A formed setting provides the impression of a spatio-sonic identity that the listener can comprehend as a coherent scene in which an ensemble of materials interact or co-exist. This need not be naturalistic, but may be a complex amalgam of divergent material sources. Forming settings involve gradual assemblage of materials which unfold, elaborating characteristics and dimensions of an acousmatic space. Enrique Belloc's *Para Bla* (1993) I regard as opening with a forming space – as two elements: between relative pitch and noise, and a registral space between. The three short low-pitched attacks are all on the same tone (around G) but the five envelope-shaped noise bands (with slightly varied attacks) have different centre frequencies. We might infer a whiff of pitch in the noise elements, but the real impression is the establishment of zones within the space that it is forming before us in the course of 54 seconds. The work's subsequent evolution is perhaps surprising after this, being concerned largely with watery textural figures underpinned by tube-like resonances. The ending of this six-minute work recalls the noise band envelopes, mixing these with intimate water sounds, high-pitched attacks resembling impacts of glass objects and a final low drone canopied by upper harmonics. As a partial echo of the opening this projects a kind of still-forming ending. The opening statement of Gilles Gobeil's *Le vertige inconnu* (1993) might be briefly described thus: an initial rapid *da niente* crescendo of a hollow pulsing sound from which a short surge of filtered noise forces a powerful whip-like explosive attack (the ear is drawn upwards to a higher region in the spectrum after the initial attack). A deep low-level resonance of this underpins a web of rising and falling glissandi that push into a second attack, more deeply resonant than the first and which generates a more extended ongoing resonance with a brief trail of high frequency 'shards' (defined by components between ca. 3.5 and 11kHz). A cloud of broadband noise recedes into virtual distance underscored by a deep drone anchored around 60Hz. This happens within the first eight seconds and conveys a formed sound image because the flow of elements feels convincingly propelled by one coherently sourced energetic flow – if we were to think in materialist terms not necessarily one substance but conveying a richness of design in one musical action. As a design, *Le vertige inconnu* can be seen to develop from this compact initial statement through a sequential process in which energy surges and impacts become increasingly separated from the more stable states they appear to initiate. These more stable states offer a range of obscure but tangibly 'real' mechanical and environmental imagery. A further feature is the way slow increases in energy suggest the approach of sound toward the listener – generally influenced by carefully constructed rises in high frequency energy.

Structuring closure in acousmatic music is more problematic than opening, and this can be understood through a distinction made by Leonard Meyer (1989, 2000) to evaluate the functional value of musical materials: namely in terms of primary (syntactic) and secondary (statistical) musical parameters. For Meyer primary parameters are those capable of being segmented into 'perceptually proportional' steps, with relationships between them shaped by syntactic constraints that enable a set of tangible, hierarchic value relationships to emerge. They are syntactic where elements within a parametric frame can be related in terms of function, e.g.: leading note/tonic, upbeat

/downbeat (Meyer, 2000: 286). The psychologically complex consequences of discrete pitch steps used to evoke a tonal centre, whether definitively or ambiguously, as well as metrically-proportioned rhythmic formations are core examples of the musical efficacy of syntactic parameters. These elements are capable of inducing an underlying structure such that a syntactical unit, for instance the tonic chord in tonal music, can be implied, or anticipated in the mind of the listener from within the musical flow without it necessarily eventuating. Secondary parameters cannot be separated definitively into proportional values, nominally: tempo, dynamics, and timbre (Meyer uses the term 'sonority') and these tend to function through relative increases and decreases in quantity or alterations in character, rather than a genuinely relational-implicative syntax. These Meyer regards as operating statistically and are '… experienced and conceptualised in terms of amount rather than in terms of kinds or class-like relationships such as *major third* or *antecedent-consequent*) …' (Meyer, 2000: 287, italics in original). One timbre may be brighter than another, and these can be understood ecologically from lived experience – impressions of height, tightening, openness, and so on (as the quick sketch above of *Le vertige inconnu* implies) – but this cannot be valorised with quite the same specificity and syntactical potency as the degree of stability or directional implication of an interval between two notes in a tonality-centred context.[10] Outside of that a potentially fruitful way of making useful distinctions and oppositions with sound in the broadest relational terms is in the notion of polarity: a sense of opposed extremes in sound, whether absolute or not. For instance, in terms of pitch and spectral types, following Schaeffer's model,[11] Smalley's continua of note-to-noise and spectral density (Smalley, 1997: 120-121) theoretically summarise a sense of both the psychological distance between sound states and the potential for grasping an uninterrupted sense of parametric coherence between them. For this to really work in music, we need to be attuned or acculturated to the notion of such a continuum in order to gain meaning (such as tension/relaxation or goal states) from stages and states of progression or play within it. So although we can hear that Smalley and Schaeffer's nodal states of spectral definition and density are perceptually relevant, and despite the fact that in certain circumstances we might reasonably regard a focal pitch or a progression toward noise as a relative goal state – which is a strategy of some spectralist instrumental composers as well – movement through the continuum cannot be inherently hierarchic. It is still *movement* which may have affective qualities such as tension through intensification, but a definitive point of arrival (or closure) will tend to be tenuous: we can never be sure which is the final value … which is the most saturate point in noise, say.

Syntactically viable elements can also behave statistically – the repeated alteration of tonic and dominant at the end of a classical symphony[12], and the harmonic

[10] Engebretsen (2020) summarises several decades of thinking about timbre in music, pointing to increasing recognition of the capacity of timbral play to evoke musical tension and release.

[11] See Schaeffer (2017:413). Grisey (1987:244) also presents a more generalised view of a continuum of sound structures.

[12] See Awagu (1987) for a commentary.

oscillations in much of Philip Glass's music exploit exactly this. Needless to say, any emphasis on syntactical frameworks such as what we might think of as tonic-centredness in a Eurocentric sense, are culturally constructed. Yet, as a grammatical system, tonality is learned through mere exposure and its cultural ubiquity inevitably makes it, at very least, a background frame of reference brought by most listeners to all musical experiences. A deeper understanding of the consequences of that, along with other culturally-derived forms of understanding is an important area of investigation. But syntactical relationships of the tonal kind are not the only factors in projecting musical closure.[13] There is a rhetoric of closure. A short punctuating sonority, fading out, slowing of activity corroborate syntactical devices and can serve to inflect and intensify a syntax – in musical performance and in the presentation of compositional ideas – to influence and animate phrase shaping at all levels. A useful example of a statistically directed process for closure is Schoenberg's idea of *liquidation*, where a phrase end drifts to closure through a weakening of the influence of a motivic figure (Heneghan, 2019). Many tools commonly used in acousmatic music enable forms of liquidation: the 'blurring' potentials of granulation and frequency domain processing, time-stretching or time-compression, extended reverberation times, looping, filtering. Fading and dissolving of sound matter itself is perhaps most poignant in acousmatic music – the ontology of the genre is such that sound materialises around us from no apparent performative action, it emerges and 'disappears'. This disappearance of sound had significant consequences and the fading of sound energy is described by Michel Chion as evoking a *window of mental totalisation*. He gives the example a single piano tone which, in the case of a note in that instrument's lowest octave, may resound for 30 seconds or more. But we can surmise its morphological fate very quickly – Chion (2016:33) says: 'the end is but the logical consequence of its beginning, and the sound is totalised before it is truly completed.' If we recall that Schaeffer's zone of balanced objects is bracketed by objects of more extended duration and possibly unpredictable shifts in spectral content or dynamic shape, then a tendency toward mental totalisation might become an agent of tension when, say, from within our extended piano note a new growth in energy is observed in a particular part of the spectrum. In this sense we can appreciate the difference between cessation of sound and syntactical closure based on the establishment of a relational architecture between elements in a musical discourse,[14] as well as potential consequences for the scale on which a form might be constructed.

[13] Thoreson (2015) stresses this as a riposte to Meyer's emphasis on primary parameters as most evidently syntactical:

'… closure and segmentation are not synonyms; it is possible to create segmentation – divisions into sections, etc. – through timbre. Probably closure may only be a special case of segmentation, and no more than segmentation is needed for laying the fundaments of musical form and syntax.' The crucial point remains however, that syntactical organisation is more than what we hear in the moment, but a system in which an underlying relational architecture binds elements functionally, such that direction of travel can be anticipated – whether correctly or not – before it is experienced.

[14] After all, how many times has the abrupt clatter of faders brought down on a diffusion mixer broken a silence and announced that a work has, indeed, faded out for the last time?

The use of dynamic fading as a phrasing device that has consequences for formal scale can be found in a comparison of Francis Dhomont's *Points de fuite* (1982, duration 12:21) and Charles Amirkhanian's *Bajanoom* (1990, duration 3:00). *Points de fuite* (vanishing points) opens with a series of surge gestures fading into silence or near silence. The first gesture alone is a microcosm of colour and energy distribution. The initial rise draws attention to a noise-sheen weighted around 7.6kHz with an increased dynamic surge at 2.8 seconds opening to a more defined pitch centre of G-sharp (3.3kHz), while remaining essentially a dense quite noisy spectral mass. Four further surges follow[15] with varying dynamic profiles, spectral weightings and durations, with varying lengths of pause between each. A telling aspect of Dhomont's phrasing is the measured sense of timing of the first three gestures in relation to the quicker appearance of the fourth which also has a quicker rise in amplitude to create an impression of impetuousness. Each also offers a different residual pitch flavour: G-sharp/B/D-sharp/D-sharp falling to C-sharp via D. Some of these pitch impressions are more distinct than others, partly because of the complexity of the spectral masses from which they flow, but the singular identity of pitch as a phenomenon allows the ear to lock in[16], with the capacity to be held easily in memory – this and the subtlety of phrasing contributes to a playful quality of rhetoric. This is a 'forming' opening, and one evoking an impression of a necessarily lengthy unfolding. The fourth gesture's more nuanced projection of pitch and slightly more protracted duration allows it to give the impression of reaching down to meet the deep drone that emerges under it. A moment such as this, where tones embedded in a spectrum conjoin, represents a way in which syntactical closure of a phrase can be evoked by spectral means. A fifth such gesture (0:33.5) followed by two more reinforce an image of growing energy continuity and spectral density toward the emergence of what appears to be the distant sound of a jet aircraft (1:08). A cluster of bell-like attacks (1:16) heralds an eighth surge gesture which dissipates into a cluster of metallic attacks that dissolve into silence. To this point we have been taken on a journey from one kind of morphological type – the surge gestures – to a quite different sound world in which sharp onsets bring us closer to a material world, with a hint of lived reality just outside our reach (the aeroplane). A ninth surge gesture presents quite different spectral colouration, evidently influenced by the more crystalline sounds that ended the previous phase. Its placement, bracketed by silences – Roy (1996) regards this as parenthetical – suggests a regeneration of the opening phraseology. In formal terms the balance of recurrence, variation and novelty of material to this point confirms the impression that the work will develop on a substantial scale. The idea of the surge gesture remains an underlying motivator, but in the latter stages (from about 9:28) a series of interruptions threaten to destabilise a possible closure that is implied by textural stability. A final 'slow motion' surge gesture lasting 70 seconds makes a final rhetorical signal that the work has receded into silence for the final time.

[15] Later we see Smalley describe this fade-in-out morphology as a graduated continuant.

[16] See Young (2013) for a discussion of this in relation to Pete Stollery's *Shortstuff*.

Bajanoom plays out on a much shorter scale. At the outset a series of three metallic attacks decay into threads of pitched resonance, each time with increasing inharmonicity, but the first of these is 21 seconds long (as opposed to the 7 seconds of the first gesture in *Points de fuite*) and consequently draws greater attention to the consequent pitch strands. A further series of varying attacks, quickening in pace, are integrated by the projection of partials in common from one timbre to another (0:50 – 1:16), slowing in the rate of attacks until 1:43 where a cluster of convoluted glissandi heralds further new materials: a rich string-like resonance, hollow clattering, muffled voice-like sounds. A richly resonant state is maintained throughout, providing a consistent sonic aura despite phases of variation and novelty. A false ending is implied when an impression of spectral cadence is created at 2:17 as a strand of the voice-like tone falls slightly to meet the pitch of a new metallic resonance – this sustains for almost 11 seconds further insinuating the possibility of closure. A short 'coda' follows, bringing together in compressed form a series of gong-like attacks and gliding harmonics. The coherence of the work is a consequence of the consistency of the sonic world, but with sufficient variation in material to evoke a journey in sound with deftly integrated spectra and sensitive timing of decays and overlaps. By setting up an initial context in which the effect of mental totalisation is triggered but then pushing away from that with carefully timed new events which individually retain a sense of balanced holism as sound objects, tension that might require a 'working out' is restrained and *Bajanoom* achieves a successful state of brevity. *Points de fuite*, on the other hand, generates tension through its extended state of a forming opening, a tension which demands a more extended formal scale for resolution.

Design impressions

Let us return to Lakoff's cog schemas and the notion that very basic designs can stimulate embodied understanding as form. I attempted to put this into practice in the final movement from my work *Three Spaces in Mid-Air* (2017). As a source design I took Chopin's Prelude in A major, op. 28 no. 7. In this work dominant-tonic rocking harmony underpins the lilting melody which forms arches over the first eight bars. The transition to B minor via the climactic F-sharp 7^{th} chord in bar 12 articulates a sudden upward projection in register and a moment of greatest pregnancy before gently resolving to the home key. This basic design impression might be notionally represented as an undulating line across which, at about two-thirds of its length, an oblique upward line is propelled before settling again to the lowest position of the undulating line. In my piece a slowly pulsing sonority, rooted around the tone of F (around 44Hz) analogises the rocking motion of Chopin's harmony and is canopied by two identities in succession: a downward glissando gesture and rotating pure tones outlining a perfect 5^{th} (2532Hz and 1688Hz) creating arches above the pulsing sonority. The latter heralds a rising tremolo figure which is projected much more strongly into the frequency space, injecting the only real tension into the movement and fading as it rises into the upper regions of the work's spectral space, its evaporation softened

by rotating pure tones now a semitone apart. While these are only sketched descriptions of the contents of these pieces, the basic lines that etch the form might be seen as congruent: the embodied sensation as one of being taken from a stably rocking state with arching lines anticipating a higher space above to a more dramatically realised elevation with a return to the ground. As expressions of form these generalisable and potentially transferrable 'images' with implications of relatedness, contrast and motion, I call *design impressions*.[17]

A further illustration of how one might convey a design impression is in the 'Helsinki' movement from my work *Five Versions of Reality* (2014). In the work five short-form movements[18] are each based on recorded snapshots that I identify as place-related, though not intended as definitive expressions of place – sounds, mostly ephemeral or transitory, recorded in a place are framed as sources for spectromorphological extrapolation. The movements are linked by some common gestural features, for example a falling arpeggio-like figure and sounds resynthesised from a trumpet sample to generate spectral clouds that prolong a pitch flavour or redirect harmonic colour. In 'Helsinki' the core identity is a melody[19]played on a bass trumpet by a street musician in the city centre. In broad terms the work offers play between what might be 'windows' on an outdoor music performance and 'interruptions' by co-active abstract sound agents. The opening suggests a kind harmonic/spectral ambiguity, initially with an E-flat flavour opening to a C spectrum by 0:17, sustained until 0:33 when the first roughly recorded trumpet melody (in F minor)[20] cuts in. In this opening the timbre of the trumpet is hinted at with extraction of some of its spectral layers, resynthesised in an overlapping sequence of pitched timbres, cut into by a wind-noise distorted recording. This 'cutting in' and deployment of rough sounds aims to metaphorically suggest a natural space opened in the midst of a more abstract one. At 1:16 the clearest image of the trumpet, in E-flat minor, is presented and whose final cadence, rising to E-flat, is met by a C-flat major chord. The long resonant state that is maintained to the conclusion emphasises a tone between E and E-flat (around 322Hz, which I will refer to as E) – with a number of cross-cutting figures. The design impression is one of a resonant field broken into by two 'found' musical images, one hazy the other clear, with a final liquidation of the quasi-tonal corroboration of these two sides of the 'world' that has been fabricated (one 'human' and performative, the other abstract). That liquidation is signalled by the confluence of trumpet and resonance in the synchronised cadence: from that point of accord the 'purpose' of the piece is made bare and the closure determined. I was aiming to promote a sense of the work moving inevitably to an end from that point – something akin to Chion's idea

[17] In principle, this may be close to Lalitte's idea of protoform, but I use design impression to emphasise the potential transferability of the image of a form, which would persist even through further listenings as a deeper understanding of form develops.

[18] Namely: 'Paris' (2:45), 'Prague' (2:04), 'Helsinki' (3:20), 'Christchurch' (3:17), 'Corfu' (2:49).

[19] The piece is *Donauwellen Walzer* (*Waves of the Danube*) by Romanian composer Iosif Ivanovici recorded on the corner of Kluuvikatu and Aleksanterinkatu, Helsinki, April 2011.

[20] These pitch/key references are approximate as the instrument was tuned sharp against a 440Hz reference.

of mental totalisation – but to delay it and arouse tension via the reinjections of sound energy as conflicting agents across the sustained E tone colour. Transient colours of A (1:47) and C (2:19) push across this in maintaining some tension as potential agents of interruption. The basic tonal stability 'borrowed' from the trumpet music offers a basis for syntactical closure, prolonged with interruptions at 2:05, 2:09, 2:14, 2:16 and 2:19. These five gestures (which I think of in anthropomorphic terms as attempts to cut across the stability of the continuous tone) could in themselves be considered a series of weakening attempts at interjection – clusters of attacks smeared or weakened in amplitude on each occasion. The gesture at 2:14 meets the pitch of the sustained tone, apparently absorbed by it, negating any possible interruptive effect. Further such elaborations of the ending are at several points where I anticipated heralding moments of closure – the noise sweep at 2:25; the quick tumbling gesture at 2:36 and finally the pulsing glissando at 2:43: all are falling figures, remembering that 'cadence' derives from *cadere* (to fall). In composing this part, something more felt right to draw out the resonant coda, but the fate of the work to close was sealed by the continuity of the E tone. Overall, then, we might characterise the design impression as: forming resonance – revelation (obscured) – disturbed resonance/interruptions – revelation(transparent) – accord – stasis/ interruption – resolution (figure 1), which might be interpreted with even broader zones implying phases of tension / windows / surprise / settling /dissolve. Because the first revelation is the 'dirty' window on the trumpet, followed an interrupted 'shadow' of the trumpet at 0:56, the sonic clarity of the second revelation (1:16) has a confirmatory function – physically we appear to be in more intimate proximity with it. The composition process led to the idea that, by realising a design impression with a sufficient mix of contour, variation and connectedness, a multi-layered but lucid sound journey could be created in a short form.

