Entanglements of Creation: Luigi Nono and the Experimentalstudio Freiburg

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Abstract

This study proposes a new analytical framework and historiography of the creative practices of Luigi Nono and the Experimentalstudio Freiburg. I present their dual histories, and how these converged during their first project together, Nono's *Das Atmende Klarsein*, a turning point that laid the foundations for Nono's fruitful late period. By combining recent musicological discourses on technologically-mediated aesthetics, critical organology, material agency, and collaboration, with insights on compositional process from contemporary practitioners in the field of electronic music, this dissertation brings Nono and the Experimentalstudio into a new kind of dialogue with contemporary perspectives. In combination, they outline a new framework that disentangles the under-examined questions of agency, authorship, instrumentality, and influence provoked by Nono's late works. Furthermore, in response to the notable absence of the subjects in existing histories of electronic music, as well as under-developed critical reflections of their practice among primary and secondary literature, new archival research by the author supports a reappraisal of the studio and Nono's historical positions as potential bridges between the otherwise disjointed paradigms of post-war European modernism, experimentalism, aesthetics of deep or active listening, and twenty-first century digital music practices. Nono and the Experimentalstudio are granted a renewed significance in their relation to contemporary practice and the now extensive technical concepts of interactivity, liveness, interface, and modularity, as well as creative and aesthetic concepts concerning space and listening.

1. Introduction

1.1 ‘look to the stars to guide you’

> I begin with virtually no idea, at times not even a vague one. This is something really new, dictated primarily by a need to study, to experiment, to validate perceptual capabilities and see how these things, with their particular responses, react to music. This process involves me as well as the two engineers, Professor Hans Peter Haller and Rudolf Strauss. Working like this is like being in the open sea, where from time to time you look to the stars to guide you. A star may lead you, through a special type of perception, to a musical element, one that is interpretable and resolvable each time in a different way. At other times, unexpectedly, we find ourselves facing real technical errors, which, as one would expect, are then of course analysed and in some cases reused. Error, as Wittgenstein says, is sometimes much more important than the rule; *in error one can find a real way of breaking through to spaces that were hitherto unthinkable*.[1]

The above quotation from Venetian composer Luigi Nono outlines the distinguishing features of the shared work on live electronic music between him and the members of the Experimentalstudio Freiburg throughout the 1980s, pointing to issues of technology, aesthetics, collaboration, compositional process, material agency, and authorship. The statement summarises the radical renewal that took place in Nono’s music in the decade before his death in May 1990: from the earlier collage and constructivist techniques of his serialist works from the 1950s, to an embrace of material and performative contingency and a phenomenologically orientated practice — the guiding stars — in the late works. Nono's article and interviews from the period attest to a shift in his experimentation methodology, for example: ‘Error as Necessity’, and ‘Technology to Discover a Universe of Sounds’.[2] The confrontational polemics of his preceding overtly political works such as *Ricorda cosa ti hanno fatto in Auschwitz* (1966) and the opera *Al gran sole carico d’amore* (1975) gave way to the more secretive late works. Though still marked by deafening roars and a political subtext, the late works increasingly took musicians and listeners to the thresholds of silence, introversion, and fragmentation, where listening itself became a politically symbolic act.

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[1] Nono (1983b), 311 (author’s emphasis).

[2] Nono (1983 and 1983b).

New technologies around the turn of the 1980s such as real-time digital sonoscopes and spectrograms, which Nono peered into during long exploratory sessions with musicians at the Experimentalstudio, afforded a novel fragile liminality to his music's materiality — a microscopic intimacy with sound — while at the same time, and by contrast, other electronic instruments, such as the Halaphone spatialisation device, helped Nono to create vast and overwhelming spaces — real and imaginary — such as the derelict Venetian church of San Lorenzo, the immense industrial factory of Milan's Ansaldo plant, or evocations of the Schwarzwald, Venetian lagoon, and ancient Greek theatres. As such, the contrast of, on the one hand, corporealised microsounds in the context of, on the other hand, multiple large-scale locations and spatialised sounds where individual identities begin to melt away and fuse into a new emergent whole, encapsulates Nono's concept of *suono mobile* throughout the late period; fluctuating fields of sound, space, and scale; never settling, always evolving, as if searching for a utopian resolution on a hazy horizon.

Of the eighteen works from Nono's final decade, thirteen feature live electronics, and all of these were created in partnership with the Experimentalstudio.[3] Under the leadership of its founding director, Hans Peter Haller, the studio developed a unique suite of bespoke live electronic instruments from its foundation in 1971. In parallel with the provision of new technology, the studio also advanced a collaborative compositional and performance practice that was honed from its first project with Karlheinz Stockhausen, and throughout the following decade with several successful international performances and key partnerships such as the annual avant-garde festival at Donaueschinger Musiktage. As such, the Experimentalstudio occupies a central role in Nono's late works, however, as detailed in the next section, today both composer and studio suffer from considerable oversight in histories of electronic music and musical modernism.

The dissertation is structured in a dialectical manner, presenting the individual histories of the Experimentalstudio (chapter two) and Nono (chapter three), before exploring their synthesis in the case

[3] See Appendix

study of *Das atmende Klarsein* (chapter four). The following two prefacing subchapters provide a foundation for the core of this study, firstly by assessing the state of and problems among existing scholarship concerning the topics at hand (chapter 1.2), and secondly by outlining a methodological framework (chapter 1.3) that responds to the uncovered problems, and which also acts as the underpinning for the historiographies and analyses developed in subsequent chapters.