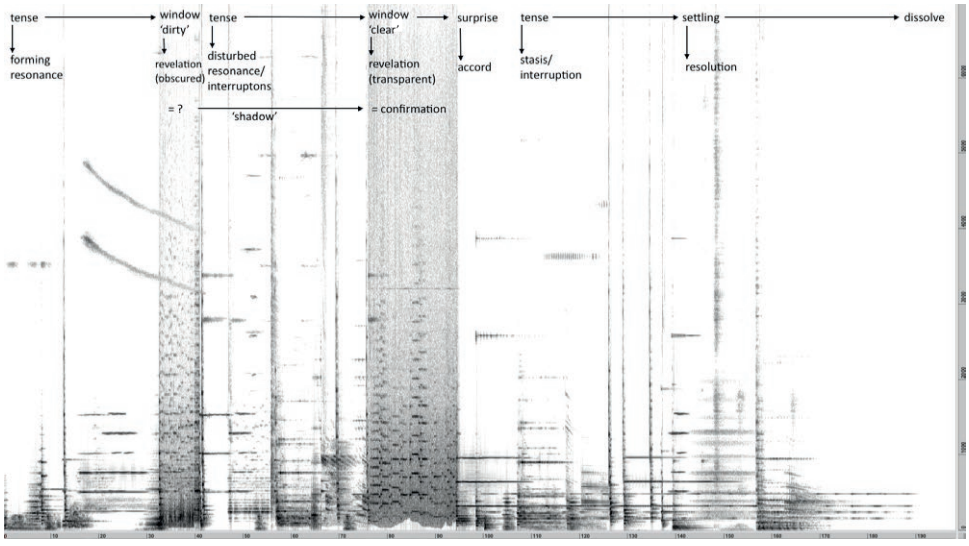

Figure 1.

Two related works by Natasha Barrett demonstrate an attempt to use something akin to the idea of a design impression to transpose formal scale, namely in *Racing Unseen* (1996) and *Racing Through, Racing Unseen* (1996). As the titles imply *Racing Through, Racing Unseen*, at three minutes duration, is a compressed version of material used in *Racing Unseen* (19:42 duration, in two movements of 10:21 and 9:21 respectively). Barrett's initial idea was to 're-scale' the main segments of *Racing Unseen* but found this to be '…impractical because proportional reduction destroys the timing and counterpoint of internal detail.' (Barrett, 1997: 94). *Racing Unseen* presents progressive envelopes of mixed sound forms in broad patterns of growth and decay, in which sound identities are masked and unmasked, often with material seeming to force its way through a texture through repetition. This is kaleidoscopic in effect, but the work's processes of apparently capricious textural massing and thinning, referential allusion and obfuscation emerge as features of a design impression. Such textures require time to establish and for the listener to 'hear into' them to locate and differentiate materials. Consequently, with a view to temporal compression, Barret's ultimate strategy for *Racing Through, Racing Unseen* was to identify the most memorable elements from *Racing Unseen* after one continuous listen and to re-mix them with 'only an approximation to the original sound chronology.' From a design perspective, Barrett's conclusion that, in terms of the original work, 'prominent material characteristics have a stronger role in the work than proportional representation' (Barrett, 1997: 95) is a valid observation. Nevertheless in *Racing Through, Racing Unseen* we find some common organisational features: loop-like repetitions that create a time-space to draw attention to a sound identity and rich amalgams of contrasting sound types – although, as a consequence of the use of reiterated cycles of sounds in *Racing Unseen,* that work projects a greater overall impression of intensity. Both works end with fades: and despite the disparity in overall length these are similarly paced. A breath/wind-like resonance ends *Racing Through, Racing Unseen* over a period of 20 seconds. That same material is the penultimate identity in *Racing Unseen* giving way to distant bell ringing which fades for 20 seconds. This rhetorical closure device is proportionally consistent between the two pieces.

Some further case studies

Denis Smalley: *Valley Flow* (1991-2)

Smalley (2014) says this of his *Valley Flow* (1991-92):

> The opening of *Valley Flow* is an example of what I regard as a fairly abstract sketch in spectral space that relies on slightly thin, distal spectral bands and ascending and descending contours – all of them what I call graduated continuant morphologies[21] –

[21] Smalley (1997:113) defines the graduated continuant thus: 'The onset starts gradually as if faded in, and the note terminates gradually as if faded out. In between, the note is sustained for a time.'

> meaning that they are relatively unpressured in their appearances and departures. The focus is on their graduated continuity. Graduated continuant or sustained strands and layers, whether high or low, are very useful for suggesting spacious expanses and over longer periods of time than is the case here – they can take on a certain timelessness. Here, [at the opening of the work] higher levitated spectral regions are outlined, using only a few sustained but grained strokes of sound. A sense of spaciousness is aided by the gaps between the lines and the glides among them. It is the entry of a lower morphological push that finally tells us more about the extent of the spectral space scale. This opening evolution of spectral space is primarily responsible for creating the basic spatial image of the piece.

This quality of unpressured spaciousness giving way to more pressured *interaction* of material can be situated in terms of Smalley's (1997) idea of a 'voluntary-pressured continuum' which characterises the behavioural dimension of 'motion passage' – a phase of shift in musical/material context. We hear this in *Valley Flow* in a way that has implications for the work's extended duration of almost 17 minutes. The opening elicits a kind of stately tension established through the gentle applications of pressure as the spectral space evolves. The very first sound is a shimmering pitch centred on 1615Hz (around G-sharp). While the widening of frequency content at a relatively slow pace (notably at 0:42 and more decisively 1:04) suggests capacity for extended structural development on the basis of spectral space alone. The remoteness of the opening sounds, for the first 40 seconds in particular – their apparent distance from the listening position, the ethereal effect of the graduated continuant and the slight instability in pitch centre – which in itself if taken as a doppler shift implies movement across the distal space – creates a kind of uncertainty, but perhaps also a suggestion of latent energy. By 60 seconds we may feel that the spectral expansion can continue to move toward some kind of saturation, but not indefinitely. Increasing intensity in amplitude and expansion of spectral space combine in an effect of sonic matter in increasing proximity to the listener. This, along with the audible impression of a registral void of about five and a half octaves (at 1:04) creates expectancy, in the order of: 'what kind of ongoing envelopment will I feel from these sounds, and how will the gap in the spectral space be filled?' The rising centre of pitch and spectral saturation is interrupted with an explosive gesture of impulsive sounds (at 1:48) which discharges tensions of the previous section but also introduces a cluster of new species morphological types. These are noisier, characterised by sharps attacks, a hollow vowel-like formant quality and evoke sensations of rattling or rebounding objects. From this we might register a sense of surprise as well as gathering some retrospective insight: surprise in that the material is of a new attack-based form with a sudden increase in the rate of change relative to that previously experienced but which, as the apotheosis of growing spectral intensity, could be construed as a close-up encounter with the obscure shimmering of the opening material (Young, 1996). From this initial section of *Valley Flow* emerges a process in which spectral space expands from a narrow seed to set up a dramatic contrast between resonant pitch-bearing graduated continuant spectra and rougher, impulsive sounds which presages an expansive formal development.

In context the graduated continuant spectra can be characterised as pitch-flavoured since they project a quality of resonant filtered noise and in isolation are almost never fully stable in pitch, betraying their likely origin in granular synthesis. Gliding noise-bands in the zone above 2kHz are often associated with such resonance, almost as upper formants (we become aware of this identity at about 0:36, and at 3:45) and a sparingly used low-frequency pulse at 3:05 and 8:08 (which we could retrospectively associate with the deep 'bounce' at 1:54). We might term these 'personnages spectrales' and 'personnages gestuels'[22] articulating a core distinction between materials and underpinning familial relationships among sounds contributing to the shaping of form as a series of transfigurations and interpolations. As examples:

– At 2:31 a flange-like attack initiates the co-existence of a series of graduated continuant resonances on a D pitch with more active sweeping noise bands and hollow attacks. There is a kind of play for dominance here with a sharp noise attack at 2:55 failing to subdue the repeating resonances. A more powerful attack of inharmonic resonance followed by a further noise attack dragging the spectral space down to a deep resonance brings the interaction to a close. At 3:35 the focus shifts to a higher stratum of vowel-like noise glides, with the D-flavoured graduated continuant persisting but pushed further from listening focus with a reduced set of partials.
– From 5:34 – 8:06 tension is established through a series of shifts in apparent pitch flavour. At 5:37 a B-flat centre is prominent since at 932Hz this touches a very sensitive zone in the ear's response but is also underscored by a recurring deep resonant mass with a peak response at approximately 29 Hz, in context creating the sensation of a B-flat root. At 6:26 attention is pulled upward toward an E pitch flavour, but with a more decisive turn to a G-rooted spectrum (tones at 392Hz and a notional 3th partial at 1178Hz form an outline for that flavour).
– At 7:41 a more powerful surge reasserts a B-flat flavour, swamped by a denser more ambiguously focused crescendo at 7:50 (B-flat and E are key flavours). At 7:56 a shadow of the hollow-rattling identity gently rises in the form of a graduated continuant, suppressed by a resonance which decisively conveys a B-flat spectrum to close the phrase. Woven above this unfolding interplay are gliding resonant noise-bands that corroborate in the flow of gestural energy but also function to cloud precise identification of shifts in pitch centre.

I have offered this sketch of some sections of *Valley Flow* to indicate the kinds of slow evolving interactions between distinct sound types which unfolds as a design impression of dominance-subordination between the principal agents of pitch and noise. The nature of these interactions as expanding over an extended timescale is prompted by the way materials unfold in the first two minutes, which is to say there is a necessity to allow the ear time to enter into the network of spectral characters and their mixes. With another nod to Messiaen one might think of this form as one derived from a process of arrangement of variations in material typologies.

[22] A reference to Messiaen's notion of *personnages* as defined agents that undergo change in the course of an expanding a musical argument. See Healey (2004) for a resumé.

In contrast to *Valley Flow*, Smalley's *Sommeil de Rameau* (2014-15) is less concerned with morphological contrast and drama, revolving more around slow spectral integration and colouration. A stimulus for the work was the sleep scene from act four of Rameau's opera *Dardanus*. Smalley reflects the rondo form of Rameau's scene with an episodic structure marked by varied chordal refrains. Three chord patterns are employed: an oscillating D-flat/G-flat minor (1:20), a diversion of this to a diminished seventh sonority (1:30), and a cycle of fifths progression revolving around an F minor sonority (2:32). They are realised in a way that characterises the overall musical flow, with slow onsets sinking into rich sonority reminiscent of viols, emerging from and shrouded by a range of coloured noise-clouds. The work opens with what we might initially predict as a graduated continuant but unfolds upward over the first 30 seconds through an initial focal pitch of F (perceptually at 349Hz) towards a canopy pitch four octaves higher (around 1397Hz). Each of these focal tones is pulled at by a pitch a semitone lower, and the figure of a rocking semitone continues to be a feature as the work progresses.[23] Still, this is an oversimplification of the initial stages of the piece as other inharmonic frequency components and wisps of noise colour the work's spectral spaces. This choreography of spectral space with emergent zones of focal pitch, as though illuminated gently by a spotlight, infers a potential for further such revelations out of the rich spectral architecture. There are three episodes, the first two (4:41 and 7:22) are marked by more transparent spectral textures, the first with a relatively stable B-flat minor flavour and the second with more undulating tonal movement. The third episode (9:55) is the longest and most complex, with the relatively remote tone colour of E (at 10:08) setting off a canonic effect of falling semitones at the major second, spawning the section with the greatest tension in the work. In previous sections many of the definable spectral constellations were conjoined by a common 'pivot' partial, but in this section the ear is drawn to falling semitone partials, especially from 11:30 such that, in particular, a progression at 11:58 from an A minor to G-sharp minor flavour has a remarkably novel quality in the context of the work. In these stages the tonal shifts and moments of spectral illumination, such as the luminous A harmonic sonority at 12:43 are remote from the work's earlier cyclic harmonies. But the falling semitone voice-leading finally leads to the familiar rocking D-flat/G-flat minor resolution at 13:25. As such a design impression would consist of: spectral forming/chordal refrains/episode (stasis)/chordal refrains/episode (rocking)/chordal refrains/episode (remote)/chordal refrains. In the scale of the work the brooding emotive effect of the refrains is a key factor – they occupy time playing out at a slow rate, and the deployment of three chord patterns allows for their melancholy affect to be sustained by variations in presentation. The episodes necessarily balance that measured quality, with the more extended and tense tonal wandering of the third episode lending an especially profound twist of tension to the form.

[23] The intervallic structure of the chordal sonority at 0:14 bears resemblance to a point in an earlier work by Smalley – *Pentes* (1974). The drone in *Pentes* at 7:22 contains two semitones a major third apart: G/A-flat and C/D-flat, mirrored by B/C and E/F in *Sommeil de Rameau*.

Noto: *kristallgitter*

Noto's [Carsten Nicolai's] album *Autorec* (2002) comprises twenty tracks of varying duration from 14 seconds to 8:19. In these pieces we find granular shards, streams of iterated pulses, sine tones and filtered noise, often placed in very sensitive regions of the ear's response, which tends to reward moderate to low levels of audition and brings to the experience a powerful sense of intimacy with the sound. In some, a particular colour or sound type is focal, and in the longer works contrasting elements coexist. The pieces have an inscrutable quality such that time seems to stand still, and the question of a teleology is made to feel irrelevant. But the pieces do rest on patterning and an awareness of register, sound-shaping and timbre as differentiating factors in these hypnotic sound ecologies. The work *kristallgitter* [crystal lattice] creates the impression of a layering of static elements which pass and connect in quasi-cyclic fashion using a range of clicks, pulses, continuous tones and bursts of broad-band noise. At the outset a sharp click, a buzzy graduated continuant spectrum of partials harmonically related to G (100Hz) and a slightly resonant deep pulse at around a C-sharp (ca. 34Hz) are interleaved to form the impression of a triple metre at approximately 90bpm,[24] with a more rapid click element introduced at the half-way point. As the work progresses, a periodically arranged set of clicks, buzzes pulses together spanning the entire audible range create a spacious texture. A one-second-long wide-band noise burst punctuates at seven unequally spaced points in the flow, and also serves as a boundary marker for new material. Continuous tones, mostly harmonically related to the 100Hz, float across this texture but barely interact in any sense of voice leading (the closest to that being between 1:00 and 3:00). There are subtleties of organisation, and perceptual curiosities. For example in the low frequency pulse left and right channels are out of phase which influences spatial localisation. The first entry of the 100Hz tone at 12.3 seconds has the effect of refocusing the sense of pitch in the low pulse, bringing it perceptually more into alignment as a D tone, which is to say harmonically related to the pitch percept of the 100Hz tone. Amplitude modulation and phase inversion of some pure tones (100Hz and 400Hz) imparts spatial 'life' and, as one would expect, the spectral spread and porosity means some very divergent impressions are imparted on different loudspeaker systems. Although sequential in structure, the design impression of *kristallgitter* as a form in not linear. The duration of the first 100Hz tone is two minutes, placed within the pulsing texture and with minimal change around it. The ongoing impression is of a series of almost-still frames offering new angles on an object of scrutiny. This produces an almost zero-scale form: it could continue with many variations of the basic textural-spatial formula. A canopy of faster pulses appears at 3:00 and the low pulse disappears at 3:48 for one 'period' marked by the noise band; tones establish new listening horizons but none contribute to a definitively teleological sense of form. A shorter form is imaginable: if the durations of the frames were compressed, and the pure tones made to overlap, a more tangible

[24] Coliis (2008) finds a connection here with traditional and contemporary dance forms.

design impression would form. And yet it is compelling listening – the durations of the sections/frames are just of an order that time appears to stand still. An ending is contrived with the reduction of the texture to 400Hz and 100Hz tones together with the buzzy graduated continuant – the latter two fading to a slightly reverberated noise burst punctuating the end.

John Young and Simon Perril: *Sun Deck Set Cogitation* (2022-23)

The sound installation genre has been characterised as one forming negotiations between space and place (Ouzounian, 2008). Installations may, for instance, be site-specific by intervening on or drawing attention to the inherent sonic features of a location, position sound in 'non-spaces', co-opt the audience as participants through direct play or responsiveness to their mere presence, or exist as a trace of a performative process. As Bandt (2006) and van 't Klooster (2017) note, a distinctive feature of installations tends to be their presence over long timescales in which audiences are likely to engage at will with potential to make return visits, as in a traditional art gallery or other public or sequestered area. This has consequences for the experience of the sound installation as form: beginning and ending may not be distinguishable – whether merging into the daily lived experience of a place, or as an exhibit in the rarefied space of a gallery – the conditions in which a complex teleologically framed musical argument is followed to its end are compromised. A listener may enter and leave at any time – we might think of the form as being synonymous with, and as varied as, as the conditions and pattern of each auditor's engagement with an installation. Beyond questions of form-as-object, form-as-process, and form-as-read by the listener, form is then shaped by the behaviour of the listener arising from their engagement with the space of the work as well as the space in which it is placed. With that in mind *Sun Deck Set Cogitation* (2022-23) is a sound installation I created in conjunction with poet Simon Perril. It is an acousmatic setting of the first set ('Promenade: Deck One') of Simon Perril's poem *Sun Deck Set Cogitation* which is derived from textual treatment of the contents of a descriptive text by Claude Lévi-Strauss, namely the *Written on board ship* section from the 'Sunset' chapter in *Tristes Tropiques* (Lévi-Strauss , 2011: 62ff). Perril's compositional approach took impetus from Lévi-Strauss's observation of the intricate nature of dandelion seed heads (Wilcken, 2010:114). Via improvised 'riffs', drawing words from the Lévi-Strauss text through freely spatialised scanning of the page, a new text was constructed. In this process Perril regards the treatment of the source texts as 'scattered and recombined word-seeds in surprising combinations: akin to blowing on a seed-head and spreading palimpsestic filaments.'[25]

[25] A key influence on Perril here is Tom Phillips's *A Humument: A Treated Victorian Novel* [1966-2016] which transforms the contents of a neglected Victorian novel (*A Human Document*, by W. H. Mallock) through processes of textural erasure by transforming the original pages through overpainting, cut-up and collage to form entirely new textual constructs, see https://www.tomphillips.co.uk/humument [accessed 4.12.23]. See also Macdonald (2009) for an outline of erasure poetics.

The result is concentrated text of paratactic verse, continuously and playfully descriptive but without a consistent or central subject or object. The first four stanzas of 'Promenade: Deck One' are as follows:

for one omenon
according morning
clear speculation aspect

betrays concrete
oscillates indivisible incidence
mixes more different

an overture at the end
the face of immediate weather
lowering rain

the early during
frothy guarantee
meteorological as rest

A cognate process was applied in my acousmatic treatment of Perril's recorded reading of his text. The vowel components of speech were erased from the recorded reading, paring it down to a skeletal outline consisting only of consonants, breath and other incidental noise elements retained precisely in their original positions.[26] There are 16 variations of exactly the same length, constructed around this 'ground' to make up the work, forming a 92-minute cycle in total. Each cycle consists of a randomly ordered non-repeating sequence of the 16 variations. The rhythmic framework of the ground, whilst always present as an underlying marker of time, is not always clearly perceptible as it is subjected to layers of spatialised digital smearing in the form of spectrally focused reverberation and granulation across a circular octophonic field. Layers of direct and processed signal provide points of initiation and connection for materials woven around it – for example particularly strong plosives are frequently used as attacks to trigger another sound woven into the texture, comprising strata of found environmental and domestic sounds and digitally synthesised sonorities. There are consistently applied forms of sound manipulation across the variation space – for instance impulsive sounds, such as particularly sharp consonants are formed into repetitive chains that mark out defined spatial trajectories, and selected words have their steady state time-stretched to form resonant envelopes which can then align with other pitched abstractions while retaining connection to their textual-vocal origin. Recognisably complete fragments of Perril's text (fragments of fragments) are woven into several variations and precisely aligned to their cognate points in the stream of consonants forming a palimpsest of text and com-

[26] Sound example at https://on.soundcloud.com/323a7 (see music references for all examples for this work).

posed material. By imposing this additional erasure process, new aphoristic micro-texts are produced which, through the continuous persona evoked by the presence of the voice, can be read as commentary on, and conversation with, the enveloping soundscape.[27] As noted above, around the many practices of sound installation, a common issue is the transience of the audience. A key formal consideration was the problem of creating a compelling experience for a transitory, ambulatory audience, and to address that by balancing micro and macro formal considerations. The aim was to form each variation with a distinct character, but to project common sonic/textual elements to evoke macro-form arches and patterns perceptible within the randomised order of variations. Strategies included repetitions of specific word-seeds (whether presented overtly or obscured through 'cut-up' via granulation or envelope substitution)[28], projection of recognisable models of spatial behaviours, floods of resonance linked across the work through familial resemblance, and elongated vowel forms drawn from words discernible in many parts of the work.[29] In these ways the work is invested with a capacity to imply long-range narrative – which might encourage sustained listening – balanced with sequences of event structures that move and connect in ways that provide interest for short-term engagement.