1.2 Problems in Historiography and Music Technology

Both the Experimentalstudio and Nono's late works are barely discussed, if referenced at all, in several notable English-language histories of electronic music and avant-garde music studios, including those by Nick Collins & Julio d'Escriván (eds. 2017), Joanna Demers (2010), Simon Emerson (2007), Thom Holmes (2008), Jennifer Iverson (2019), Peter Manning (2013), and Margaret Schedel (2007). Such historiographical oversight chafes with the comparatively regular international performances and numerous recordings of Nono's late works (relative to the field of new music), including his final opera, *Prometeo, Tragedia Dell'Ascolto* (1984 rev. 85); with over 60 performances since 1990, and four commercial recordings.[4]

In the face of the apparent absence of Nono among anglophone histories of electronic music, there nonetheless exists a rich and varied Nono scholarship, and to a lesser extent, some academic discussion of the Experimentalstudio too. In addition to Nono's own writings and interviews in the 2001 edition *Scritti e Colloqui*, edited by Angela Ida De Benedictis and Veniero Rizzardi, important secondary sources include monographs by Jürg Stenzl (1998), Carola Nielinger-Vakil (2016), and Jonathan Impett (2019), as well as several articles by musicologists and Nono's collaborators published as part of the 1999 double edition of *Contemporary Music Review* dedicated to the composer. In regard to the Experimentalstudio, the single most important source is arguably Haller's 1995 double-volume book recounting the techniques, projects, and history of the studio. A more recent collected edition in

[4] See performance records of the Fondazione Archive Luigi Nono http://www.luiginono.it/en/works/prometeo-tragedia-dellascolto/

German and English (ed. Biró et al: 2019) provides further insight from original collaborators as well as musicological studies.

Throughout the existing Nono and Experimentalstudio literature, discussion of the collaborations between Nono, Haller, and the studio's technicians and guest musicians, remain on a rather matter-of-fact, biographical, or anecdotal level. Two examples illustrate the theoretical limitations and unresolved tensions here. Firstly, with Haller: while Haller argued for sound technicians to be seen as musicians and interpreters in their own right alongside the instrumental and vocal performers since the studio's founding,[5] his writings evidence a conformity to the conventional romantic artist, classical composer, or genius model as detailed by Lydia Goehr (1994), where the composer is supreme, and where everyone else — musicians, technicians, audience — are essentially secondary. The irony of this ostensibly regressive socio-cultural trope recurring in such an otherwise progressive and collaborative organisation forms one of the central concerns of this dissertation.

The quotation below from Haller's 1995 monograph, reproduced in full, proves the unresolved problems of authorship by unambiguously espousing the romantic artist hierarchy, reserving top status for Nono while demoting himself and other musicians to secondary roles; artisans rather than artists (emphases added):

> Interpreters who were involved in the rehearsal work in the studio would later repeatedly make claims to the intellectual right to a composition on the grounds that through their instrumental experiments they had invented many musical forms, even motif formations, which the composer then took over into his compositional work. *This accusation was raised repeatedly*, especially against Nono after his death. It is correct that composers demanded and received a certain amount of creative thinking from all of us, including my colleagues in the Experimentalstudio. But the results of our work and those of the instrumentalists were *always just building blocks, sound stones*, which the composer then put together to form a whole, a building comparable to architecture. And let's stick with the comparison: no company that has supplied building blocks for a house will dispute the architect's technical, intellectual ideas, or artistic abilities. He is the creator of the complete works, although he was certainly *inspired* by many materials and developed new forms from them. Such an architect, such a composer was

[5] Haller (1995, vol. 2), 25-26.

> Luigi Nono, along with many others, we supplied the building and sound stones, and above all I'm still happy today that he in turn *inspired me* to create many new sound stones.[6]

In the following study, Haller's blunt curtailing of his own and other collaborators' agency and authorship will be challenged and re-examined in a more critical light. In the above quote, Haller relies on 'inspiration' to characterise the relationship between him, others, and Nono, but as he points out in the last sentence, this exchange wasn't unidirectional, but rather a mutual exchange. The question of inspiration and exchange will be explored in later sections, for the moment, however, and in direct contrast to Haller, we can turn to Nono himself to show how even among the original subjects there were contradictions on the question of authorship (emphases added):

> There is a profound and intense collaboration among everyone. Whatever is accomplished I would define as a *collective achievement*, achieved with the *indispensable* contribution of every person […] It is an interaction among several participants, and each one contributes with atypical instrumental practices related to his own instrument and adapted to the compositional purposes.[7]

The above two quotations thus pose several questions which this study investigates, chiefly: exactly what were the artistic contributions of Nono's collaborators? How exactly did the process of reciprocal 'inspiration' between Nono and his collaborators work? To what extent is this exchange symmetrical? To what extent can we view the collaborators as co-creators of a final work, the *collective achievement*? What model best describes the practice-led compositional and performance paradigms of this music? We will return to and build on these questions in the analysis of *Das atmende Klarsein* in chapter four, but first, there are yet more accounts from other Nono collaborators that need to be introduced to reveal the problems at hand in fuller scope.

The next example from exiting literature that raises further questions comes from Haller's successor at the Experimentalstudio, Andre Richard (director from 1989-2011), in his recollection of the issues he

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[6] Haller (1995, vol. 2), 117. All translations by the author.

[7] Nono (1983b), 317.

faced in later years following Nono's death, when he was preparing the critical edition scores for Ricordi Milano, which he co-edited:

> [Flautist Roberto] Fabbriciani and [Clarinetist Carlo] Scarponi were initially reluctant to help edit the score and did not really want to collaborate [on preparing the critical editions]; they wanted to maintain their exclusive knowledge of the piece — which is, in a way, understandable since they had contributed so much of their musicality to the work's genesis. They gave very little information, and it was not always accurate. … From my notes, it became clear that they never played the same way twice. This may sound surprising, but the music of Nono is like that: there is a text, but it serves only as a starting point to inspire the performers who play the written notes in a slightly different manner each time. This is what the performers could not really explain.[8]

While Fabbriciani would eventually collaborate on the new critical edition scores, nonetheless, again the nebulous ideal of 'inspiration' appears in Richard's account, and again, this provokes yet more questions: what is *inspiration* in material and agential terms? How did it manifest? How does it reflect the contributions of the collaborators?

Complicating matters further, there are a host of other non-human actors at the core of Nono's late music, but which suffer from arguably even less critical regard by both the original creative team and subsequent scholars. Technology, or, the electronic musical instruments themselves, are of principal concern, however, the rich complexity of Nono's late works means we must further extend our view to include a range of other non-human actors, including discourse, media, and physical spaces, to name a few. The studio drew on a team, led by Haller, including other engineers, but also comprising administrative workers and a board of directors who were SWF employees and effectively external to the studio's inner workings. As for its non-human team, the studio's technology incorporated devices created by Peter Lawo and Hans Peter Haller, discussed in chapter two, as well as other commercially available instruments and equipment (microphones, cables, furniture). Haller referred to the different stages of the studio's instrumental constitution as an *Ausbaustufe* (expansion stage) (Haller 1995).

[8] Andre Richard (2019), 189.

Experimentation, engineering, and performance were integrated into the studio's operations from this very first endeavour, and, over the course of a dozen more projects over the following years, they also formed distinguishing creative and performance practices by the time Nono first visited the studio in December 1980 with Fabbriciani, a decade after *Mantra*. At the core of the studio's practice was live performance and live electronics; realtime sound transformation, *Klangumformung* in Haller's words. Their focus on liveness would have profound implications for Nono. As will be shown in the case of *Das atmende Klarsein*, the liveness of both studio experimentation and performance was an intrinsic driver behind the defining aesthetic and philosophical shift in Nono's late works, and a precondition to his concept of *suono mobile*.

Around the time of the arguable zenith of Nono's work at the studio, the premiere of *Prometeo* in 1984, the studio had its third *Ausbaustufe*. As such, the studio was never fixed in space nor time, moreover, it existed in a state of constant reconfiguration and motion, sometimes literally, like when it went on tour for performances, but also instrumentationally, with devices constantly being added, removed, replaced, updated; the instrumental body of the studio only truly concretised into a stable form in moments of performance. Nonetheless, even in performance, contingency and instability were still present in the form of performance practice, technical faults, and the particularities of performance venues and musicians, as will be shown in the case of Nono's late works, which often foregrounded such contingencies as a key aesthetic principle.

By the time of Nono's arrival, the studio's arsenal comprised filters, delays, synthesisers, vocoders, harmonisers, samplers, and the Halaphone (spatialisation device). Connecting these individual instruments together to form changeable modules of signal chains, or meta-instruments, the studio developed its own matrix devices, which were vital in performance, enabling Haller to rapidly switch between different pre-programmed patches, effectively reconstituting the instruments' relations and functions to enable different live electronic transformations and musical behaviours. Another characteristic sub-component of the studio were *gates*. These were voltage controlled amplifiers (VCAs),

commonplace in synthesisers, which enabled one signal to control another, or more paradigmatically in the studio's case: sounds to affect sounds; interactivity. For example, the dynamics of a live instrument picked up on a microphone could control the speed of a spatialisation trajectory when the gate sent a control signal positively correlated to spatialisation speed in the Halaphone, as was the case in the early versions of Boulez's …*explosante fixe...* (1972) produced with the studio.

Furthermore, as mentioned above, the studio also had digital sound analysis devices such as the sonoscope, a computer which analysed sound and displayed a sonogram on a computer screen, and which could make print outs. The sonoscope was a key transformative technology in guiding the materiality and aesthetic of Nono's late works, as it enabled him to explore sound and the act of listening itself in a completely new way: externalised and augmented through technology, capable of visualising components of sound that are usually difficult to perceive, such as attack transients, high harmonics, and very quiet sounds. The sonoscope even pushed Nono to discover new modes of instrumental playing and live electronic processing with his collaborators, for example when Fabbrciani and Schiaffini created incredibly quiet sounds without any overtones, just the fundamental. Thus, the sonoscope was a sonic microscope for Nono, a tool to discover new dimensions of acoustic and electronic sound, and especially the intimate qualities of particular instruments if not also the musicians themselves, but it also had a second and perhaps more profound effect in provoking new instrumental modalities hitherto unexplored by either composer or musician alone, aided by a new visual-aural interface. All of these instruments will be discussed in depth in chapter two in relation to their instrumentality, materiality, and the particular compositional and aesthetic affordances that they offered Nono and his collaborators.