In conclusion

There is growing recognition of commonalities between the materials and practices of electroacoustic music composers and film sound designers (Knight-Hill and Margetson, 2024). As well as in cinema, other electronically enabled forms of sound design are ubiquitous across mediated experience – gaming, radio, television, the web, advertising. But the creative shaping of sound into intrinsically standalone forms – not in support of acted out drama or in short bursts to illustrate or illuminate cinematic action – such that sound tells its own stories and projects its own unique capacity for meaningful expression is the distinctive domain of acousmatic music. For acousmatic composers to speak to listeners in powerful ways, working toward an understanding of the experience of music as connections between the shaping of sound and the scaling of form should remain key aims. In that spirit, I will accord Trevor Wishart the final words:

> One of the big experiences I have is you can't make the whole piece at once, you make it in bits and those bits sound really great, the length is just right, everything is perfect. But when you come to put it in the piece alongside the other elements, it usually turns out that it is too long. So in the context it has to be shortened. And I do that by just listening over and over again. (Knight-Hill and Margetson, 2024:177).

[27] Sound example at https://on.soundcloud.com/tuRhR

[28] Sound example at https://on.soundcloud.com/bmPt7

[29] Sound example at https://on.soundcloud.com/Yf6KP

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Space, Sound, and Acousmatic Music. The Heart of the Research

Annette Vande Gorne

The spatial projection of music for acousmatic listening – the sound in space – enables the space of the future to open up to a fifth dimension of expression in music: the space of sound.

The listening conditions of acousmatic music (with no real established sound source) approach those of a blind person, who senses space by close listening to the acoustic qualities of his or her physical environment. The ›eyes closed‹ approach abolishes the physical limits of the performance space, and it allows the imagination to deploy its spatial sensations.

Species of Spaces: The Four Main Spatial Categories

Four categories of space emerge from this particular practice of interpreta- tion and knowledge of the acousmatic repertoire: (1) the ›ambiophonic‹ or ›surround space‹ immerses the listener in a ›bath‹ of sound; as opposed to (2) the ›sound source‹ space, in which sounds may be localized; (3) the ›geometry space‹ in a work structures planes and volumes; and (4) ›space illusion‹, works in the traditional stereo format. The first three categories relate mostly to multichannel recordings. In contrast, the fourth category, the traditional stereo form, creates both a phantom sound source (possibly moving) and an illusion of spatial depth across the distance of two loudspeakers, regardless of whether that depth is consciously perceived as such. This sonic image resembles a film that displays spatial depth in the central perspective format on a screen.

1a – Ambiophonic Space

A space is termed ambiophonic if we cannot determine where sounds come from, so that the auditor is bathed in a diffused ambiance. Listening achieves a ›mixing‹ of all events hinted at. One can draw an analogy to Byzantine churches: these include domes covered with gold tesserae, which redistribute what little ambient light there is equally across the whole church, but the source cannot be localized.

Musica/Tecnologia, 18 (2024), ISSN online 1974-0050, ISSN print 1974-0042, pp. 35-49
DOI: 10.36253/music_tec-15335 – http://www.fupress.com/mt
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For ambiophonic diffusion, we surround the audience with identical speakers, relatively equidistant to each other, so that there is no acoustic ›hole‹. The encircling takes place in every plane; the sphere is the ideal model. If the audience is encircled on only one plane, then the circle be- comes the appropriate model. Dolby and THX cinema systems can also be classified in this category: three different channels at the screen but the sides and rears share one or two channels. The sound projection should be done with identical loudspeakers surrounding the audience. There should be only little movement realized with the aid of the console.

1b – Divided Space

Unlike general surround space, which favours the same type of sound positioned, with a few variations, on several loudspeakers, and spatialised in a unified global movement (like the octogris software), divided space allows a polyphony of different sounds and a superposition of diversified movements, in an encompassing and unified perception of space.

Unlike pointillism, spatial sources are not precisely heard. Space is globalised. It is, however, permeated by small internal movements that bring it to life and make it vibrate. It immerses the listener in multiplicity. It can be compared to flux, in the taxonomy of energy-movements.

The dome projection instrument seems to be the best spatial configuration because it is associated with an envelopment (bath) of sound, and therefore ambiophonic in all dimensions, including height. The perception of auditory space in height is almost as precise as angular perception (the circle). Spatial division is conditioned by the multiplication of output channels: 16 at least (8 and 8).

The expressive capacity of such a domed device at the time of compositionn is very varied:
overflowing: an accumulating figure of space.
Multiplied internal movements: wave-like figures of space, rapid alternation, distributed breath, etc.
Dramatisation :surprise :figures of space: incrustation, appearance/disappearance.
Dialogue (spatial antiphony).
Action/reaction: clarification through space: triggers/resonances
Superimposition (spatial polyphony) in different planes: figures of space: accumulation, unmasking, filling/emptying.
Superimposition (spatial polyphony) of different movements, paths and geometries.
Realism (false landscape): figures of space in accumulation

2a – Source Space: Pointillism

In contrast to the previous category, the ›pointillist‹ type of space pinpoints the source of the sound, which can be monophonic, two track, or multitrack (but not ste-

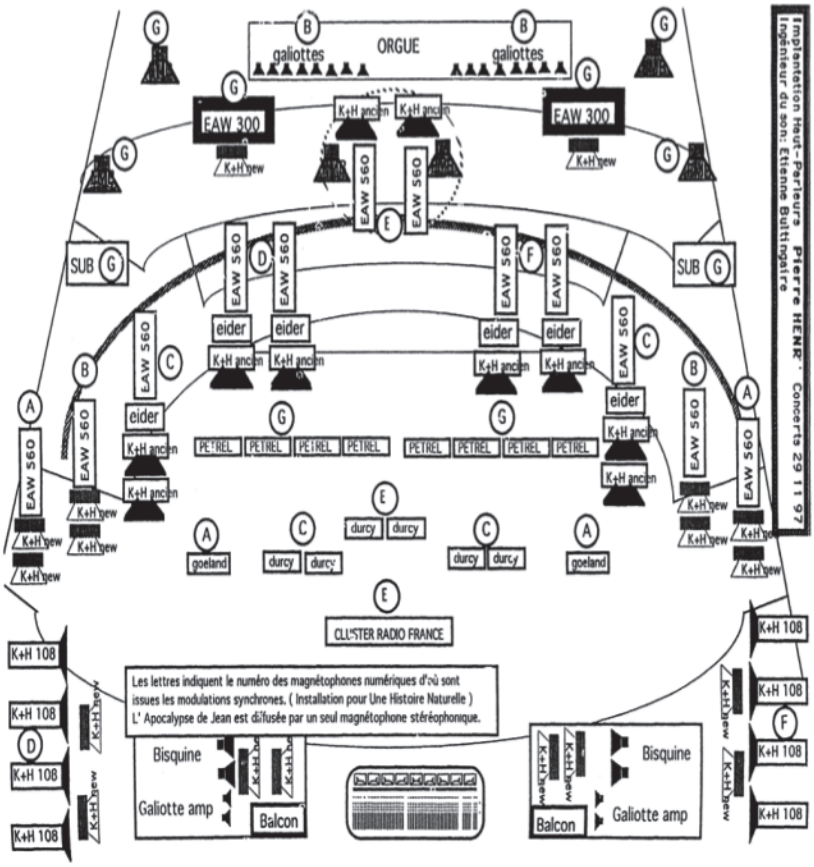

Figure 1. Loudspeaker distribution of Pierre Henry's Histoires naturelles, Paris, Radio France, Olivier Messiaen Hall, 1997.

reo[1]). The movements and the localization of the sound are what matter. We may also want to make the audience feel the differences in colour and power of each speaker.

Pierre Henry was probably the first to explore the musical possibilities of this philosophy of space, during both the compositional process and the concert. In this context, he often contrasts the right and left channels and tracks (›biphony‹) using the geography of the space as an organizational principle (cf. Figure 1). Today, the most common use of the source space is the multiphony from a multitrack player.

Creating a source space involves placing sounds with attack transients sufficiently delineated for localization, even if these transients are very short.

The composition then becomes a pointillist environment, playing with mass- es, the occasional phrasing, and variations in density. Multitrack dialogues and sequence overlays assigned to the same speakers are another kind of this source-space aesthetic,

[1] In contrast to stereo, two-track recordings have different sounds on each track, while stereo works carry interrelated information on their two channels.

which highlights sonic characters or counterpoint.

Sound projection can work with identical or with a diverse range of loudspeakers, selected according to the musical situation. Only little movement with the console is required for realizing this type of space.

2b – Source Space: Movement

Anything in movement is also part of the source space, an audible trajectory in ›outer space‹, generated by the interpreter or written by the composer on the multitrack tape (›inner space‹). As Aesop's tongue, the movement itself can be the worst or the best thing. Indeed, it has always seemed useless to try to save a poor composition, one without internal energy, by applying movements or external ›agitations‹. The movement remains mere ornamentation, not integrated into the music, nor is it justified by musical structure or phrasing. But if we consider the musical expression from the point of view of energy, the trajectories may strengthen the internal energy of the sound. Western music history is strewn with works that give importance to agogics themselves as a factor in expression (think of Claudio Monteverdi and his *stile concitato,* of word painting, particularly in the work of Johann Sebas- tian Bach or the *Symphonie fantastique* by Hector Berlioz) and a structural factor (Igor Stravinsky's *Rite of Spring*, Arthur Honegger's *Pacific 231*, Gi- acinto Scelsi, etc.). If you forgive a banal example, an orbit around the audi- ence, or any other pivot, will highlight to the ears any rotary motion of a spinning top, a swivel, or a repetition.

Finally, the application of a swinging spatial movement to a neutral, ab- stract sound gives it a special meaning, that of a lullaby for example. It may be recalled here how much time, space and motion are related: fast or slow rotations do not generate the same meaning, and if a rotation gradually moves to a faster tempo, it changes its shape and becomes a spiral. This movement space would especially have an ornamental or metaphorical function to sustain: expressive sounds themselves in which it provides a spatial support. In the nineteenth century, timbre and melody maintained the same relationship.

Sound projection is based on identical loudspeakers in a multichannel set. The various colours and movements of this type should be strengthened or created at the console.

3 – Geometry Space

If we consider space from a structural point of view, we can imagine it as the intersection of different lines and planes, as surface or volume interspersed with lines that are bisected biphonically, obliquely, vertically, laterally, etc. From multiple sources (multichannel), think of the sound in terms of composition of the space (monophonic, two track, quadrophonic, triple stereo, dual quadrophony, octophonic, etc., or in any combination possible) applied to a single acoustic chain or to many, simultaneously or sequentially, in close or distant planes. This gives space the equivalent parameter status of the other four parameters. The movement is part of the form when it becomes a

figure, a repetition, a transition, a rupture, a trigger, etc. Here, space geometry is not a carrier; it is a real and abstract musical object that leads the perception of listening and structure, with its evolution over time.

This organized and controlled space requires a diagram of the diffusion system and the choice of the spatial patterns to appear on the tape, for exam- ple, within the sound systems of specific venues or installations. Too much complexity (number of tracks, the possible spatial variations) will affect the transparency of the architecture. My current perceptual experience is limited to four movements or four differentiated geometric spaces. The disposition *a priori*, writing space for itself from multiphonic point sources, generates a stabilizing musical thought that binds the space to the form, so once again, to time.

Sound projection of this kind has to work with identical loudspeakers and a diverse choice of situations by sequences.

4 – Illusion Space

This type of sound projection is based on the illusion of spatial depth and uses stereo technology and its capability to create so-called phantom sound sources (which may be heard in fixed positions or moving between a pair of loudspeakers), thereby building a sonic plane. The sound is no longer per- ceived as a real object, but as an image or as a representation. We enter the world of media coverage, a world of photos, film, video, radio, etc.

Technologically, phantom sound sources appear in the interrelation of two sound tracks. This must be considered throughout the entire chain of production, and the two channels should stay connected to each other. The creation of an imaginary space is based on multiple pairs of loudspeakers; each pair forms its own sound plane in the three-dimensional concert hall.

Therefore, perspectives need to be created and depth planes need to be multiplied, highlighted by multiple phase screens (pairs of loudspeakers), by their staged disposition in at least three positions (near, middle ground, and distant), and by at least three different types of spatial width (very large calibre, medium, and very thin). One may play different calibre registers on a single plane or in 3-D space to enhance the centre of a wide phase screen (static) or to effect a movement of expansion or contraction (dynamic).

The direction of the loudspeakers relative to the audience may or may not specify the contours of sounds as they converge towards one another and towards the centre of the cone of the audience's presence or, on the other hand, diverge as the loudspeakers project sound live. Conversely, the projec- tors may radiate the sound towards reflective surfaces indirectly, or fill the entire space.

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Sound projection of this kind has to work with identical loudspeakers and a diverse choice of situations by sequences.

The colour (i.e. the spectral response of the transducers, from low to hyper-high frequencies), also plays an important role. The transducers are di- vided into five families:

- the basses, called ›double basses‹ (10–400 Hz) in a very wide stereo that covers the whole field of the room, or in the centre if there is only one sub- woofer;
- the ›hollow‹ midrange (250–1000 Hz) is used to fill the space;
- the ›clear‹ midrange (400–3000 Hz) is responsible for maximum audibility of the message, and especially of the human voice;
- the ›bright‹ midrange (3000–8000 Hz) reinforces the presence of microscopic life of sonic beings;
- a multiplied group of very high-frequency loudspeakers or tweeters (8000–16000 Hz), which specify the edges. We will use small tweeters to refine the contours present in the audience. The very high pitched speakers or trumpets are used to help locate a set placed far away. The bass is diffuse. Speakers of poor quality (hollow medium) will smoothly play a role of diffuse mass (radiators).

All combinations of placement, calibre width, colour, and directivity give to each pair or group a different musical role, like orchestration: soloists (a pair of references, often in close and converging focal length), mass (distribution of loudspeakers in reflection, on a large area), referential stereo (large width calibre, all frequencies), double basses (bass), and effect (vertical stereo, ceiling, presence in the public etc.).

This projection instrument designed to enhance existing space on the tape (the internal space) and reach the imagination and emotion of the listener was developed by François Bayle in 1974, who named it an *Acousmonium* (cf. Figure 2). The last step of the acousmatic production, the *GRM Acousmonium*, counted more than 80 speakers by 2002.

The *acousmonium* of *Musiques & Recherches*, Brussels, founded in 1980, had more than 70 speakers in 2014. It combines the interpretation of the imaginary space with that of the multiphonic space source.

The sound projection works with a variety loudspeakers. Spatial figures and situations of the internal space need to be reinforced from the mixing console.

François Bayle, article »L'acousmatique ou l'art des sons projetés«*, Encyclopoedia Universalis*, Paris 1984.[2]

[2] reprinted in: idem, Musique Acousmatique, propositions... positions, Paris 1993.

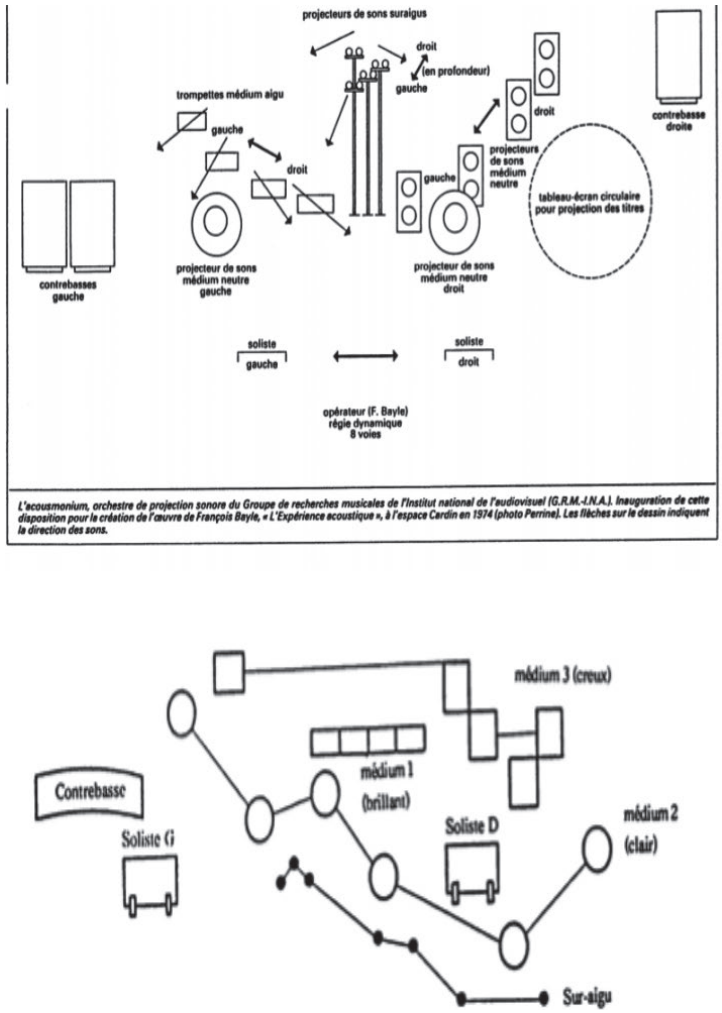

Figure 2. The first version of the Acousmonium, by François Bayle, Espace Cardin, Paris, 1974.

Spatial Interpretation: Stereo-based Spatial performance

The console of projection (fader, multitouch surface, interactive gestures, etc.) is a musical instrument, and its ›operator‹ is a performing musician.

This requires some virtuosity on the part of the interpreter, taking into ac- count not only the chosen speaker system but also the ergonomics of the sound projection instrument, stylistic knowledge of the repertoire, a graphic statement of the simplified works and relevant to their spatialization, and maximum memorization of the works.

The interpretation of acousmatic music tends to bind different spatial figures that reinforce the writing of the work; the figures highlight existing figures or create new ones. The stereo works also offer more freedom of choice to the interpreter. Sixteen figures are listed, with their musical function:

Crossfading

Crossfading is a slow or imperceptible transition of sounds between pairs or larger groups of loudspeakers. The gesture must be careful to avoid digging any acoustic ›hole‹. Start to move up the faders to be faded in before bringing down the first set of faders, and find a balance point.

Musical function: strengthening the existing crossfade on the tape by changing the plane or depth calibre. Draw a path by successive crossfades if, for example, this sound evokes a moving object (ball, car, plane, etc.).