From the above outline of the diverse cast of actors involved, one can discern how a new critical examination of Nono's late works and the Experimentalstudio is motivated by both the subjects themselves — their music and the compelling aesthetic-techno practice — and by the questions, points, evasions, and omissions present throughout the subjects' writings and later scholarship. The knotted

combinations of human composer, technicians, and musicians alongside non-human actors (acoustic and electronic) instruments, architecture, performance practice, instrumental technique, and more abstracted forms of aesthetic and technical knowledge in Nono's late works brings into focus matters of human and non-human interaction, the discussions of which are made seemingly more complicated by the contentions of authorship and agency among Nono literature. The following section introduces a methodological framework with which such questions can begin to be untangled.

1.3 Methodological Framework

This study takes the questions provoked by Nono's late works as an opportunity to create a new framework that intertwines theories from contemporary musicology with insights from practitioners of electronic music, all of which have yet to be drawn into dialogue with Nono's corpus of late works. In chapter two, a principal aim of the research is to establish a new historiographical and organological view on the Experimentalstudio, building on the key accounts offered in Haller's monograph on the studio, other scholarship, and subject testimonies. Throughout this chapter, connections are drawn with the burgeoning area of literature of critical organology, which emphasises the material and social-cultural affordances and situatedness of musical instruments, viewed themselves as 'makers of musical meaning' (Sonevytsky: 2008, 102). Key accounts include Regula Quereshi's account of the Indian Sarangi (Qureshi: 2000), Maria Sonevytsky's study of the Ethnic Whiteness of the Accordion in New York City (Sonevytsky: 2008), Trevor Pinch and Frank Trocco's history of the Moog Synthesiser (Trevor & Pinch: 2002), Brian Kane's exploration of magnetic tape (Kane: 2017), Patrick Valiquet's study of digital instruments' entanglements within neoliberalism (Valiquet: 2022), and several publications by Eliot Bates, including studies of the Turkish Saz and Eurorack modular synthesisers (Bates: 2012, 2019, 2021). Throughout these studies, the emphasis is placed on an instrument's physical relation to its performer, their corporeality and sensuality, and how such intimate material encounters ramify at the macro level to produce affective, symbolic, and aesthetic affordances in a musical genre and culture.

To begin exploring this area, it is helpful to recall a broader ethnomusicological view: throughout human history, people have viewed musical instruments as holding certain powers, for example moral, religious, or magical. These powers 'index a variety of socially prescribed attributes' (Sonevytsky: 2008, 102), for example, social class or interpersonal relations (romantic, devotional, militaristic). Consider, for a moment, the contrasting social contexts of the Celtic carnyx with that of the Japanese shō, the flamenco guitar, the Indian tabla, or the Chinese zheng. This study will show how a similar type of magic (affordances and emergent properties), took hold between the instruments of the Experimentalstudio, Nono, and his collaborators, by arguing that the source of the magic lies in the studio's prismatic power, as a producer of particular modernist aesthetics, and as a strong and dynamic mediator of sound, people, places, spatialities, and other objects.

Bates' work on modular synthesisers is of particular significance to this study, not only because it shares a topical proximity to the electronic instruments of the Experimentalstudio, but also because they bring critical organology into dialogue with Actor Network Theory (ANT) as a means to examine the 'messiness of encounters' surrounding musical instruments and their actual uses in cultural settings (Bates: 2019, 42). In Bates' words, 'Rather than distilling things down into a sanitised account, [with ANT,] the mess is front and centre' (2019, 47). As outlined in the above section, the plural materialities and shifting relationalities of the Experimentalstudio's instruments and the practices that they afforded require that we take seriously the agency of all components involved. ANT enters our view here, not only because of its increasing importance in recent musicology, but because of its appropriateness to the problems this study seeks to unpick.

ANT assumes an analytical equivalence between human and non-human actors i.e. musical instruments. In the case at hand, this enables the analytical eye to consolidate the fullest possible ambit of actors, materials, and spatiotemporal scales of the Experimentalstudio's work. As many authors have explained in musicological contexts, ANT is not a theory with a predictive power or universalising

agenda, but instead, an open-ended methodology (Born & Barry: 2018, 447). Benjamin Piekut offers an important historiographical approach to ANT and music studies, dissecting four principles in ANT — agency, action, ontology, and performance — and uses them to reconsider questions of influence, genre, and context in relation to historical musicology. Piekut describes ANT as 'an empirically justified description of historical events, one that highlights the controversies, trials, and contingencies of the truth, instead of reporting it as coherent, self-evident, and available for discovery' (Piekut: 2014, 193). Particularly illuminating and relevant to this study is Piekut's notion of *historical ecologies*, since it provides a framework that captures the 'variegated temporality' of the subject at hand (ibid, 212). This is pertinent to Nono and the Experimentalstudio, because, while one could argue that their practice consisted of discrete instances as manifested in the individual works and performances, nonetheless, as this study will show, the collaborative and performance practice within these works was in a state of constant flux and re-configuration, thereby posing a substantial challenge to analysts heretofore.

As the opening quotation makes clear, Nono indeed embraced and encouraged such contingency and instability, or the potency of 'error', both as a springboard for discovery and as a reflection of his deeper-held *immanent materialist* aesthetic orientation, introduced in chapter three. Therefore, we need a framework that can account for both the practice that surrounded each work and its performances, but also, one that captures the macro-level evolution of the meta-practice and aesthetics through the course of Nono's late period live electronic works, beginning with *Das atmende Klarsein* in 1981. ANT promises a productive framework for Nono's late works, not only because of the diverse and numerous actors, materialities, relationalities, and types of agencies that they entail, but also because both share an affinity for embracing the complexity of the world without recourse to abstraction and reduction. For ANT, this is a result of its sociological and ethnographical origins in Science and Technology Studies. For Nono, this reflects his complex aesthetic, philosophical, and political agenda, which, among many other features, could be characterised as fundamentally anti-hegemonic. The connection between the two will be unfurled in later sections. Nonetheless, despite their supposed aptness, how do both ANT

and critical organology need to be adapted to work with the subjects at hand, the available sources, and evidence, i.e. to analyse a historical subject rather than produce an ethnography of a living subject?

By way of answering this question, we can outline a few key principles that guide this research, and which draw from some of the above-mentioned references:

1. De-essentialise context: treat context as another object to be defined along with the subjects, and not as a presumed or self-evident absolute.
2. Analyse empirically, but do not limit the analysis to only the empirical domain; make theoretical suppositions and judgements to try to reveal what lies between the material.
3. Analyse subjects across multiple spatiotemporal scales in order to establish their fullest possible relationships within one or many networks i.e. do not treat actors and networks as static entities.
4. Regarding the ontology of compositional and performance practice: do not assume that the micro (workshops, individual works and performances) gives rise to the macro (performance and composition practice, aesthetics), or vice versa. The analysis must remain open to more subtler exchanges between actors that include both symmetrical and asymmetrical networks.

The above four points summarise some observations by several notable writers concerning the productive application ANT to historical musicology. With regard to the first point, Piekut writes 'a Latourian accounting of networks does not cover up asymmetries, but instead issues a realist description of associations and the hierarchies and inequalities they create; it is ontologically indeterminate, allowing the shape of the networks to emerge empirically' (Piekut: 2014, 211). Piekut then suggests Anna Tsing's concept of 'worlding' as a means to provide 'partial, tentative sketch maps' that leave open possibilities of revision and reformulation instead of relying on a presumed and fixed concept of 'context', as she explains: 'context gets in the way: context identifies the actors in advance, making it impossible to attend to how they make themselves through networks.' (Tsing: 2010, 47). In

practice, this means that the contexts surrounding the subjects in question will continually be adjusted according to the different questions at hand.

As the second point clarifies, relying exclusively on the empirical domain risks a tautological, narrow, and fragmentary analysis. As Born and Barry write: 'ethnographic research is often at its most insightful when it probes the limits of what is readily discernible by interrogating not just what is observably present—as in Latour's formulation of ANT—but also what is hidden' (Born & Barry: 2018, 465). Moreover, in his compelling analysis of contemporary pop music, music technology, and neoliberalism, Patrick Valiquet makes even more concrete the risks of narrowly empirical formations of critical organology in speaking of contemporary cases of neoliberal cultural dynamics: 'the "affordances" of music technology today are not necessarily discernible when organologists limit their attention to the instruments themselves. Music technology today necessarily involves dynamic, systemic attachments to a logic of generalised bankruptcy, in very much the same way as speculative financial instruments, social media platforms, and entrepreneurial gig work schemes.' (Valiquet: 2022, 119). Rooting this back to the case of Nono and the Experimentalstudio, this study continues with Valiquet's point, treating an analysis of the empirical (instruments, sketches, scores, recordings) as one mediatory dimension of a more expanded and entangled field that includes aesthetics, philosophy, and politics.

The third point addresses a perceived weakness in the original formulations of ANT which treat subjects as belonging to fixed instances of a network rather than, as is more often the case, living and changing networks. It also clarifies a departure from existing critical organological accountings of instruments, where the objects of their studies are usually long-established, popular, or vernacular instruments of a certain concrete physicality, analysed in the course of a short-term field encounter, or several brief encounters. On the contrary, the instrumentation of the Experimentalstudio was, as this study will show, heterogenous, and it evolved continuously over the two decades before and during Nono's involvement. The Experimentalstudio *as instrument* is plural and distributed in its materiality, comprising both self-contained analogue and digital devices of both commercial and bespoke origin.

Furthermore, it was the infrastructural devices such as the gates and matrix which afforded the specific *instrumentality* of the studio, even if these devices are not sound-producing instruments in their own right, understood in the commonplace view of a musical instrument. Thus, the materialities of the studio and of Nono's late works, extend beyond individual instruments both spatially and temporally, and indeed, beyond notated scores. Overall they instead present a more complicated multi-articulated body defined by its potential for emergent technical and musical functions, as well as aesthetic affordances. The evolution of these instrumental bodies is further addressed in chapters two and four.

The fourth point proposes a general principle which is applicable to the previous three points, and again asks the analysts not to assume, and not to think in terms of branching or pyramidal hierarchies, but rather, to remain open to more subtle and knotted forms of causality within an actor network. This is particularly pertinent when considering the relationship between actors of different materials and spatiotemporal scales, for example, in relating to small individual devices like the sonogram (non-human, digital, physical) to vast and multi-material objects like Nono's *Prometeo* (human and non-human, material and non-material).