Unmasking

This is a sort of ›upside-down crossfade‹ from a given mass; we hear the de- sired pair or group of loudspeakers by reducing the amplitude of other speakers or by removing them from the mix entirely. The gesture can be gentle, imperceptible, or brutal, using the mute buttons for example.

Musical function: to strengthen an existing unmasking effect on the tape, to change the plane or the depth calibre, or to impose a trajectory on the sound by successive unmasking if, for example, this sound evokes a moving object (ball, car, plane, etc.) and the starting spatial situation is a *tutti* or a mass encompassing the public.

Emphasis

This is the highlighting of a specific location (the soloists, for example) or a group forming a particular space, volume, or a new calibre, by slightly increasing the amplitude of the chosen speakers without modifying the others. The amplitude of departure (the basis) is important because it determines the overall level. We balance it from the stereo reference pair (also called ›the principals‹).

Musical function: this approach can be applied to a specific passage of the work or to a general strategy of projection, in which case we slightly open all the main faders (which thus provide the basis) and then we increase some points following the structure or sections of the work, the desired effect on the listener's perception. This is the general strategy used by François Bayle. Emphasis is a soft, light, and relaxed way to play on the console.

Sparkling

This figure consists of fast, cascading operations highlighting a given mass (and back). Random play of the amplitude within the acousmonium, play on the spectrum (by filtering) in the context of the *Cybernéphone*, developed by Christian Clozier at the *Institut International de Musique Electroacoustique de Bourges* (IMEB) in 1973. To ensure continuity, also keep some channels open and fixed.

Musical function: the spatial equivalent of a *tremolo*, to create liveliness ›inside‹ a thick and smooth mass by digging, or lightly increasing spectral and dynamic frag-

mentation. This can also highlight a moment composed by micro-montage or pointillist (granular) techniques.

Oscillation

Rapid and regular alternation between two loudspeakers or two groups of loudspeakers; the dynamic and the spectrum are subject to alternation. The effect of ›vibration‹ given by a very rapid regularity is only possible on an automated console. A low frequency oscillator (LFO) could serve as a controller.

Musical function: the spatial equivalent of the trill, agitation preparing an explosion, a burst, or otherwise, creating a lively reflux or a fermata.

Swinging

Slow and gestural alternation between two loudspeakers or two groups of loudspeaker; subject to alternation are the dynamic and the spectrum.

Musical function: highlighting the composed musical dialogue, delimitation of spatial landmarks, lullaby.

The Wave

A ›round trip‹ that runs through crossfades or successive unmasking gestures, a series of speakers in a line. For example, from the backstage to the front of the stage, or along the sides, or to the back of the room and back again to the front.

Musical function: the effect of moving mass and of predictable unidirectionality. This gesture has the advantage of joining a known agogic archetype.

Rotation

Circular trajectory between four speakers on stage or, more often, around the audience, with a gesture slightly highlighting each of the points by successive crossfades.

Musical function: evidence of the sound's internal rotation (then we must keep the pace of this internal motion) or creating movements to give, for example, a sense of confinement.

The Spiral

A circular trajectory onto which is applied an acceleration or a deceleration, where the endpoint would be somewhere other than the start.

Musical function: a preparation, an announcement, or a goal-oriented or conclusive trajectory.

Rebound

A quick jump from one point in space to another, from one group to another, or from a soloist to a group (and *vice versa*), by effectuating a quick, alternating gesture on the console or by using a set of mute buttons. The rebound is even more effective when both poles are distant.

Musical function: launch (or relaunch) of a triggering sound; going into another spatial region without any transition.

Insertion (Rupture)

In an area that has already been established, and over a sufficiently long period, a sudden shift or overlap (by unmuting) of a characteristic space or a different width. For example, inserting a directional solo of narrow width into a large and diffuse mass.

Musical function: a rhetorical figure, highlighting written inserts on the tape; an accentuation. The rupture can be used as an abrupt and contrasted departure to another state.

Appearance (and Disappearance)

An unprepared burst or closing from a different spatial state, superimposed on or following the preceding state. The use of mute buttons is the best way to proceed.

Musical function: surprise, ›magic‹, or awakening the listening.

Explosion

The sudden passage from a narrow or directional space to a large and environmental space: not diffused.

Musical function: highlighting an eruptive mass, or a characteristic and energetic morphology.

Accumulation

The successive addition of planes or calibres on top of each other to achieve a spatial *tutti*.

Musical function: the highlighting of a corpuscular sound material (e.g., grains) or the progressive enlargement of a frame.

Invasion

A rapid accumulation, an accumulative trajectory oriented towards the audience.

Musical function: similar to the Lumière brothers' *Arrival of a Train at La Ciotat Station*, an effect of subjective aggression.

Empty and Full

A game playing with the density of the stereo ramp, planes, or volumes. A stereo ramp bounded by two distant speakers seems ›empty‹ or transparent, compared to the same thing when it is filled by other pairs of loudspeakers

placed on the same front (as in the case of wave field synthesis, WFS). The same choice is also possible between depth planes or volumes that incorporate an additional dimension of height, away from one another or filled by intermediate loudspeaker pairs.

Musical function: to clarify or strengthen a sonic mass, akin to a symphonic orchestration. Note, however, that a spatial *tutti* destroys any sensation of space.

The Multiphonic Spatial Performance

The interpretation of multiphonic works raises new requirements, both in terms of technology (including drivers, interfaces, and types of transducers) and in terms of aesthetics. This becomes evident in an examination of interpretations of stereo works.

Today, the means of access (for example, multitouch tablet) and multitrack recording of a sound or sequence, in real time, allow for greater accuracy of trajectory and positioning in space. Each sound can receive a precise spatial identity in the studio. Space truly becomes a musical parameter equivalent to others, if the composer so desires. In concert situations, however, the interpretation is less free and creative than in the case of a stereo work. Unless we multiply the total number of loudspeakers by eight – octophony has become a *de facto* standard in electroacoustic music – with one group of eight loudspeakers controlled by a single fader (cf. BEAST in its second version, for which Jonty Harrison has completed a piece of 72 channels [*BEASTiary*], is the precursor system), it reduces the possibilities of choice in the play on the projection console and it also decreases the diversity of colours offered by the *acousmonium ›à la française‹*; indeed, to fulfil the spatial balance of the composition, we must give the same colour, so the same loudspeakers in each group. The *acousmonium* used at *Musiques & Recherches*, Brussels, solves these two requirements (diversity of colours and groups of eight speakers) with an *›à la belge‹* compromise.

Stylistic Aspects

Depending on the character of each piece, one can, for a different work space, focus on some aspect of the writing, for example, iconicity, movement, ›unmix- ing‹ of polyphony, phrasing changes, matters of subjectivity, or the fluidity of the trajectories.

- image, or iconicity: The ›phonographic‹ image is viewed, understood and reframed, and enlarged with appropriate dimensions to present its content. We do not give the same emphasis, the same calibre to an outdoor soundscape, or to a vocal character's portrait, or to a sonic representation of an interior.

- movement: The energy, the inherent movement in the nature of a sonic sequence or a thread, will be all the more apparent if it is translated by a correlated spatial movement of the same nature.
- ›unmixing‹ of contrapuntal writing: The mixing is ›stripped‹ from the original, after it has been analysed for specific spatial placement of types of sounds. If the writing gives more importance to an individual sonic element, this can be highlighted from a pair of loudspeakers inside a larger group.
- phrasing and variations: The structure of the work – its phrasing, rhythm, and variations – are made explicit by an interpreter who has internalized the work and who now ›relives‹ it, playing it with eyes closed, as if interpreter and composer were one and the same person. This is ›acousmatic modality‹ ap- plied to interpretation.
- subjectivity: Often, in works with text, for example, it comes to making the listener feel the internal situation of which a character speaks. A kind of
› subjective camera ‹, it is the balance between different points of space, de- fined and fixed, which the internal space (often reinforced by the tone of voice in the presence of a text) clearly differs.
- matter: The roughness, grain, or flow, the density and mass of the materials will be enhanced by the proximity, distance, number, and density of the loudspeakers.
- mobility: Create fluid and unpredictable trajectories by a set of successive crossfades separating stereo into two mono channels that are placed inde- pendently on different numbers, locations, and qualities of loudspeakers.

A New Profession: The Spatialization Interpreter

The concert stereo projection of sonic images on phase screens that are pairs of loudspeakers – this is undoubtedly the form of spatial interpretation that is most flexible, varied, and free. This new interpretative profession requires both experience and learning.

It takes the knowledge of the work, which may be helped by its graphic transcription and a well-founded knowledge of the response of each pair of speakers in the acoustic of a given space. The act of interpretation begins with the design of the sound system and its placement, the orientation and the role given to each loudspeaker, the ergonomic allocation of these on the potentiometers of the console. The interpreter then becomes familiar with the system and memorizes the configuration of the console to acquire gestural reflexes that are both lively and reliable.

Then, the rehearsal will take into account the internal space of the work, movements, highlighting speeds will increase, clarifying planes in the depth of field. I still assign other functions to the spatialization in the context of the interpretation itself in concert, as well as part of the multichannel composition in the studio. This is to clarify to the listener the structure of the work and its sections, for example, by attributing to each a different spatial configuration. It will then perform spatial figures within each configuration. This is also to strengthen the perception of memory games, by returning to the same spatial configuration or location with the resumed signal sounds or identical sequences in the different times of the composition.

Multichannel works, for which the writing space is already defined, leave, *de facto*, less freedom or fluidity for the interpretation in concert. The task, then, is to set in place the ratios of tracks on a system, of which the number of speakers is greater than the number of tracks, and to play varying combinations of groups, ensuring that all tracks are always audible: indicate in this design, the track number on the console of projection.

These are just a few aspects of the profession of the spatialization interpreter, which responds, just like any other instrumental discipline, to the combination of competence and performance: technical knowledge of the instrument, analytical and memorized knowledge of the work, and the desire of forward following the ›feeling‹ of the moment, the emotion experienced during the concert.

Levels of Composed Space

As for any musical element, the space of sound is attributed a level of musical function determined by the composer. Nowadays, technology allows for any variation in the use of space, from a micro-event (static or dynamic spatial location for each sound) to a macro-structure (whole spatial structure, dynamic or static, monophonic or polyphonic for each section, phrases, or group of events). Among other possible levels, I have selected the following six that, to me, are particularly useful and expressive:

- The abstract level of space, conceived of planes, volumes, movements, or ge- ometric figure.
- The structural level of space, used to emphasise sections, transitions, or recall.
- The decorative level of space, often in movement, added to an event to strengthen its meaning or temporary function.
- The figurative level, relating space to the imagination, the key feature, the metaphor.
- The archetypal level of some obvious space figures, such as the wave (rocking movement), circle (locked-in effect), etc.
- The ›madrigal‹ level of the expressive strengthening of elements external to the music itself (text, image, etc.): through figures, movements, and appro- priate spatial situations.

Abstract Level

In stereo, depth planes lighten and clarify the sonic orchestration, the mix. The space becomes an active agent, as well as terracing pitch registers and tonal colorations in orchestral writing. Spatial differentiations allow a form of variation on the same material.

Without going back to the 1950s and the 1960s (Karlheinz Stockhausen's *Gesang der Jünglinge*, from 1956, and *Kontakte*, from 1960) or 1972 (John Chowning's *Turenas*), abstract multichannel writing evolved in the 1990s, with digital 8-track player-recorders. In 1989, *Lune Noire*, by Patrick Ascione, composed and mixed at the *GRM* on analogue 16-track, 2-inch tape, installs a dual-space movement swirling

around the audience and on stage. The same year, *Terre*, the fifth element of Annette Vande Gorne's *TAO*, combines geometric figure spaces in and around the public on 8-track, analog, 1-inch tape.

Structural Level

The choice of movement helps to clarify a form or section, highlighting a particular moment. For example, a double-mirror section, of which events and materials are similar, but inverted spatial movement accentuates an inverted form, for example in *Yawar Fiesta, Act II, »Combattimento: sous les coups de ta croupe, et le lait de tes reins«*[3].

Ornamental Level

Space or added movement strengthen the interest of a sound figure. As with a *mordent* or trill, the path directs attention to perceptual elements among others. This space allows source-type »background and figure« writing. For example, in the first act of *Yawar Fiesta*, »Condor«, a circlular movement takes place on the word »Taureau«, in order to fight the bull.

Figurative Level

The imagination, which is based on recognition, recreates space, movement and location. In *Voyage*, from Annette Vande Gorne's *Paysage/Vitesse*, the movement from left to right is artificially applied to a cicada sound; what does one hear more: the source or the movement?

Archetypal Level

Certain movements, by their mere presence, qualify the meaning of the mes- sage, the context, and the communication. Examples for such archetypal movements are:

- the wave (as a representation of a round trip, a hesitation, a rocker), for in- stance, in the final monologue (»The Gods«) from *Yawar Fiesta*;
- the circle (as a representation of confinement), for example, the final mono- logue of *Yawar Fiesta*; and
- the explosion, for instance, in *Terre*, the first part of *TAO*, to express the pri- mordial big bang.

Madrigal Level

The abstract architectures of polyphonic music have evolved towards ex- pressiveness, thanks to the passage of the text and its immediate naive relationship developed

[3] *Yawar Fiesta*, acousmatic opera, (2009-2012) libretto by Werner Lambersy, music by Annette Vande Gorne.

in the 16th century madrigal. I aimed for a similar rela- tionship in my opera *Yawar Fiesta*, assigning this role to spatial movements, or spatial illusion. In the second act, *Combattimento*, the words »I dream« are illustrated with reverberation on all channels; the phrase »sound of your hoof« is depicted with rhythms on the fragmented words; and the sentence »We have fed our souls on it« is expressed with a movement far away in front and with medium-high frequencies on the word »soul«. Also, in the fi- nal monologue of the third act such ›madrigalisms‹ are to be found. So, for example, in the following sentence, »Here at least where words are sung all meet up again for the games « (full space), »[. . .] of darkness [. . .]« (empty space rear), »and light« (solo front center).

Conclusion

The spatial projection of music for acousmatic listening – sound in space – enables the space of the future to open up to a fifth dimension of expressive music: the space of sound.

Acousmatic Music and its Extension towards Instruments

Daniel Teruggi

It can seem contradictory to talk about acousmatic and traditional instruments as a component of the same intention; the basics of the acousmatic concept is that you listen to music without witnessing how sounds are produced, your imagination constructs the context, it becomes pure listening through sound images. What happens when there is an instrument which is playing at the same time, are we still in an acousmatic situation or else are we in front of what is often called a "mixed" situation, closer to the traditional concert music performance?

As it often happens, there is not a unique and only answer to this question, it mostly depends on the point of view of the composer and how he conceives sound and the relation of the instrumental sources and the fixed sounds. I am quite radical when discussing this point: *acousmatic* is *acousmatic*! It describes a listening situation more than a musical current. No visual aids (be it instruments or video or dance), only sound arriving to our ears through an array of loud-speakers. In 1993 I wrote an article titled; "What about acousmatics?"; giving a definition of what, to myself, the term meant:

> From an esthetical point of view acousmatic music concentrates on the poetical and spectral richness of sounds, and plays with this very particular characteristic of sound hearing in which the perception of an acoustic phenomena is associated with its cause; hence the perception of a sound whose cause is unknown or unrecognizable for our perception, induces the listener to imagine non-existing causes and to perceive music as a complex creative phenomena in which musical sense and musical sounds have to be interpreted simultaneously, with generally very little relation with our perceptive reality. The question is not to find out how sounds are made but how their combination will generate imaginary perceptions of imaginary realities in our mind.[1]

I tend to like this definition, it's more an explanation on how one should listen to acousmatic music and how our mind makes sense of this kind of listening. I also wrote in those days a different approach to it: Can I recognize something I listen to

[1] Teruggi, D. 1995. *What about acousmatics?* In Journal of Electroacoustic Music. Vol. 7. London: Sonic Arts Network

Musica/Tecnologia, 18 (2024), ISSN online 1974-0050, ISSN print 1974-0042, pp. 51-71
DOI: 10.36253/music_tec-15336 – http://www.fupress.com/mt
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as being acousmatic? Is acousmatic in the listening or in the intention? This is what I wrote in 1991:

> When questioning how would it be possible to determine that a music is more acousmatic than another, I would rather tend to direct my detective magnifying glass towards the way of thinking about sound and how it is used, rather than on the judgment of the result. Certain music by Ligeti or Xenakis "sounds" acousmatic although this intention never existed in these composers. Conversely, certain works by François Bayle (the case is rare, nonetheless) could be understood as being the product of very complicated instrumental writing, with some "special effects" added, which would be extremely distant from the composer's intentions.[2]

These writings are some 30 years old; I don't think I ever continued on this road of defining what is or isn't an acousmatic music. I have however many times in conferences and courses explained what the acousmatic situation is; and how we listen acousmatically, not trying to define what acousmatic music is, just explaining its functioning. This is because as I suggest in the second quotation, our ears may make us think we are listening to something acousmatic when it isn't, so I rely in the definition made by the composer, who may define his own work with different possible adjectives other than "acousmatic", as electroacoustic, electronic, musique concrete, cinema for the ear, electronica, fixed-sounds, tape, computer music or whatever term the composer considers more adequate to define his musical content. In any case, if I assist to a concert and there is no instrumental performing, only loudspeakers, I'm sure I am within an acousmatic situation, whatever is given to my ears to listen.

And here is where I can start using the word "extension"! I use the expression *extension towards instruments* as a way of enlarging the musical scope and at the same time indicating that I am abandoning the pure acousmatic listening situation, not pretending that there exists an acousmatic music with instruments, but considering it as an enlargement whose origin is within acousmatic thought and practice. However before talking about the extension, I would like to talk about the "magic" of the acousmatic situation. Some 70 years ago acousmatic was considered an unnormal way of listening music, since music was strongly associated with instrumental performance; the absence of performers was disturbing and considered a non-musical act. Since then, the situation has totally changed and listening only to sounds has become an accepted and widely diffused situation. There are also many acousmatic approaches which have diversified the limits of acousmatic music, this is why it is difficult to define acousmatic music and much more reasonable to talk of the acousmatic situation, which is what I say in my first quotation.

[2] Teruggi D. 1991 *Quelles sont les conditions*…, in Vous avez dit Acousmatique? collective work, Ohain : Éditions Musiques et Recherches, p19.

Instruments and their use of Sound

One of the great intellectual heritages of Pierre Schaeffer[3], but not only him, is that any sound is potentially usable when composing music. The realm of traditional instrumental sounds strongly increased during the XXth century and sounds from any origin were progressively used in music. For many centuries music was produced through a limited number of specialized sounds, produced by musical instruments; *specialized* means here that they were only used for musical purposes and were thus differentiated from other sounds, mainly everyday sounds. All other sounds were considered nonmusical or non-adequate for musical production.

The slow introduction of new sounds in performing music during the XXth century (new instruments, everyday objects used as percussions, etc.) was strongly upset by the arrival of *Musique Concrète* at the end of the forties. The fact that recorded sounds could be combined to make music was a totally new perspective for musical composition. This was followed by the use of electronically generated sounds in *Elektronische Musik* at the beginning of the fifties and these two tendencies marked a total renew of the musical fact and progressively of musical thought. It was not immediately a total revolution, initially limits were introduced as to which sounds were more "adapted" for music; however, at the beginning of the sixties it was widely accepted that any sound could be used for music, that it was the composers' decision as to which sounds were more adequate to his ideas.