Overall, this gathering of theoretical perspectives reveals challenges to the traditional hierarchy of western musical production — the composer-performer-audience paradigm — and sees Nono decentred as the primary creative agent within his own musical enterprise. At the same time, other sociocultural aspects of Nono's late music, most notably their reliance on institutional support, from state-sponsored radio stations to national festivals and orchestras, efface and short-circuit such challenges, leaving Nono in an unusual historical interstice between stronger forms of institutional modernisms (e.g. IRCAM and Boulez; Neue Musik), and a plurality of informal or anti-establishment experimental music scenes (Cage, Sound Art, Free Improvisation). Taking this point further, chapter three reconsiders Nono's historical position in light of other experimental music figures who developed alternative aesthetic and practice of listening, from Cage, to Lucier, Oliveros, Amacher, and Radigue. The goal of this thesis is not to argue that authorship should be equally (re-)distributed among the

various actors involved in Nono's late works, rather, it seeks to build a critical framework that disentangles and examines the empirical matters of who contributed (human and non-human) and how, which in turn, helps to demarcate the idiosyncratic ontology of musical modernism demonstrated by Nono's late work and the Experimentalstudio.

More recently, Snape & Born (2022) argue that in studying complex interactions in digital music technology such as with the Max programme, one requires a double historicity of technology and aesthetics: 'it requires that we engage not only in tracing the technological genealogies immanent in the assemblage, but also the specific aesthetic genealogies being drawn on in contemporary practices.'[9] As such, before turning directly to the case study of *Das atmende Klarsein* in chapter four, in the next two chapters, I explore a double genealogy of the technological and aesthetic history of both the Experimentalstudio and Nono before they each met one another, so to speak, in order to delineate and introduce the multiple converging historical contexts that each sat within, and to build a portrait of each in the lead up to their debut project in 1980-81. Haller's 1995 book is a primary source, being the most thorough chronology of the studio, however, I also cross-examine his accounts, where possible, with other primary and secondary sources, including archival materials from Experimentalstudio, the Luigi Nono Archive in Venice, and the Haller Archive at the Akademie Der Kunst, Berlin, further supplemented by online interviews made by the author more recently with Haller's successors, Andre Richard, and Joachim Haas, as well as Roberto Fabbriciani.

This research is further motivated by a desire to remedy and clarify the otherwise overly discursive, anecdotal, and sometimes self-contradictory accounts among the primary sources, where questions of authorship and the sociocultural facets of composer-performer-technician interrelationships arising in the work of Haller and other collaborators are left without substantial critical self-reflection. Thus, the following chapter presents a new critical history and organology of the Experimentalstudio that combines evidence from sources that have been overlooked in anglophone scholarship, while providing

[9] Snape & Born (2022), 223.

new insights by the author pertaining to the aesthetic and historical significance of the electronic instruments and practices, proceeding chronologically, instrument by instrument, and their attendant concepts.

2. Studio as Instrument

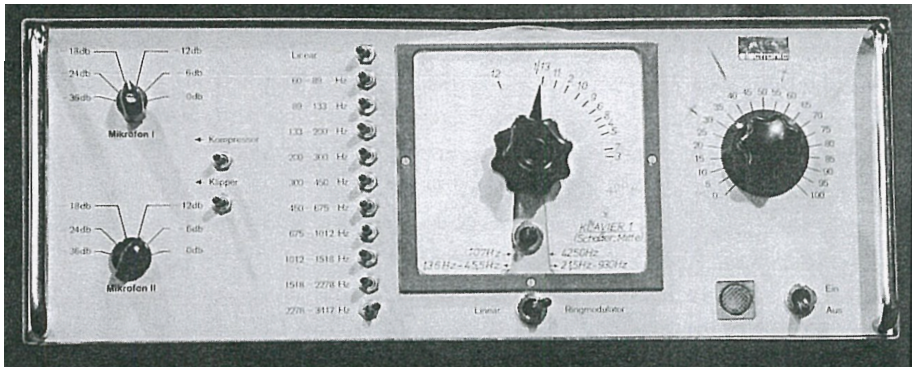
2.1 Klangumformung: Liveness

In September 1971 Heinrich Strobel, then Music Director of Südwestfunk (SWF), founded the Experimentalstudio der Heinrich-Strobel-Stiftung des SWF located at the new Landesstudio Günterstal in a village on the outskirts of Freiburg, with Hans Peter Haller appointed as the first director: a composer with a range of experiences in electronic music, and a long-standing employee of SWF. The studio existed in an informal manner several years prior, scattered across several SWF facilities in Baden Baden and Rastatt. As the director of the major festival of European modernist music, Donaueschinger Musiktage, Strobel commissioned Stockhausen in 1969 for what would eventually become *Mantra* (1970) for two pianos and ring modulators. This was the founding event of the studio-to-be. As such, the studio's origins are grounded in specific project-based working practices, responding to needs of composition and live performance, and organised within the context of establishment organisations: a state-funded radio station and festival.