What this revolution implied was that the technology of sound production followed the evolution of technology itself and that from sound-recording to computers, any new device capable of producing sounds could be used in musical practice. Any kind and type of sound is potentially usable in music, and *any* means *any*, no boundaries, no forbidden sounds or relations, music has developed an unlimited approach to sound where the only limits are those of composers' minds. We could quote Schaeffer here, speaking about Edgar Varèse after his death in 1965, he then said: "Like us, Varèse wanted to incorporate music into all the sounds of the universe"[4]. It is a wonderful way to turn the concept around; music goes into all the sounds…

Different roads to Sound

Two tendencies have developed since then: composers using technology as an expansion of the instrumental practice, and composers concentrated in sound listening

[3] Known as the founder of *musique concrète*, Pierre Schaeffer (1910-1995) was a composer, writer and pioneer of radio technology, notably creating the research branch of the Office de Radiodiffusion Télévision Française (ORTF), which he directed from 1960 to 1975. His main contribution to musical thought is found in his book: *Traité des objets musicaux,* first published in Paris, Éditions Le Seuil, 1966, the English version *Treatise on Musical Objects*, was published by University of Southern California, 2017.

[4] Pierre Schaeffer in the Television series*, Les grandes répétitions, Hommage à Edgar Varèse (1883-1965)*, 2e chaîne ORTF, program broadcasted on 20/04/1966, directed by L. FERRARI, S. G. PATRIS, n° INA: CPF 86622743.

and the effects produced when combining sounds without any visual support to create music. This last tendency, very active today, was called *Musique Acousmatique* during the seventies, by one of its strongest defenders: François Bayle. Composers may swim between both tendencies; they are free to bathe in any domain that will adapt to their musical intentions.

I am myself a strong defender of Acousmatic Music finding in pure sound listening a new realm of perception as described in my article of 1995[5], I enjoy the situation and find it has brought a new way of thinking and listening to music. As a composer I fabricate my own sounds and set them together to construct structures of increasing complexity; sounds can have any origin; actually, more than thinking in terms of sound, I think in terms of color and action or how sounds evolve through time, what is their behavior. Acousmatic composing permits to explore the limits of listening, inventing totally unheard sounds using any kind of sound source, transforming existing sounds to create new structures, using everyday sounds, using synthesis to invent new realities, using space as a medium to convey complex movements and invent "impossible" quasi realistic solutions that fascinate our ears and permit our imagination to discover unexpected reactions. Acousmatic music also permits a unique listening experience through Acousmoniums, which are large arrays of loudspeakers installed in concert halls or any kind of space and used to enhance music during a concert, a kind of performance where the composer or the performer adapts the sound of music to the hall and introduces spatial and intensity variations to sound.

Nevertheless, I am also very fond of instruments and the sounds they produce. Since any sound is potentially usable in music, this also includes instrumental sounds which may be considered as highly perfectioned "sound-producers" and can be used as recorded sources or on stage. In parallel to my Acousmatic works (circa 40), I have composed many works including instruments ranging from soloistic works to orchestral works (circa 30), always with non-instrumental sounds or invented sounds performing simultaneously with the instrument. This kind of situation in which on-stage instruments are performed with other sounds is often called *mixed music*; strange denomination because it is actually a mixed situation and not a kind of music that mixes other music. It is also called *live-electronics*; however, this denomination concerns more the fact of performing live with technological devices, with or without instruments. The way a sound situation is named depends largely on the composer; there have been discussions regarding how this kind of music should be called in order to create a specific vocabulary, however every composer names his music as he likes; either to make it clear to the audience what kind of sound situation he is using, either to differentiate himself from other denominations in order to create a personal realm that applies only to himself.

I name my music as *Acousmatic*, when it doesn't imply any live situation; and when using instruments, I use a rather obsolete denomination which is, for example, music for *Piano and tape*, referring to the ancient denomination of "magnetic tape", which actually implies recorded sounds on a media. I have been using this denomination for

[5] Ibid 1995

more than twenty years and up to today nobody has ever asked me what do I mean with the word "tape". In a more colloquial way when somebody asks me which kind of music I compose, knowing that the person doesn't know anything about this kind of music, I tend to say that I make music with my computer; "I create and design the sounds with which I build my music". Incomplete denomination that however seems to open some kind of imaginary door in peoples' mind. I am against no particular denomination; I just choose mine to communicate and let other composers communicate through their own conceptions.

What is important is not how composers name their music, but how they conceive the function of sound in their music and by extension how does the use of instruments imbricate with their sound ideas and define their works. There are actually two ways of "thinking" sound: sound as series of parameters where pitch, intensity and duration relations are highly considered; or as a material where its evolution, changes and timbre generates perceptual impressions. These two ways are not exclusive and of course all sounds have pitch, intensity and duration as well as timbre, evolutions and density; however, the important issue is what are you listening to, or what does the composer want you to listen to, where does he put his priorities which will influence the way the listener receives and reacts to music.

When I say I am an Acousmatic Music composer this doesn't only mean that I compose for "fixed media" (term largely employed nowadays to describe the fact that there are no performers) but that I privilege the impact of sound in the listeners perception. There will be pitches, intensities and durations but the main listening aspect is how sounds interact among them and create new and changing structures for our ears. This is why, when introducing instruments to interact with my "fixed sounds" (you will see that I wasn't always a "fixed sounds" composer, I used to work with real-time sound generation), even when writing melodies and rhythms, the "sound" aspect is primordial as well as the relation with the fixed sounds. As we will see in the following paragraph, many different situations exist in which "technologically produced sounds" can interact with an instrument. In an article written in 2017 I conciliate both tendencies with the following sentence:

> These two trends, expansion towards instruments and acousmatics, are not opposing forces, but two approaches to sound. One articulated on the presence of the performer and the strength and meaning of the live musical act, where music is created before our eyes. The other is based on the abilities of our imagination to construct an enriched perception of the sound phenomenon and transform it into musical power.[6]

Different ways of "expanding" Acousmatic Music

There are different ways of dealing with the extension of Acousmatic Music towards instruments. These are the five categories I identified in an article written in 2016:

[6] *L'invention du son*; Article written for the Catalogue of the Festival Musica, Strasbourg, 2017

1) Instrument and tape,
2) Electronic instrument played live,
3) Instrument processed in real time,
4) Instrument processed in real time with tape or recorded sounds,
5) Instrument controlling a device from sensors or according to the player's performance.[7]

I will quickly describe each situation so to analyze the different options a composer has. There is a previous situation which is purely acousmatic and this is the use of recognizable instrumental sounds within a composition; this can be the recording of an instrument performing a sequence or isolated sounds. Our perception immediately recognizes the performing situation and the listening is oriented towards the instrumental situation; the doubt subsists as if it is an acousmatic music or the recording of an instrumental music?

1) Instrument and tape

This is probably the oldest mode of interaction between sounds and instruments. It describes an instrument that plays with musical sequences made from composed and pre-recorded sounds that can interact in different ways:

a) Recorded sounds are played simultaneously with the instrument;
b) The recorded sounds intercalate between two instrumental parts.

As examples of these two approaches, the founding work is the first version of *Musica su due dimenzion*i by Bruno Maderna (1952) for flute, cymbal and magnetic tape as well as the interpolations for *Déserts* by Edgar Varèse (1953) as an intercalation example; work composed at the GRMC with the assistance of Pierre Henry. Without forgetting André Hodeir's short study for tape and piano, *Jazz et Jazz* (3'02) created by the GRMC in 1952 which is the first work int GRM's catalogue for instrument and tape.

It should be noted that the term "tape" indicates the initial medium on which the music was recorded: the magnetic tape. This name continues to be used today, even though magnetic tape as a technical medium has been abandoned for many years. Note also that the term also continues to be used in other languages: *Tape* (English), *Bande* (French), *Tonband* (German), *Nastro* (Italian) or *Cinta* (Spanish).

The method combining instruments with tape continues to be very widespread, mainly due to its ease of implementation. The technical means required are simple: audio file, reproduction device, amplification, and it does not require great technical skill on the part of the operator for it to work. Many performers perform concerts independently, ensuring the launch of files and the general balance themselves.

[7] Portraits Polychromes Number 23: *Hors-série thématique sur les Musiques Mixtes*, Paris Ina GRM 2017

2) Electronic instrument played live

In the early days of electroacoustic music[8], the only way to use different technologies was to record the result on a medium; the magnetic tape was the only medium to broadcast or have music performed. With technological developments, mainly the arrival of transistors, it was possible to design the first synthesizers at the beginning of the 1960s – this means devices integrating several modules producing sound signals within the same environment (oscillators, filters, generators noise generators, envelope generators), with the possibility of combining them and playing them live[9]. With synthesizers, a split occurred between those favoring the creation of works of electroacoustic music on a medium (Acousmatics); and those who, not satisfied with fixed-media, aspired to create music in real time.

Since the appearance of these first synthesizers in the mid-sixties[10] (Buchla, Moog, Synket, etc.), many composers began to use these machines to perform or improvise music (notation of patch configurations was not easy on analog synthesizers and was often limited to general instructions or descriptions of patches or combination of modules which defined the nature of the sound to be produced). These new tools arrived at a time when experimentation and improvisation were very popular and an important place was given to the performer in the creation of music during concerts. Among the first works we can cite *Silver Apples of the Moon*, by Morton Subotnick in 1967.

This trend continues to be very active, as evidenced by so-called "electronica" music, most of which is based on live improvisation on different devices and very often analog synthesizers, either vintage or reconstructed. The same evolution of magnetic tape was observed with computer-produced sounds. Initially, given the time required to calculate a sound, the music was fixed on an analog magnetic medium. With the evolution of the computing power of computers, composers began to work with real-time computers, the first large devices of which were developed at the end of the 1970s and beginning of the 1980s.

3) Instrument processed in real time

The next stage is that of the traditional instrument whose sound is captured and modified by an electronic or digital device. The sound of the instrument becomes a source for new sounds that are modified, shifted or multiplied through different analog and digital devices. The difficulty with analog devices used to lay in the difficulty of reproducing the same effect, due to the variability and unreliability of analog devices. But the gradual arrival of digital systems firstly through processing devices such as Harmonizers or Flangers, as well as the first digital delays and, after that, computers allowing several sound-processing devices to be programmed and combined, it was possible to ensure better reproductible actions.

[8] Although there were precedents, I place the beginnings of electroacoustic music in 1948 with the first "concrete music" composed by Pierre Schaeffer.

[9] The first synthesizers were mainly used in Pop-music.

[10] We certainly must mention the pioneers: Ondioline, Ondes Martenot, Trautonium, Hammond Organ, who from the 1920s offered innovative (and often bulky) devices for instrumental playing.

This modality was very successful given the coherence it created between the source – the instrumental sound – and the processed sound coming from the same source. This allowed and still allows to extend the possibilities of the instrument either by transposing the pitches, or by shifting the interventions in time until creating rhythmic structures or to modify the timbre of the instrument by adding other components to it.

Two major uses then emerged and continue to be used: the real-time processor as a tool for enriching the sound produced by the instrument, which allows spectral modifications or enrichments and complex shifts of the instrumental playing over time, or the use of the processor as a tool capable of analyzing parameters of instrumental playing and generating sequences of sounds complementary to or related to the playing of the instrument. The general objective of these two approaches is to expand the possibilities of instrumental playing to situations of great complexity where an instrument seems to be a soloist in the middle of an orchestra constructed by the sound of the instrument itself.

Nowadays, real-time instrument processing is relatively easy to implement. The capture and control tools as well as the programs which allow the processing are well stabilized and allow excellent reliability and simplicity of implementation. It has not always been the case; during the first experiments in the early 1980s, their implementation was very laborious and the reliability of the device, despite the digital tools, quite low. Gradually, experiences and uses have enabled easier practice and very high reproducibility and transportability of the devices.

4) Instrument processed in real time with tape or recorded sounds

A simple extension of the previous situation, which brings potential complexity, is the addition of either a tape or using the instrument to trigger recorded sounds. This modality makes it possible to considerably vary the sound context of the work by introducing sounds from sources other than those of the instrument. In some cases, by using sampling functions, played passages or fragments are recorded and triggered at other times, creating a sort of duet with the instrument itself.

The level of processing of the instrument can also vary greatly, we find situations where the sound of the instrument is slightly colored, a kind of scent different from a known sound. We also have situations where the sound of the instrument is completely drowned out by other sounds and, except for seeing the performer during the concert, it is difficult to recognize the initial source. This allows us to understand the great diversity of situations available to the composer in his technological work and the different types of sound balance that he can develop in his work.

5) Instrument controlling a device from sensors or according to the player's performance

This is the final stage, it implies that different capturing devices make it possible through the physical playing of the performer, or the sound produced by the instrument; to generate, control, trigger preset or improvised actions according to a series of constraints. This is the current trend where the composer will build a technological tool for processing, synthesizing or triggering, based on his own needs and his musical

project. The technological tool is directly part of the musical project and participates in the writing process, most often controlled by the composer himself.

In some cases, improvisation plays a very strong role in the musical result, especially when it comes to composers or sound artists who will build the device and play it themselves. Moreover, they can be instruments in the traditional sense, but also "sound bodies" which serve as sound generators which are subsequently recorded, modified and amplified. In the field of "electronica music", this type of situation is very common; the composer constructs an acoustic sound production device which gives the music a particular coloring and dynamic. Then, thanks to a subtle set of processing based on capture or recording of the source, he constructs a sound universe that can be an expansion of the original sound or a diversion of the sound towards other sound possibilities.

It is common to see in concerts several associated devices to process sounds played live or pre-recorded, synthesis devices controlled by external sources or prepared sequences which will be added to the rest. The composer and the performers decide at the time of the concert which devices will be implemented.

Who is in charge of a performance using technology?

In the first decades of electroacoustic music, composers worked with assistants during the composition process or/and during the concert. The musical assistant, as he is often called, fulfilled a complex and sometimes poorly recognized role, between a technician and performer, often having to improvise in order to make things work. Production conditions were often difficult and in contradiction with the traditional implementation of instrumental playing, where once the instrument is in place the performer arrives and plays the music. Here, long hours of installation and calibration of the equipment made the process slow and subject to considerable variations between each performance with technical risks for the outcome of the music.

The improvement of technology and the appearance of software specialized in real-time processing[11] have considerably simplified the implementation of processing devices. Also, recording tools such as microphones or sensors have been specifically developed to take into account production constraints and the particularity of each instrument. Therefore, it is much easier nowadays to imagine, design and implement a composition for a mixed environment. For complex and ambitious projects, a new technical profile has developed in expansion of the initial concept of musical assistant, which in France is called a RIM (*Réalisateur en informatique musicale*)[12] or musical computer director, responsible for following a composer from creation to concert by providing him with knowledge of the existing tools, and sometimes going beyond existing possibilities and designing innovative tools associated with a musical project.

[11] We can mention here software like MaxMSP, GRM Tools or Ableton Live…

[12] This term was first used by the Ircam in Paris to describe skilled musicians well in knowledge of the inhouse developed tools and working with composers who were often developing a research program

Composers have also developed strong expertise and many compose complex technological works in complete autonomy ensuring the production and the execution or clearly defining the context necessary for the production through the work by a third party. Here the question often arises of the portability or re-production of a work in the near or distant future with new technological environments; a completely new problem in the musical world where the conservation of means and concepts for the implementation is essential to the survival of the musical work. There are many works for which the production technology has disappeared and which are therefore technically non-reproducible; in certain cases, thanks to recordings of a performance, the technological environment can be reconstructed and emulated through more recent devices. The current trend in order to assure the re-production is to sufficiently describe the intentions and the expected result of the work. This permits to modelize the required actions carried out in order to have a clear description of the actions to be emulated in new environments.

The art of making music

Up to know I have described the different directions through which the expansion towards musical instruments can be developed. These descriptions tell us nothing about the musical intentions or the reasons for which a composer would choose such or such situation. First of all, there is the attraction a composer may feel regarding the use of extended technological devices to express his musical ideas; it is not indispensable to use technology, many wonderful music is composed on "traditional" instruments and let us hope this will continue for a long time since instrumental sound is one of the most wonderful inventions of humankind. Then, the questions are: what to do with technology, what is its function, which relation with instruments if there are any, what kind of sounds for a composition, which skills are needed?[13]

My impression is that the relation between the composer and the use of technology has also evolved through past decades. In the fifties, when *Musique Concrète* and *Elektronische Musik* emerged, well and less-known composers were invited to work in the recently created studios (generally inside a radio institution which was the only place where sound-recording technology was available), in order to discover the new possibilities of technology but equally to test the impact of the ideas among musicians and strengthen the importance of the studio. Many composers thus discovered the possibility of electroacoustics; I have already mentioned Edgar Varèse being guided by Pierre Henry and like him many composers that composed only one work as an ex-

[13] As I have suggested earlier, today composers are generally skilled in the use of computers and other technology. This is due to the fact that in general musical training includes the knowledge of technology which is a valuable tool for composers even when they don't use electroacoustics, just for writing their scores. Another important element also has changed the situation and this is the simplification of the use of software, not that software is easier to use today, but software has become increasingly "user friendly" over the last decades.

perience, like Olivier Messiaen (1952), Henry Sauget (1957), Darius Milhaud (1954) Earl Brown (1963) or Jean Barraqué (1953)[14].

Other composers walked into the studio and stayed there forever, here we mention once again Pierre Henry who arrived in the studio in 1950, when Pierre Schaeffer was looking for a young composer and Olivier Messiaen recommended this promising percussionist who became one of the greatest figures of *Musique Concrète*. Another extraordinary visitor was Karlheinz Stockhausen to the WDR studios where he composed some of his great works; he didn't use the concept of "acousmatic" he preferred the concept of electronic, but his works were indeed landmarks for many composers.

We also have to mention composers like Pierre Boulez or Luciano Berio[15] who independently of their experiences in studios in the fifties, remained attached to instrumental music and only in later years they started including live technology in their music. In the sixties the situation tends to evolve, many composers become interested in technology and the arrival of the first synthesizers accelerate the diffusion of this new practice; education also started to be interested and many conservatories and universities started regular training courses from different approaches, either acousmatic, or synthesizers or live-electronics. The sixties are also the period of the first computer sounds which would reach wide diffusion and use, at the beginning of the eighties, among composers and home users.

What I intend to say is that in early days few composers had access to technology[16], there were many assisted visitors to studios and only a few of them embraced electroacoustics as a musical choice. As time goes on and technology slowly invades our personal sphere, an increasing number of composers choose the electroacoustic way and dedicate themselves to this modality even from a young age. Many composers today don't have a traditional musical training, they just dive into technology as their first musical experience, it is not very expensive and there is at least an audience of friends or other composers available. Musical practice has thus undergone a strong change and the number of composers as well as the roads to access music have totally exploded.

How to compose with technology?

Nevertheless, the central question remains: what to compose? Technology is a mean which doesn't make composition necessarily easier; technology conditions the

[14] All these composers worked at the GRM studio, which until 1958 was called the GRMC (Groupe de Recherche en Musique Concrète), most of them under the guidance of Pierre Henry.