Haller was tasked with providing the equipment and technical supervision in performance. Responding to Stockhausen's desire to apply ring modulation to the pianos, and to mix the resulting electronic sound with the untreated amplified piano as a form of sonic augmentation of the piano, Haller developed a bespoke ring modulator device (fig. 1) for the project in partnership with electrical engineer Peter Lawo. With the success of this debut project, Lawo became Haller's creative partner and a central figure in the studio's early development, with Lawo and his audio technology company providing the otherwise lacking expertise in electrical engineering and manufacturing that were required to develop new electronic music technology in the nascent organisation.[10]

[10] Lawo's company continues in the present day as a manufacturer of professional-grade broadcast AV and networking technology. https://lawo.com/

Figure 1: 1st Generation Ring Modulator: Lawo Electronic MODUL 69 B[11]



Together, Haller and Lawo worked with Stockhausen and the piano duo (brothers) Aloys and Alfons Kontarsky during a week-long workshop in a college auditorium in Rastatt in the summer of 1970. During this workshop, and throughout several later test periods and rehearsals at the SWF studios, Haller and Lawo optimised the device both for its sound quality and performance practicality, i.e. as an instrument in and of itself, since the pianists had to operate the devices in concert, selecting specific frequencies, which Lawo's device had notched into its primary control dial as presets. The MODUL 69 B also included a filter, compressor, limiter, and amplifier in order to optimise the input signal i.e. so the piano sound captured by the microphone was loud enough for the device to process it effectively, without the noise floor being too audible. The low pass filter attenuated noisier high frequencies in the attack transients of the original sound, as these tended to produce a noisy output signal with harsh attacks, whereas the team wanted clearer, 'bell-like' tones.[12]

In the development and premiere performance of *Mantra*, Haller successfully proved the prototype of the collaborative technical and aesthetic practice that distinguish the Experimentalstudio from other comparable Western avant-garde electronic music institutions, most notably, with its emphasis on liveness and *Klangumformung*: the realtime transformation of sound, as well as the experimentalism (in the methodological rather than stylistic sense), and interdependence that such liveness and the many

[11] Photo from SWR Experimentalstudio Freiburg's archive, used with permission.

[12] Haller (1995, vol.2), 36.

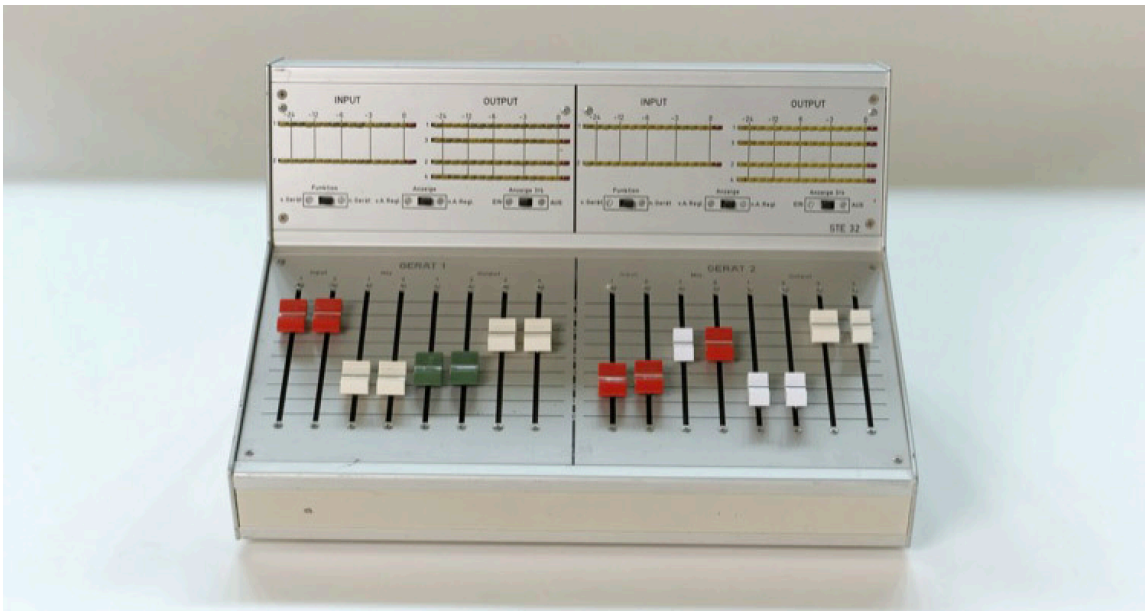
practical issues relating to performance encourages between composer, musician, engineer, producer/director, and even the technology itself.

The performances of *Mantra* revealed the need for a new technician-musician role, the *Klangregisseur* (sound director), who was responsible for the technical assistance in the process of composition, as well the execution and balancing of live electronics with amplified acoustic instruments in performance, located at the sound desk at the centre of the hall, or another optimal listening position among the audience. In the rehearsals and performance of *Mantra*, the team found it necessary to both amplify the pianos to match the levels of the electronics, but also, after several performances of mixed results, for Haller to ride the faders of the electronic sounds on the mixing desk to achieve the best dynamic range, responding to the dynamic structure of the work, and thereby avoiding a 'permanent mezzofortissimo' in the electronics, which proved to be the case earlier, without live mixing.[13] Fig. 2 shows one of the studio's later custom-built mixing desks manufactured in 1985 by Frei Systemtech.[14] This live sound aspect of the Klangregisseur further reinforces their status as a fellow performer alongside the musicians on stage, since they are the only person in the ensemble who can hear the full mix of the performance, and therefore, they wield a certain power over the actual sound of the entire ensemble.

[13] Haller (1995, vol. 2), 26.