[15] Luciano Berio like Luigi Nono and Bruno Maderna were more than visitors! They created a Studio within the RAI premises in Milan which was one of the important highlights in the fifties. As other studios they invited composers like André Boucourechliev and John Cage to compose and to discover the possibilities of technology. Luciano Berio somehow renounced at the end of the fifties, he was not interested in the "acousmatic" situation, only when real-time technology was mature enough, he resumed his experiences.

[16] I use the word "technology" with a certain freedom; it ranges from old tape-recorders, to digital devices to any computer software one may think of.

way we think and make music and this is particularly present in instrumental music. When composing for any instrument I keep constantly in mind what the instrument can do and which are the limits of what it can do (I consider an instrument a technological object, evidently). When expanding music to other sounds, this implies new technologies, with their limits and conditionings however broad technological devices may be. Composers choose in which sound domain they want to work in: for many of them the instrumental world is largely enough and music will always find new ways of expression. Others prefer to "extend" the realm of sounds through different technologies in order to enlarge the performance or timbrical possibilities even to the extreme, as in Acousmatic music, of not using instruments and composing music with no visual or recognizable production device.

That is the first point; which technology should be used. This must not be seen as a life decision; composers may extend progressively their sound domain, from traditional instrument playing to extended performing techniques on the same instruments, to synthesizers, transformations or accompanied by other sounds… They experiment, change, choose and decide sometimes based on personal choices, others due to circumstances (as for example the availability of such and such device, or working with a performer that uses certain devices) generally having sound ideas in their minds and trying to achieve their musical conceptions.

The second point is what to do with any technology. What kind of relations between instruments and their extensions, what sound environments, which kind of control… Many questions and decisions composers have to undertake, which is not in itself a problem since composers *want* to compose. It is a part of the evolution of a composer to deal with all these questions and figure out which way to follow and what role do they want technology to have in their musical works. *What to do with any technology* is not only a question of relations and choices, it also reaches the way a composer writes music, his melodical, rhythmic or timbral decisions, his conception of sound produced by technological devices, his explorations in the sound of instruments. I tend to think that composers build a possible sound universe for their music, which may change or evolve but tends to remain coherent through time.

What are my compositional views then?

When I was a young student my theory book began with the following sentence: "*Music is the art of sounds*"[17]. This definition totally suits me; however, it is not clear what "art of sound" means: the art of combining sounds? The craftmanship of music? The art of transferring ideas to sound? Several possible answers of which I prefer the concept of an "art of inventing sounds with which to compose music", which is actually the definition I give when I talk about my own music.

[17] A. Danhauser, *Teoría de la música*, Ricordi, Buenos Aires, 1960. The French composer Adolph Danhauser (1835-1896) wrote his *Théorie de la musique* in 1872, and this book is still a reference today for studying the theory of instrumental music!

I started having a traditional but poor musical education. When I was 18 years old, I decided I wanted to be a composer, not knowing very well what that meant. I then started studying piano and musical training from scratch for five years, while studying Physics, which is what I originally had intended to study. At a certain point having acquired a tape-recorder, I started making sound experiments with the piano and other sound producers, improvising, playing in improvisation groups, composing short music for films and having a lot of fun with sound manipulation.

When I was 25 years old, I moved to France and studied "Musique électroacoustique et recherche musicale" at the Paris Conservatory for two years, in the course which had been initiated in 1968 by Pierre Schaeffer but which was in those days directed by Guy Reibel; however, Schaeffer was still present until 1980 when he retired. After that I started working at the GRM in 1980 and developed all my professional life there as well as in the Research department of Ina[18] until my retirement in 2017. This is, in a very short description, how was my professional life. From 2018 onwards, I've finally become a full-time composer.

In the meantime, I never stopped composing, mainly concert music, acousmatic (40 works) and with instruments (29 works), but also ballet, radio, theatre and occasionally music for films. As I said earlier, as much as I love the acousmatic situation, instrumental sound has always fascinated me and I regularly compose works with instruments accompanied with technologically produced sounds. This is one of the central points of my thought which means that I see the instruments as magnificent sound generators which perfectly contribute to the extension of the acousmatic situation.

It wasn't always this way, even if my first "mixed" work was for piano and tape (*E cosi via* for piano and tape, 1984); when I wrote the score, in my mind it was a work for tape and piano, and you can see this through the fact that the top score is the tape and the lower score the piano. Actually, I composed all the tape, leaving blanks for the piano and then I started writing the piano score, based on the sounds and action of the tape. It was really an extension from acousmatics to the instrument. That was my starting point, it would take several years before I went back to instrument + tape!

In the mid-eighties there were several large research projects running at the GRM and one of these was the Syter system[19], a real-time sound processor controlled by a mini-computer which was relatively easy to program and very powerful for sound processing. I worked a lot with this system being in charge of teaching its functioning to composers and having composed several works for instruments and real-time processing (the tape part of *E cosi via* was also composed with Syter). Two of my mayor real-time works *Xatys* for saxophones and Syter (1988), and *Syrcus* (1992) for percussions

[18] Ina: Institut National de l'Audiovisuel; in charge of the preservation of France's audiovisual heritage; also a center of production, training and research and containing also the GRM (Groupe de Recherches Musicales) which I directed from 1997 to 2017. I also directed the Research and Experimentation department from 2001 to 2016; department in charge of research in the preservation domain.

[19] For more details about the Syter system and technology at the GRM, see D. Teruggi: *Technology and musique concrète: the technical developments of the Groupe de Recherches Musicales and their implication in musical composition*, in Organised Sound: an International Journal of Music Technology. Cambridge University Press, volume 12, number 3, December 2007.

and Syter were composed using real-time processing of the sound of the instrument. This was a different situation; the sounding element was the instrument and the extension was the sound-processing which totally depended on the sound produced by the instrument; if the capture of the sound failed, all the transformation process would fail. The crucial point was then how to obtain the best sound from the instrument without any external interferences and avoiding feed-back loops on the loudspeakers, it was not a mere amplification but trying to capture the sound as close as possible to its production, including very subtle sounds.

Today, thirty years later, there have been many technical improvements in the quality and precision of microphones and loudspeakers which permit a better capture of sound, but at the end of the eighties, it was quite a performance to process instruments having to control the processing parameters on the computer with one hand, the input level in a mixing desk with the other hand, and assuring the sound diffusion in the concert hall[20]. I did this for 6 years, performing my own works and other composers works, I was the official "Syter performer"; and then one day I realized that every concert was a moment of great tension in which I was more worried about the technical result than in the musical interpretation by the performer and then decided I would stop doing real-time processing and go back to a more traditional situation of instrument with a tape[21].

There was a second reason for going back to tape other than the dependance on the sound produced by the instrument; and this was the diversity of processing that could be obtained. Even if the Syter system was very powerful, its action can be simplified to two points: either processing the timbre of the instrument, thus modifying the original timbre of the instrument and adding spectral components or modifying the spectra of the sound; either processing the evolution of sound through time based on a temporary memory that reproduces the sound after a certain lapse of time, with different types of modifications. And, of course, the combination of spectral and temporal actions. This could bring a certain redundancy in the processing and very subtle calibrations needed to be done in order to obtain results that would fuse and enrich the original sound.

I never got to the situation I described in point 5 (Instrument controlling a device from sensors or according to the player's performance), where the sound produced by the instrument controls other sound sources or interacts with the performance; maybe I stopped a bit early, however I'm extremely happy with the instrument + tape situation and have continued to explore this situation mainly with solo instruments but also three times with an orchestral ensemble.

[20] This can be a very tricky situation, you rehearse in a studio with dry acoustics and at a short distance from the performer; then you go to a large hall and things work totally different, all the amplification levels have to be modified and the diffusion in the hall adapted to the circumstance.

[21] I must say that I reprogramed these two works on recent systems in 2002 and then it was much easier from a technological point of view; more reliable processing systems (GRM Tools) and specialized microphones.

What possible relations between the instrument and its tape extension

If Music is the art of Sounds, which sounds are to be used when composing any work. That is the composers' choice, to decide what sound situation he will use in a particular work depending on his general ideas on sound and the particular sound situation he is going to explore. When it comes to choosing sounds, two important criteria can be the spectra of the sound or the behavior of the sound, but other components may intervene as the reminiscence a sound may have for the composer, morphological aspects of it, or how a sound affects our listening.

In my case a musical project is first of all a sound project; I imagine or start exploring a sound situation and then slowly build the sounds that will be the matrix of the work. When an instrument is present it tends to be (not always) the sound leader; this means that most of the sounds used in the tape part will derive of the sound of the instrument. In order to do this work, I work with the performer (when composing for soloists, I never composed abstractly for an instrument but always in relation with a performer of the instrument with which I experiment possible sounds) and record short sequences or isolated sounds. I then process the recorded sounds and obtain a large variety of sounds, often generating new timbers very different from the original source. This process of transforming the instrument sound has the advantage of creating series of derived sounds which are quite coherent with the original source, from a spectral and formal point of view. This creates "families" of sounds sometimes close to the original sometimes so distant that it is difficult to imagine that the origin is the instrument.

I thus create my starting material, which actually begun when I first recorded the instrument through the sounds and sequences that I asked the performer to play. Composition, for me, begins from the very moment you start imagining the music and conceiving the elements that will intervene. Then takes place the actual composition of the work, which means bringing together the sounds and writing the score. I used to separate these two processes, but more and more tend to do it simultaneously or only with small time-gaps.

The fact of advancing together is very important for me to avoid the *E cosi via* syndrome in which I first composed the tape, almost as an acousmatic work, and then added the instrument. The opposite situation, often encountered, are the works in which the composer writes the instrumental part which tends to be autonomous in itself and then figures out what can be added as a tape or as real-time transformations. Working both parts simultaneously for me guarantees a good complementarity between both parts. Among the salient works composed with this method, we find: *Summer Band*, for bandoneon and tape (1996); *Autumn Song*, for piano and tape (2008); *Struggling*, for percussion and tape (2000)[22]; or *Voix légères sur des flots* (2001), for children choir and tape[23].

[22] Percussions are in itself a sound world, so I tend to choose a group of then with which to work.

[23] Excerpts from my work can be found on Soundcloud under the name of **danter**: https://soundcloud.com/user-770526998

Over the last years, I tend to use as always the sound produced by the instrument but I also include other sounds with no relation to the instrument. This extension to other sounds enriches the expressive possibilities and diverts listening to different sound universes. A first attempt was done in 1995 with *Crystal Mirages* (1997), for piano and tape, and more recently *Una storia antica* (2021), for flute and tape; and *E basta cosi!* for piano and tape (2022). Every work has its own set of sounds which were "composed" only for that piece; even if many of the sounds are not used, in general I never use them again; one could say that those sounds are worn-out once they have been used in a work. I am constantly looking for and inventing new sounds…

The relations between instrument and its extension

Here we start talking of the relation between both sources, how they dialogue, or contradict themselves, or fuse so that no part is recognizable. I have worked different relations among both parts:

- The instrument is the leader and the tape expands or magnifies the sounds of the instrument in a duet relation, (*Crystal Mirages*),
- The instrument dialogues with its double in the tape, here non processed instrumental sounds are included to create an illusion of two instruments, together with other processed sounds (*Summer Band*),
- The tape creates a concerto like situation un top of which the instrument will be a soloist (the end of *Crystal Mirages*, *Una storia antica*),
- Both parts are totally compenetrated without fusing in a relation in which they are totally complementary, as if one were the right-hand and the other the left-hand (*Autumn Song*),
- The instruments are totally autonomous and the tape creates transitions between different movements; mainly explored in *Reflets éphèmères* for orchestra and tape (1997) and *Syrcus*,
- A dense and massive tape (actually almost an independent acousmatic work) is confronted to an orchestra which underlines and expands the rhetoric of the tape; the concept is that the tape is the general frame and the orchestra draws the details (*Sounding landscapes* (2007) and *Circling waters* (2011)[24],

How to make things work together

There are other more technical and practical considerations which are necessary to be taken into account when performing a work for instrument and tape. One of the most difficult issues for a composer is learning how to listen the result of his music; not listening with his intentions and ideas, but with his ears in order to judge the final result and detect any imperfection. This implies listening during the composition process and, as we will see now, in the performance situation:

[24] I could add here, something I have never used, the situation in which the tape is a long drone without any particular "soundmarks" on top of which the instrument freely plays or improvises.

- Spectral distribution of sounds. If the instrument and the tape work in the same spectral region, there is a risk of one masking the other; this may have the consequence of making it very difficult to equilibrate their levels. When functioning in different registers this assures a good spectral complementarity and clearness.
- The use of reverberation. Except for the piano, the harp and some percussions, most instruments don't have an internal reverberation; they function with the reverberation of the concert hall. If the complementary sounds have a strong reverberation, this will difficult the dialogue between both parts; some sounds will be sharp and the others damp creating a perception confusion. Unless reverberation is considered as a kind of halo which englobes the instrument.
- Amplification. It is recommended, mainly in large halls, to slightly amplify the instrument, this equilibrates better the sound produced by the instrument and those of the tape and permits to equilibrate both in intensity. Beware of a too strong amplification which may erase all the instrumental subtilities. In order to create a sound level independency between both sources, it is recommended to place the tape loud-speakers in front of the instrument and not behind (see next point). The tape is very effective and gives a strong clearness when coming on the sides of the hall, however trying always to obtain a good fusion with the instrument. A tape performer should always remember that the more distant the loudspeakers are from the audience, the more the acoustics of the hall will intervene in the behavior of sound.
- Stage returns. Performers have to be able to listen to the tape sounds, not through the general amplification for the audience but through specific loud-speakers placed near the performer. These loudspeakers don't have to be very big or powerful and low frequencies can be equalized so only medium and high frequencies will go through; this assures a good reproduction for the performer permitting him to identify important elements on the tape and at the same time doesn't interfere with the global level of the work.
- Stopwatch. I tend to ask soloists to listen to the tape and synchronize themselves in function of outstanding elements on it. Sometimes I even place landmarks so they can orient themselves. However, it is not always possible and, even if possible, it is always safe to have a stopwatch so the performer knows exactly his position in relation to the tape. The stopwatch can be triggered by the performer or else triggered by the tape performer or even by the tape itself.
- Click-tracks. If there are many tempo changes and very precise synchronisms a click-track is absolutely necessary. The performer feels at ease in this situation even if it can sometimes be slightly unpleasant for listening. In some cases it is possible to place the click-track one or two measures before a tempo change and then after a couple of measures silent it down. Performers are nowadays quite accustomed to their use and they will say which situation they prefer.
- Tape triggering. Tape can run all along the work or intervene in different moments, with eventually precise moments in which the tape needs to be triggered. The tape performer at the mixing desk can do the triggering or else the performer can trigger the tape with a Midi pedal. This guarantees a high precision in synchronization.

- Tape Score. How should the tape score be written? It can be a very simple graphic representation as a straight line indicating where it starts and ends, or a highly developed graphic drawing where all the sounds are represented. The difficulty lies in finding the good equilibrium between both ends; a simple line doesn't help at all the performer and a highly developed drawing may contain many unnecessary details for the performer. Personally, I tend to underline the strong moments in the tape, as crescendos, attacks or other landmarks and, of course, I always write the time indication from the beginning of the work or of the section, so the performer can also synchronize easily.
- Rehearsals. There are two kinds of rehearsals, music rehearsals and sound rehearsals. In the first case what is rehearsed is the performance of the work; in the second case it is the relation between instrument and tape within the concert hall which is rehearsed. If possible, the musical rehearsals should be done before the concert hall rehearsal, however often this is not possible and rehearsals become a moment of tension (hoping there are no technical problems independent of the work which tend to strongly reduce the duration of the rehearsal). During the sound rehearsal there are many things to check like the amplification of the instrument, the stage returns, the global amplification, the equilibrium between both sources.
- Making the work transportable. The circumstances of contemporary mixed music performance tend to the situation in which the composer is generally present each time the work is performed. But how to assure the fact that it will be played when the composer is absent or, as it sometimes happens, the instrument performer plays in different locations and assures the equilibrium of the instrument and the tape. What is difficult to define is the equilibrium in sound level between the instrument and the tape; this sometimes can be described (for example with a note saying that the instrument has to be heard on top of the tape at a certain moment, or, vice versa, the tape has to fuse or cover the instrument), however it may be very variable even between one section to the following one. In this case, it is wise, if possible, to have a good recording of the work, in which the composer clearly shows the desired equilibrium and clarity among both components.

Many of these points depend on the experience of the performer with mixed situations[25]; if they are experienced, they will have specific demands regarding stage returns or time tracking issues and will be at ease with click-tracks or MIDI pedals; if not, it can be a stressing moment because of the difficulty of playing with a purely sonic partner who "plays" with a totally rigid tempo and doesn't "listen" at all the instrumental performance. Probably the best performances are those done by performers who listen to the tape and are capable or reacting to it or adapting their performance to the sound levels of the tape.

Time is very tight in the organization of a concert with mixed means and often, mainly for a first performance, there is little time for working on the sound of the

[25] It goes without saying that it also depends on the experience of the composer who, beyond his musical intentions, will know the difficulties and ambushes when putting together an instrument and recorded sounds.

music during the rehearsal. However, this may be crucial for the success of the work because the way the two sources are equilibrated permits to clearly listen to all the aspects of the instrument and the tape without creating confusion. There can be a slight tendency to overamplify the instrument and the tape, thus increasing the overall level to obtain an equilibrium. From my point of view this is never a good solution because the more you increase the level, the more influence you get in return from the acoustics of the hall which may induces loss of clarity and excessive reverberation. The solution lies in the opposite action; bringing down the levels in order to improve the clearness and find the good intermediate level that will permit the best results. Easier saying than doing, it may be very frustrating that many details in the tape or an excellent dialogue between tape and instrument are "erased" by the acoustics of the hall.

Several aspects are essential for me in my creation:

When working with technological devices, I have some strong ideas about sound and the way sounds should articulate or evolve. This is not based on a theorization about sound and music but the result of experience and experimentation. Before ending this article, I would like to express them so to explain what attracts or interests me in my musical work. As I said earlier, probably the starting point is my pleasure in inventing and working with sounds; I have often compared it to the work of a jewelry maker who takes raw material and from it carves the stones, builds the setting for the stones and slowly builds a complex structure that is not only coherent but beautiful to observe. In any case this concept of beauty is very important for me; I want to enjoy my music and, if possible, transmit the enjoyment to the listener. Here are the main trends of my thought concerning acousmatic works as well as mixed situations:

1) The work on sound material, its richness and flexibility as well as its coherence, which makes me organize the work around a few basic sound elements that I will process and transform multiple times until obtaining a wide variety of objects. The treatments applied to the sounds, have been and are of very diverse orders, which can be done with tools already existing like in the GRM Tools, up to more recent tools. Each new work is a new universe of sounds, with its own rules and constraints, upon which the musical structure is built.
2) Pitch. Particular attention is given to the area of pitch. Toned axes articulate my works functioning as poles of attraction or repulsion, generators of movements or developments, often involving harmonic relationships to generate tensions. This is also valid in instrumental writing in which melodic and rhythmic aspects are used to generate homogeneous organizations.
3) The spectrum. This third aspect, more subtle for our perception, is the one which will condition the spectral balance of my music. This concept involves the organization of the sections of the work in relation to the sound material, its spectral richness and the connection of different sections to each other. The organization of the spectral balance throughout my works is intimately linked to the formal aspect

of the works; with sections highly polarized in a spectral region and sections where the entire sound spectrum is present.

4) The formal articulation of my works takes into account the aspects previously described. All my composition work revolves around projects designed over long periods of compositional time. The projects are imagined in relation to different kinds of material, instrumental, dramatic or spectral, and a continuous experimentation around different articulation concepts for each work. The material can have an important incidence in the structure of the work; my works alternate compositions with separate movements, or continuous evolutions through time.
5) Space. Since the arrival of high-performance tools and after the first steps in the 80s where it was difficult to control and reproduce movements in space, I have been working since 2004 mainly on multi-track works, 8 tracks most of the time with experiments in 30 tracks. What interests me is the movement of sound in space in a situation of circularity and being able to compose in a multi-track space similar to the concert presentation space, with tools that allow me to finely control the movements. The correspondence between type of sound, movement and perception of sound through movements, is another characteristic that I exploit extensively in my multi-track works, whether acousmatic or with instruments. The presence of an instrument provides a spatial polarity which allows me to move the sounds away from the instrument or position them as close as possible, to ensure spectral fusion.

And the audience in all this?

Through the slow evolution and expansion of the modalities of contemporary music, the audience has adapted its listening to changing situations and new reception possibilities. Mixed music plays on the musical action produced in a concert situation, with a percentage of risk and with the visual relationship that the listener establishes between the instrument and the non-instrumental sounds. As much as the game is clear with traditional instruments when it comes to causes and effects, in the field of technological music, it remains relatively mysterious. The same gesture on an electronic keyboard can generate a very subtle sound or a myriad of actions; the only relationship that remains is that of the gesture that triggers something. Nevertheless, musical activity continues to arouse great attraction; predominantly in mixed instrumental music where technology is positioned as an extension of the instrument, where the musical fact tends to reside in the playing of the performer. In many electronic types of music, devices of all kinds allow musicians to generate, in unusual situations, incredible sound worlds, which expands even more the musical and stage possibilities of music.

A recurring question that a listener may ask himself, is: why do you need a tape? And why do you need so many loudspeakers? Regarding the first point, probably the introduction of technologically produced sound in musical performance has been one of the mayor revolutions of instrumental music. It has changed the relation to sound and way the listener perceives music. However, the essential point is the will of

composers to go beyond sound, to explore new regions and to experiment with new musical situations. Regarding the need for loudspeakers, it is a question similar to that of "do you need so many violins" in an orchestra. Multiple loudspeaker arrays permit to use the concert hall space in a totally new way, breaking down the frontality of the musical act and creating a new perspective for listening.

I deeply enjoy composing with sounds; the art of sounds; and exploring unknown worlds for my pleasure and with the intention of sharing them with the listener. The listener is free to enjoy or dislike what he listens to. Ultimately, it lies in his point of view and in his interest to discover new sound worlds, whether played, written, improvised or mysterious.

The Genesis of Acousmatic Music - Espaces Inhabitables by François Bayle

Lelio Camilleri

In today's electroacoustic music scene, all music diffused through speakers is labelled as "acousmatic." In reality, it often fails to truly embody acousmatic conditions, as the mode of diffusing fixed-support music is frequently confused with authentic acousmatic music – a distinct compositional and writing form within electroacoustic music. I will endeavor to delineate these specificities, particularly in relation to the piece under examination.

In recent years, the concept of post-acousmatic has emerged – a phase in the evolution of electroacoustic music that transcends traditional acousmatic boundaries. The post-acousmatic phase implies the conclusion or surpassing of acousmatic conditions, a state that is not definitively consigned to the archives. Therefore, it would be compelling to both define the inception of the acousmatic musical journey and outline its principal characteristics in terms of sonic composition.

The term "acousmatic" traces back to the definition coined by writer Jerôme Peignot (1960) for Pierre Schaeffer's music, referencing the manner in which Pythagoras conducted his teachings: invisible and veiled behind a curtain.

As I mentioned earlier, there is terminological confusion regarding what can truly be defined, in terms of sound writing, as acousmatic; it is certainly not sufficient for the music to be fixed on a medium and exclusively transmitted through speakers.

The issue is not only about listening without seeing, but about producing a different sonic content that requires a different listening attitude and is constructed to be perceived autonomously (Bayle 1999, p. 150)

A piece like *Funktion Orange* (1966) by Gottfried Michael Koenig, for example, is not acousmatic in terms of sound writing. Its connection to past electroacoustic experiences and compositional strategy is far from what can be defined as acousmatic, even though its diffusion can only be achieved in an acousmatic performance context – through a system of speakers, without the sound sources being visible.

Koenig's piece employs a specific series of transformations starting from a signal produced by a variable function generator and then delegates the formal construction of the piece, sequencing and overlapping of generated events, to random operations using a computer program. It is certainly not a mode of acousmatic sound writing.

Musica/Tecnologia, 18 (2024), ISSN online 1974-0050, ISSN print 1974-0042, pp. 73-84
DOI: 10.36253/music_tec-15337 – http://www.fupress.com/mt
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So, starting from a contrasting example, what are the characteristics of acousmatic music? Furthermore, is it possible to identify the emergence of these characteristics in certain works that may indicate when the genesis of this electroacoustic "genre" began?

Therefore, we will attempt to define some main characteristics of music defined by this terminology, in addition to examining a piece that, in certain aspects, breaks with the tradition of musique concrète, employing modes that anticipate the onset of the acousmatic era.

Acousmatic writing

To begin a brief examination of the characteristics of acousmatic writing, let us use this statement by François Bayle:

> Music constructed in the form of i-sounds is truly and fully acousmatic. In other words, music that establishes in its object as well as in its project, a mode of organization of the morphological and spatial qualities of the sound material that owes its existence and pregnancy solely to the properties of the image. (Bayle 1993, p.179)

From this statement, it is evident that the organization of morphological and spatial qualities of the material (Smalley 2007) serves to produce sound images whose properties form the coherence and substance of the musical discourse. In a further definition, Bayle states:

> Music that can only be conceived in the form of sound-images or i-sounds, and can only be perceived through their projection. (Bayle 1993, p.179)

The term i-sound (i-son) for Bayle means a sound image, the basic element of acousmatic sound discourse, which consists of other hierarchically superior levels. The higher levels somehow refer to Peirce's theory of signs (Hoopes 1991) and involve "three levels of intentionality" (Bayle 1993, p. 97), including that of the i-sounds. The levels of intentionality are understood both poietically, compositionally, and esthetically, perceptively, borrowing the terminology defined by Molino (1975). Contextualized in this way, the three levels defined by Bayle are:

- i-sound (i-son): isomorphic image (iconic, referential)
- d-sound (d-son): selection of simplified profiles (diagrammatic, indexical)
- m-sound (m-son): metaphor/metaform connected to universality or generality (sign).

Beyond the functions of each level, it can be noted how the three levels range from the most "concrete," the spectromorphology of the object (Smalley 1997), to the more abstract, the images associated with the relationships that these spectromorphologies and the sound textures they construct (d-sounds) can stimulate. Two additional concepts that emphasize the specificity of acousmatic writing concern the notions of form and archetype. In a lecture at the Conservatory of Musica G.B. Martini in Bologna,

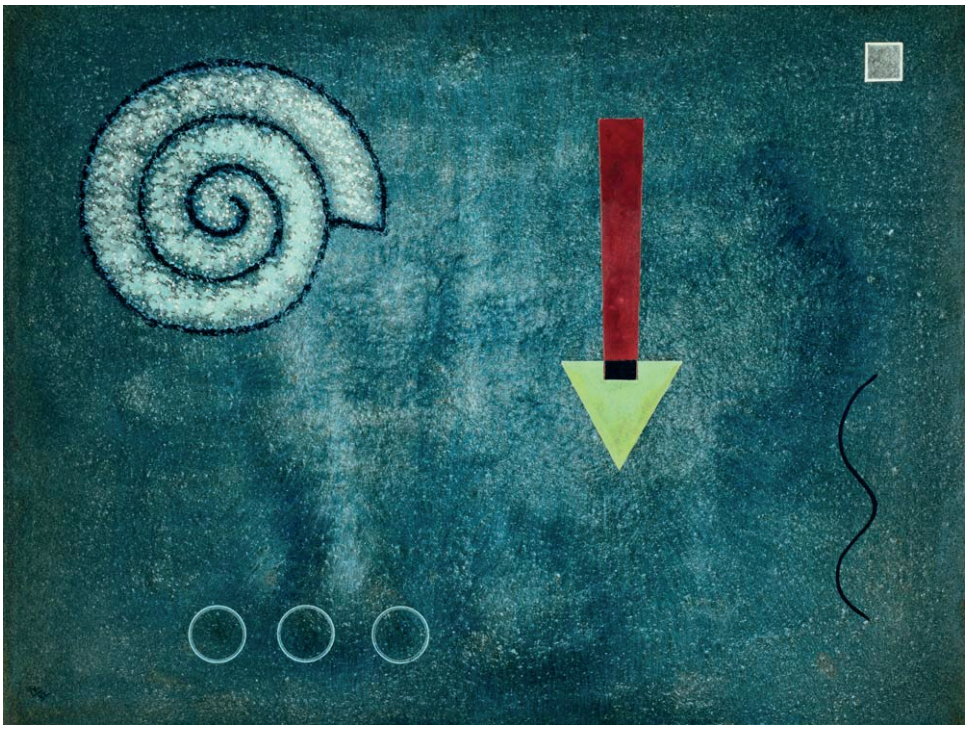

Figure 1. Grüne Spitze (1932).

Bayle (2011) spoke about form as a central element in acousmatic writing. Form is understood not in the sense of the overall structure of a composition but in the spetromorphological qualities of individual sound objects or complex textures constructed by them. For this definition, he refers to Focillon's definition in his book "Vie des formes," stating that in contemporary art and specifically in music, the domain of forms is one of the foundations of their syntactic construction. A related concept is that of "nothing" (rien), indicating a spatial realm in which forms dialogue through their individual characteristics and relationships. Bayle (2011) provided an interesting example based on a painting by Vasilij Kandinskij, represented in Figure 1.

In this painting, as Bayle asserts, at least four complex forms can be identified: a spiral, a linear form, a directional form, and a dynamic form, whose characteristics are related within a space, the pictorial plane. Forms that have inherent significance and acquire further structural and expressive meaning through their morphology, position, and spatial trajectory in relation to each other. Through this example, one can connect to the notion of archetype, which relates the experiences of human life to the perception of spectromorphologically complex musical structures. Archetypes can be further divided into three types: static, dynamic, and positional. Staticity is correlated with the principle of horizon, landscape, and gravitation, all terms that can be defined through the forms and behaviours of the spectromorphologies composing a piece. Dynamism, on the other hand, concerns all articulations that move or move away from a goal,

anticipate or postpone resolutions, or change characteristics. In this case as well, all these definitions can be correlated to the behaviours of spectromorphologies: timbral mutations, directionality of sound structures, anticipation of certain types of events, resolution due to the stabilization of certain sound parameters, or a deviation due to their sudden change, reaching towards a well-defined structural end (the closure of a section or the piece itself). Position is linked to movement or spatial localization. It involves defining an external or internal space, the distance and proximity of sound sources, the design of the trajectories of spectromorphologies within a well-defined space: stereophonic, hexaphonic, octophonic, or otherwise. The three levels between the concrete and the abstract, the concept of form as an intense and characterizing element with its spectromorphological aspects, and the archetypes form the foundations of acousmatic musical language. They constitute those intentionalities that contribute to musical construction from a poietic perspective and stimulate the activation and elaboration of sensory and metaphorical structures regarding perception. It can be affirmed that acousmatic music possesses properties that tend to correlate, at the level of sound writing, spectromorphological and structural qualities at different levels of meaning, in addition to stimulating mental representations with different degrees of abstraction. This means that acousmatic sound writing aims to create structures formed by complex spectromorphologies that can refer to elements of evidently mimetic character or to a much more abstract level, where the evoked images have a lesser definition in terms of their relation to real concepts, actions, or meanings. The structures in question are based on the organizations of parameters related to space, time, spectral types, morphologies, and different types of sound identity. The broad definition of the properties of acousmatic writing leads us to consider two aspects. The first concerns its connection to previous electroacoustic musical experiences. Consequently, the close connection that acousmatic music has with musique concrète has already been implicitly stated; both for composers who have participated in both musical experiences and for the common elements between these two types of electroacoustic musical writing. The second concerns the historical moment in which the experience of musique concrète began to change its nature with the introduction of elements specific to acousmatic music. Therefore, it is not difficult to identify in the work of one of the composers who has experienced both musical experiences; a sort of genesis of acousmatic music, in which we witness the introduction of certain types of this sound writing into a historically related musique concréte composition. I think it can be affirmed that one of these musical compositions is *Espaces inhabitables* (1967) by François Bayle.

From concrete to acousmatic – Espaces Inhabitables

In the 1968 discographic edition of *Espaces Inhabitales*, music critic David Risin makes this intriguing statement:

> The normal reaction (of musique concrète) has been to want to forget, eliminate, the slightest anecdotal trace in the sounds used. Today, it can be observed that composers

> like Pierre Henry and François Bayle are once again assimilating, with a significant deviation, the poetic and extramusical value of electroacoustic sounds. (Risin 1968)

Already from this assertion, entirely adherent to the content and sound writing of the composition, one can infer an initial break, or deviation to be more precise, from some postulates of musique concrète. Postulates that were necessary at the beginning of this experience to avoid being accused of creating a sort of anedoctal representation of a sonic context. Assumptions that had to be overcome, considering the potentialities arising from the access to the entirety of the sonic world.

Risin's consideration provides an implicit indication of the types of sonic materials used in the piece; sound events recorded in different environments that bring along their original context, which, in this case, is not reduced in the sense of reduced listening formulated by Schaeffer (1966 pp. 270-272), where the cause and source of the sound are ignored, privileging exclusively the spectromorphological traits of the sound.

Espaces Inhabitables consists of five movements, maintaining the typical suite structure of musique concrète. However, the titles of the movements already indicate a certain narrative interest of the composer:

1. Jardins de rien
2. Géophonie
3. Hommage à Robur
4. Le bleu du ciel
5. Amertumes

In Risin's reflection on this piece, Bayle is related to Pierre Henry for the intention to include extramusical elements in their compositions. In this piece, there is another element that connects Bayle to Henry, that of melody. Henry has always expressed his interest in musical construction based on overlapping lines with varying degrees of independence. In this composition, Bayle explicitly speaks of melodies, understood as sound lines, each with its specificity for each movement: 1) Interrupted melodies; 2) melodies transposed into a sound accumulation; 3) ostinato melodies; 4) melodies developed in a continuous line; 5) fused melodies and traces of melodies.

The term "melody" should be understood as a sound line or profile and not in the traditional sense. Nevertheless, it is interesting to note how the line, understood as an event moving through time within a frequency range, is one of the basic elements of the composition and one of the unifying features of the different movements. The five movements, while having their structural coherence, still have connections; not by chance, the last one can be seen as a kind of recapitulation of the other four. Bayle's words highlight how this is a compositional decision belonging to the acousmatic musical language:

> There comes a time when you have to resist the modernist temptation to move forward by always changing, because I think it's very important to keep the memory alive. The

> time of acousmatic sounds, which is therefore a time of memory, associates you with very varied representations. Thus, you have to take charge of the contexts of memory and you should have some flashbacks. (Chion, Vande Gorne 1994)

The musical construction based on the recapitulation of the fifth movement should not be seen as a simple re-presentation of some materials but as a decision based on the fact that acousmatic sounds stimulate various types of representations recalled and contextualized in a different structural framework. It is not about "recalling" only the sound morphologies (i-son) but also the abstract images they evoke (m-son). A decidedly acousmatic approach.

Jardins de rien

The first movement is based on two non-sonic models referring to solid and liquid matter. Reference is made to archetypal forms, typical of the acousmatic language, as mentioned earlier. The relationship between these models and sound material is established according to the following criteria:

1. The solid model is defined through melodic gestures.
2. The liquid model is defined through granulated sound textures.

A very important gesture is a prepared piano sound, a kind of "signal" that also returns in the concluding movement. This type of sound, modified in various ways, becomes a discursive element contrasting with the other sound textures not only because it represents the "solid" sound model but also because of its instrumental identity.

The liquid sound identities, on the other hand, have two different levels of surrogacy: remote textures and textures composed of sea sounds. The movement is based on a progressive revelation of the sound source (sea sounds) from which, through transformation, granulated sound textures derive. Therefore, the sound discourse is based on both the dialectic between "solid" sounds, the prepared piano, and its transformations, and the different orders of surrogacy of sea sounds.

The sound of the prepared piano and its transformations mark the different sound sequences of which the piece is composed. As can be seen from the following figure, the presence of this type of events is more concentrated towards the end, a way to resume the initial gestures as a "memory" element, contextualizing them in the conclusion.

Géophonie

This movement exclusively employs sound types based on noise. In this case, the dialectic is between textures based on a saturated spectral consistency and a granulated morphology. Granulated sound material is found in the first and last sections of the piece, while the saturated one includes most of the piece, the central section, where it develops through sound structures based on the percussion-resonance model; rapid

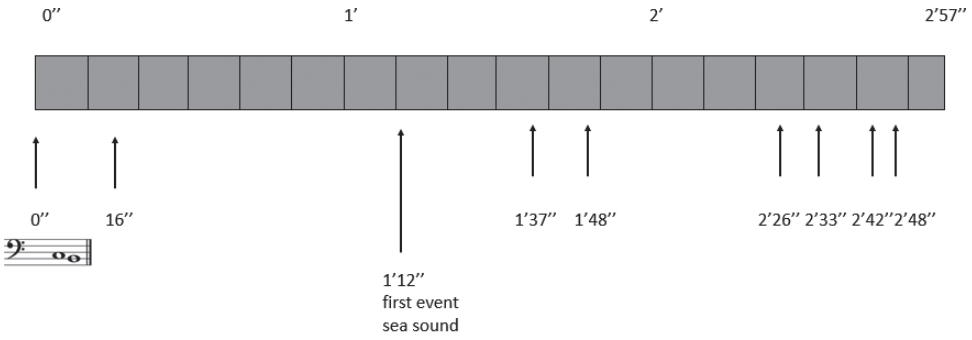

Figure 2. Distribution of prepared piano sound and its transformation in Jardin de rien structure.

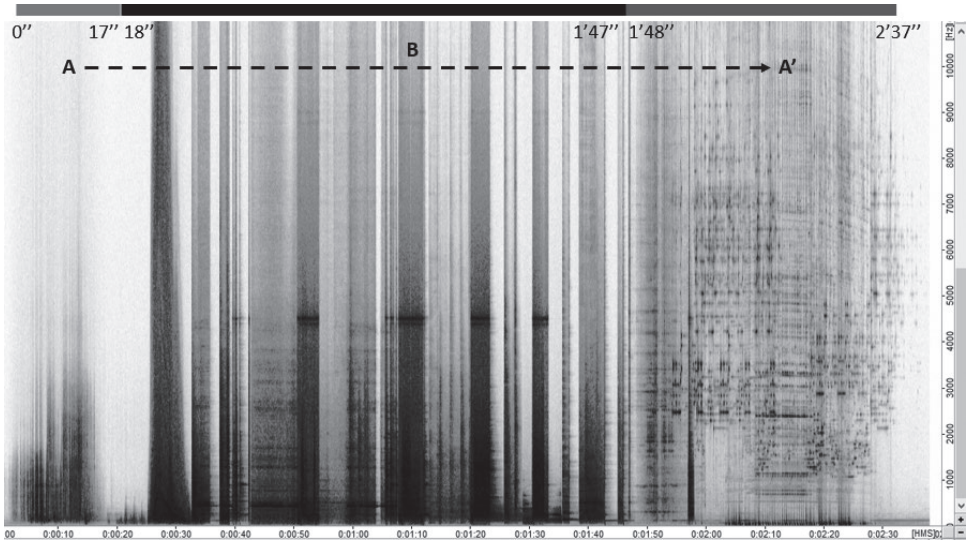

Figure 3. The segmentation and the spectral space of Géophonie.

attacks with a decreasing sound tail of varying length. We can then speak of an A B A' form, where the A sections are distinguished by a different use of spectral space, more compact the first, subdivide in bands and acute the second. Section B tends to saturate large parts of the spectral space and could be seen as a kind of parenthesis between the first and third sections (A and A'). In the following figure, both the segmentation and the occupation of the spectral space can be seen, more saturated in the central section.

Hommage à Robur

The sound material of this movement is similar, in its original source, to that of the previous one; sounds produced in a shipyard. What changes are the modes of

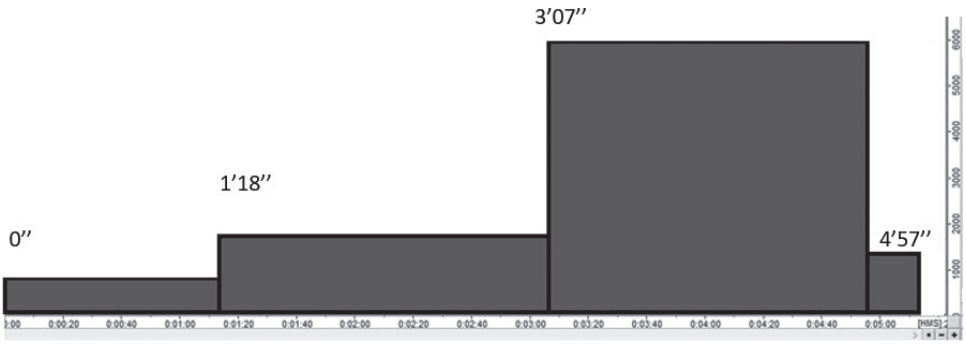

Figure 4. The spectral occupancy in the overall form of Hommage à Robur.

transformation and organization of the form. If Géophonie is structured with an A B A' form, Hommage à Robur is based on a continuum in which, over the course of the piece, the sound texture occupies an increasingly wider spectral space, with a repeated pitch (A flat) as if it were a signal. Not by chance, the closure of the piece is indicated by a more marked glissando movement, in order to dissolve the stabilizing function embodied by this pitch.

There are two other features to note. The sound texture has an internal glissando movement, and the expansion of the spectral space is not gradual but in steps. This form may be employed to avoid the gradual nature of the continuum and thus create a more articulated form. In the following figure, the stepped evolution of the spectral space occupation over time can be seen.

Le bleu du ciel

Similarly to the previous one, this movement presents sound material derived from a specific sound type and its transformations. The difference lies not only in the type of sound employed but also in how the piece is constructed. The musical construction here is fragmented, the opposite of the continuity of the previous one. The form is articulated in a kind of theme with variations, in the sense that the three sections function as follows: the first exposes the type of material, the prepared piano sound in its original gesture, while the two subsequent ones are articulated by sound events derived from transformations with different types of surrogacy orders. Another aspect derived from this mode of form organization concerns the progressive departure from the initial source. Unlike the expansion of the spectral space occupation in the previous movement, in this case, there is a progressive distancing from the initial source of sound material. In the following figure, the formal subdivision of the fourth movement of *Espaces Inhabitables* is represented. The arrow indicates the progressive introduction of sound events derived from increasingly remote transformations of the original sound material, the initial gesture of the first movement.

Figure 5. The structure of Le bleu du ciel.

Amertumes

As mentioned earlier, Amertumes is the recapitulative and concluding movement of the composition. In this last piece, the "traces of melodies," as defined by Bayle, are actually traces of identities, events, and sound textures presented in the previous movements. The connection with the previous movements is important because the sound images presented in the first four pieces produce further ones, through the acquisition of a different context and function; for this reason, Bayle speaks of the time of acousmatic sounds and their varied representations.

The recapitulative nature of this movement leads it to have a fragmented structure. The four sections it is composed of are progressively shorter, always containing material from the first movement, combined with one of the others, except in the last one. The fact that the sound material of the first movement is prevalent and the closure of the piece occurs with the sound of the prepared piano suggests that this movement can be understood as a kind of extension of the initial movement. The following figure presents the structure of the fifth movement. The numbers below indicate the movement to which the materials in the respective section refer.

Although each movement of *Espaces Inhabitables* has its specific sound and formal characteristics, except for the concluding one, the composition in its overall form has ties both at the level of sound events (the prepared piano gesture) and at the discursive level.

The concepts of solid, liquid, saturated, granulated are implemented through sound textures that have peculiar characteristics in each movement, but connected through these and other types of sonic metaphors. If acousmatic music is based on "forms and forces," then this composition certainly introduces models pertaining to this type of sound writing.

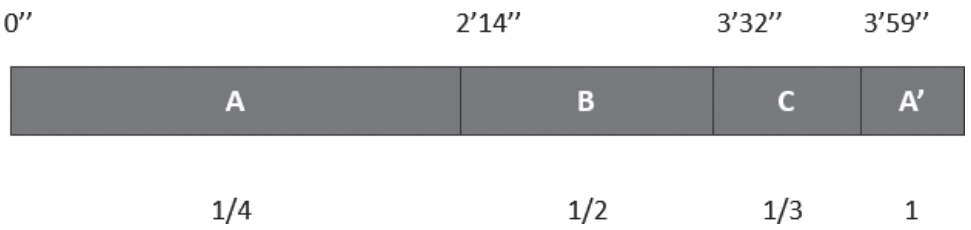

Figure 6. The form of Amertumes.

Conclusion

In an era predominantly characterized by post-acousmatic discussions, it proves intriguing to rewind the clock and scrutinize a pivotal moment – the transition from the era of musique concrète to that of acousmatic music. In a recent article (Adkins et al., 2016), though acknowledging the distinctive features of acousmatic language compared to its post-acousmatic counterpart, certain assertions are subject to debate. Claims such as acousmatic music replacing the harmonic musical teleology of the European musical tradition or its inclination towards prioritizing gesture over texture may be contested. What goes unnoticed, however, is that within the realm of acousmatic music, access to the entirety of the sonic world represents not merely an expansion of the sonic palette. Indeed, the broadening of the available sonic world pertains to the potential for these sounds to influence the modes of composition articulation, along with the ability to employ sonic and non-sonic patterns as archetypes shaping the musical construction of a piece or a segment thereof. It is also accurate to assert that acousmatic music relies on sonic forms and forces whose individualities inhabit a spatial realm through which they relate to one another, contributing to the structural characteristics of a sonic and musical construction.

The first movement of *Espaces Inhabitables* is titled "Jardin de Rien." Its title encapsulates two elements inherent in acousmatic music in general and in Bayle's work in particular. In a previously mentioned lecture, Bayle (2011) spoke of "nothing" (rien) as the constitutive element of his music, a metaphor for space. One of the characteristics of acousmatic music is the "construction in nothing," i.e., the musical construction that "fills" a specific spatial domain. The other metaphor is that of the garden. Bayle (2011) emphasizes that the garden is not nature but an artificial construction where plants and trees of various types, sizes, with leaves and flowers of different colours and shapes coexist. They have different growth times, foliage, and flowering. The different aspects of these elements form the structure of the garden, resulting in relationships between different types of plants, the timing of their growth, and transformation. Sounds in an acousmatic composition have their own metabolism (another Bayle metaphor) that articulates them in the temporal structure and produces relationships between their morphologies through the interaction generated by the "random" overlap of their forms and, at times, constrained within a predetermined form. Another acousmatic composer, Bernard Parmegiani, stated that there are essentially two modes of sonic writing: allowing sounds to live their own lives or constraining them within a previously fixed structure (Mion, Nattiez, Thomas 1982). Even a composer like Smalley asserts that sounds often indicate their position and trajectory within the composition (Smalley 1996). All these characteristics seem to be of fundamental importance for the sonic writing of acousmatic music.

Characteristics that can be found, if not fully, at least in an initial form in *Espaces Inhabitables*, whose sonic forms engage in dialogues within textures and spaces of varying complexity, referring to metaphorical representations: the complex network of relationships among i-sounds, d-sounds, and m-sounds in acousmatic music.

Furthermore, the metaphorical aspect is crucial to emphasize the distance from the experience of musique concrète. Bayle, speaking of the final movement, affirms:

> And then Amertumes, I had the idea that it would be salty, evocative of the sea. (Chion, Vande Gorne, 1994)

The metaphor of the sea recurs throughout the composition, as do those of solid and liquid materials, continuous and granulated sound materials, or references to instrumental gestures.

Furthermore, Bayle himself states that in this composition he did not seek to evoke impressions or replicate the real world through sound traces, but rather to evoke the laws upon which nature rests (Gayou 2003, p.92): a concept that is linked to that of archetypes. Bayle reinforces this kind of thinking, invoking a statement by Picasso:

> I do not copy nature, I work like her. (Gayou 2003, p.92)

None of this could fit within the aesthetics of musique concrète, where the reduction of listening becomes a central element to focus exclusively on the typological and morphological aspects of sounds, rather than their connection to real and hypothetical sources or the extramusical contexts to which they belong. *Espaces Inhabitables* breaks away from this approach to sonic composition, embarking on the adventure of acousmatic music.

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Abstracts

John Young
Scaling Form

This paper examines the question of formal scale in acousmatic music, aiming to identify ways in which relationships between a composer's materials shape or determine the duration of the final form. Successful short and long forms in music are traditionally regarded as encapsulating a sense of completeness with notions such as narrative, development, departure and return as informing principles – the nature of which may influence formal scale. Yet, as with many contemporary music practices, acousmatic music may not always be read in terms of such established teleological models. The digital tools we find at the heart of acousmatic music make it possible to fabricate large quantities of new sounds very quickly, with signal processing and synthesis routines capable of giving composers unanticipated sonic outputs, setting up challenges for sorting, sifting and valorising materials with a view to formal design. That given, in order to locate some formal mechanisms, attention is given to ways in which materials are initially shaped and presented in a work, using the metaphor of 'formed and 'forming' spaces. Through analysis of selected acousmatic pieces the idea of the 'design impression' is used to show through how salient levels of musical form can be identified and that comparable readings of acousmatic forms can be made across different formal scales.

Keywords: Acousmatic music, musical form, formal scale in music, design impression in music.

Annette Vande Gorne
Space, Sound, and Acousmatic Music. The Heart of the Research

The acoustic and musical relationship with architectural space has a long history: ancient Greeks, the Romanesque Middle Ages, and the Renaissance, for example, utilized it in various ways. Electroacoustic composition on a support (acousmatic music), with its deliberate choice of "nothing to see," and the acousmonium as an instrument

Musica/Tecnologia, 18 (2024), ISSN online 1974-0050, ISSN print 1974-0042, pp. 85-87
DOI: 10.36253/music_tec-15338 – http://www.fupress.com/mt
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for spatialized performance, serves as a laboratory for researching space as a musical element both during composition and as the principal agent of performance. Four categories of space emerge from this particular practice of interpreting and understanding the acousmatic repertoire: ambiophonic space immerses the listener in a sonic 'bath', source space localizes sounds, and geometric space structures a work in planes and volumes. These three categories most often pertain to multiphonic pieces. The fourth, illusion space, is consciously or unconsciously addressed in works in a stereophonic format, which create the illusion of depth of field through two loudspeakers.
A few examples, diagrams, and explanations demonstrate how various spatialization systems are designed, particularly the acousmonium as designed by François Bayle in 1974. The performance of an acousmatic work tends to connect various spatial figures that reinforce the composition's writing, highlight existing figures, or create new ones. Stereophonic works offer the performer greater freedom of choice. Sixteen figures are listed, along with their musical function. Depending on the character of each piece, a different spatial approach can emphasize one aspect of the composition over another: icons, movement, unmixing of polyphony, phrasing and variations, subjectivity, and matter.
Thus, we can observe the significant role of the 'spatializer' and the necessity of their active presence in concerts. We witness the emergence of a new musical profession with numerous other applications. The spatial writing of multiphonic works also employs these figures in the studio. Some software is dedicated to this function, but multichannel control is essential in the studio. Lastly, figuralism, by playing with spatial figures, appears to be a key approach to giving meaning to and justifying space as an element that enhances the expressiveness of musical works. Annette Vande Gorne's opera Yawar Fiesta is an exploration of this topic. The spatial projection of music for acousmatic listening – sound in space – opens up the future space to a fifth dimension of expressive music: the Space of Sound.

Daniel Teruggi
Acousmatic Music and its Extension Towards the Instruments

Over the last sixty years there has been a progressive inclusion of instruments within the practice of electroacoustic music in parallel with the development of acousmatic music. This article analyses the conceptual implications and the crossovers between both musical attitudes, and the different tendencies which have sprung over this period. In many cases the use of traditional instruments has "expanded" the outreach of acousmatics.

Keywords: Electroacoustic, Acousmatics, Instruments with electronics, Performance, Sound-processing.

Lelio Camilleri
The Genesis of Acousmatic Music – Espaces Inhabitables by François Bayle

The article examines some fundamental characteristics of acousmatic music, referring to the statements of one of its major composers, François Bayle. A further aspect that is examined concerns the transition between the experience of *musique concrète* and the birth of acousmatic music. For this topic, the composition *Espaces Inhabitables* (1967) by François Bayle is examined, which in some ways represents the birth of acousmatic music, breaking away from certain structural and discursive typologies of musique concrète.
Further considerations regarding the constituent elements of this work and the birth of acousmatic music are developed.

Keywords: musique concrète, acousmatic music, François Bayle, spectromorphology.

Biographies

Lelio Camilleri is Professor of electroacoustic music composition at the L. Cherubini Conservatory of Music in Florence. He has also taught in the Master in Multimedia, University of Florence, the International Master in Composition for the Screen (InMics) and the MOVES Master at IUAV, Venice.

His compositional work is mainly electroacoustic. His works, performed in Europe and in many non-European countries, have received national and international commissions and awards. His research activity concerns electroacoustic music, popular music, sound communication and audiovision, all disciplines in which the subject of sound is of crucial importance. He has published articles on these topics in national and international journals. He has published five books including *Il Peso del Suono* (2005) and *Il Suono del Progresso* (2022). He has published an anthology CD of his music, Parallel (2005).

He collaborates regularly with the Tempo Reale centre in Florence, of which he is a member.

Annette Vande Gorne. Following her classical studies (piano, writing and composition) at the Royal Conservatoires of Mons and Brussels and with Jean Absil, Annette Vande Gorne discovered acousmatics during a course in France. Convinced of the revolutionary nature of this art form, she went on to study musicology (ULB, Brussels) and electroacoustic composition with Guy Reibel and Pierre Schaeffer (CNSM, Paris). She founded and ran Musiques & Recherches and the Métamorphoses d'Orphée studio (Ohain, 1982), as well as a series of concerts and an acousmatic festival, L'Espace du son (Brussels, 1984, annual since 1994), using an acousmonium with 86 loudspeakers. It launched the musical aesthetics journal LIEN and the electrO-CD repertoire of published electroacoustic works. It also founded the "Métamorphoses" acousmatic composition competition and the "Espace du Son" spatialised performance competition. It is gradually becoming the only Belgian documentation centre for this art form, accessible on the Internet. (http://electrodoc.musiques-recherches.be).

Professor of acousmatic composition at the Conservatoire Royal de Liège (1986), then in Brussels (87) and Mons (93, honorary since 2011 and 2016 for the spatial in-

Musica/Tecnologia, 18 (2024), ISSN online 1974-0050, ISSN print 1974-0042, pp. 89-91
DOI: 10.36253/music_tec-15339 – http://www.fupress.com/mt
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terpretation course), she founded an independent electroacoustic music section there in 2002, which now has a team of 15 specialist teachers, for a master's degree (5 years) in acousmatic composition.

SABAM Awards 1985 and 1995 for his body of work. Prix 2021 des octaves de la musique contemporaine for his CD Haïku (Belgium). 2021 Thomas Seeling Prize from DEGEM (Germany).

His works can be heard at all the festivals that make room for music composed on a medium. Nature and the physical world are models for an abstract and expressive musical language. The writing of space, considered as the fifth musical parameter, in relation to the other four and the archetypes used, is an area of research that fascinates her. The relationship between words, meaning and vocal material is the other subject of her current research. Her work is essentially acousmatic, like the suite *Tao* or *Ce qu'a vu le vent d'Est* and her opera *yawar fiesta,* two works that renew the link between electroacoustic music and the past, apart from a few forays into other arts: theatre, dance, installation sculpture and painting.

Daniel Teruggi studied physics, composition and piano in Argentina, his native country. In 1977, he moved to France where he studied at the Paris National Conservatory. In 1981, he started working at INA (Institut national de l'audiovisuel), as part of the GRM (Groupe de Recherches Musicales). In 1997 he become director of the GRM and kept this position until his retirement in 2017. From October 2001 to 2016, he was simultaneously Director of the research and experimentation department of INA.

In research, he actively worked on the preservation of audiovisual collections and especially in the field of electroacoustic music. Teruggi has composed more than 90 works mainly for concert settings, using either electroacoustic devices in acousmatic situations or live instruments. He is the author of numerous research articles on sound, perception and analysis of music. His works have been performed in more than 30 countries and published in various CD collections.

Doctor in Art and Technology at the University of Paris VIII, he developed an important educational activity at the Paris I Universty, at Paris IV Sorbonne and at the University of Paris Est. In 2016, he received the "SMPTE Archival Technology Medal Award" for his efforts in the preservation of audiovisual content with a focus in music. In 2016 he also received the from the Société des Arts Technologiques in Montréal, Canada, the SAT award for his artistic trajectory. In 2022 he was awarded the prestigious "Giga-Hertz Award" granted by the ZKM in Karlsruhe, Germany and in 2023 the "Lifetime Honarary Award" given by the International Federation of Television Archives (FIAT/IFTA) in Locarno, Switzerland.

Retired since 2018, he continues his musical activity as well as his activity in the audiovisual preservation domain.

John Young is Professor of Composition at De Montfort University, Leicester. Prior to that he was Senior Lecturer and Director of the Electroacoustic Music Studios at the Victoria University of Wellington (New Zealand), introducing the practice of

multi-loudspeaker sound diffusion in that country. His main interest in composition continues to be in acousmatic music, particularly forms based on the interplay between recognizable natural sound sources and computer-based studio transformations, but he also works with instrumental media in combination with electroacoustics. Recent works have also made use of oral histories of wartime experiences. Awards for his work include the inaugural Prix Francis-Dhomont (Montréal), the Klang! international competition (Montpellier), Musica Nova (Czechia), the Stockholm Electronic Arts Award, Destellos (La Plata, Argentina) and the Bourges International Electroacoustic Music and Sonic Art (including, in 2010) the Bourges Euphonie d'Or. He has been a visiting composer at many institutions in Europe, North and South America and New Zealand. His music in published by empreintes DIGITALes, Montréal.

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18 • 2024

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