[14] Archival photo from Experimentalstudio's Virtual Studio Tour, accessed 24 April 2020: www1.swr.de/experimentalstudio/preview/

Figure 2: Fernsteuerung Mixer-Einheit[15]



Another distinguishing technical feature of the studio's practice took hold in this first project: the preference for the now ubiquitous and cheaper dynamic microphones (Shure SM58) for the live electronic inputs, instead of higher fidelity studio recording condenser microphones. The dynamic microphones were not only better at avoiding feedback because of their pickup pattern and frequency response, but also, as confirmed by Andre Richard in an interview with the author: live electronics did not benefit from higher quality recording microphones; the difference could not be heard in the quality of the electronic output in a performance context with large venues and multiple loudspeaker arrays.[16] Thus, the very *sound of the studio* — sound in the audio production sense of the term as encapsulating the spirit of a studio or instrument — was an inherently *live* rather than *phonographic* style, which is another line of demarcation against comparable western studios of the time such as GRM in Paris or the WDR Studio in Cologne.

From liveness in sound to in compositional method: according to Haller, while Stockhausen arrived at the initial workshop week in Rastatt with an already extensively written score, he continued to adapt

[15] Photo from SWR Experimentalstudio's online Virtual Studio Tour: www1.swr.de/experimentalstudio/preview/ (accessed 22 October 2019).

[16] Online interview with Andre Richard and the author (22 April 2000.

the composition itself in response to the many ad hoc experiments and improvisations that occurred during the sessions.[17] For example, they found that with slower sub-audio modulation frequencies (6-12hz), the ring modulation created 'amplitude vibrato' effects, which today are more commonly referred to as a 'tremolo' effect in digital signal processing. This experiment eventually led to the addition of bb. 132-150 in the final score, where the pianists change the modulation speeds according to the scored values to create pre-determined rhythmised pulses. Furthermore, bb. 421-433 at the centre of *Mantra* show another more playful and spectacular moment afforded by the ring modulators, where each pianist slowly turns the modulator dial so that we hear strange electronic glissandi morph over austere yet striking atonal piano chords. These two examples offer a glimpse of how the team embraced experimentation with technology as a co-creative force in the studio's practice; a means of surprise, disruption, play, and invention that, moreover, the composer could not pre-calculate *a priori* as part of a post-serialist paradigm. In the workshop process of *Mantra*, reflexive exchanges provoked by both human and non-human actors encouraged an ethos of experimentation that would prove critical for Haller and the Experimentalstudio's later work with Nono.

We can further understand the studio's unique founding features, and in particular the role of experimentation and play, through critical organology. Writing about experimental phenomena in scientific laboratories, Bruno Latour and Steve Woolgar state that 'it is not simply that phenomena depend on certain material instrumentation; rather, the phenomena are thoroughly constituted by the material setting of the laboratory.'[18] Taking this idea further in a musical setting, we can say that in the case of *Mantra*, the new technology of the ring modulator became the nexus for circulations, exchanges, and re-mediations of cultural, technical, and musical ideas and matter between the collaborative team. Writers including Antoine Hennion and Eliot Bates have drawn comparisons between the science laboratory and music studios as productive analytical starting points, although, these comparisons soon bump into problems because the phenomena and ontology of music are far more complex,

[17] Haller (1995, vol. 2) 11.

[18] Bruno Latour and Steve Woolgar (1979), 64, original emphasis.

multifarious, and less objective than the often isolated and minute phenomena of the science lab.[19] In studying the emergence of Turkish studio session musicians, Bates writes that studios have 'a constitutive force in producing new kinds of musicianship and new kinds of musicians.'[20] The Experimentalstudio resonates with Bates statement, not only with the example of the Klangregisseur, an entirely new category of musician, but also in how the studio, its technologies, and practice of workshops transformed the existing categories of classical musician, granting them more agency in the compositional process, particularly in the context of post-war musical modernism and its frequent obsession with excessive notational control. This will become even more important in the case of Nono and his studio collaborators, as well as Haller, explored in chapter four.

In considering this first project by the as-then unofficial Experimentalstudio, its *Ursprungsstück*, we might further consider the significance of the ring modulator as the first instrument among the studio's instrumentation, especially in light of the device's striking sonic and aesthetic affinities. The non-tempered electronic tones are arguably one of the defining modernist and, in more popular terms, *sci-fi* electronic sounds of the twentieth century, responsible for a panoply of music and sounds, from the eerie and harsh sound effects by Lous and Bebe Barron in the 1956 sci-fi classic, *Forbidden Planet*, to the inhuman voices of the Dalek in the BBC's 1963 series *Doctor Who*, as well as countless other TV and Film soundtracks, plus earlier modernist works such as Stockhausen's *Gesang der Jünglinge* (1956).

The ring modulator and its cultural position in western post-war science fiction as a signifier of the electro-mechanical and alien, exemplifies a certain western cultural attitude of the primordial otherness of technology — a paradoxical fear yet fasciation in both its technical and aesthetic power — as it distorts and disfigures human presence in sound, while also flouting the expected sonorities of conventional tempered harmony.[21] Furthermore, we might consider the ring modulator as a sonic prism of cyborg and transhumanist aesthetics, taking one worldly and corporeal signal — the piano —

[19] Hennion (1989), Bates (2012, 2012a)

[20] Bates (2012a)

[21] For a discussion of perceptions agency of technology in modern cultures, see Andrew M. Jones and Nicole Boivin (2010).

and transforming it by colliding it with a pure, electronic, and unnatural entity; the sine wave. In this light, we can view the sonorities of ring modulation as a twentieth century echo of the historic romantic sublime in visual arts and literature; the awe-inspiring, epic, and euphoric yet terrifying, overwhelming, inhuman, and ungraspable.[22] The ring modulator's foundational place in the Experimentalstudio's history can thus be seen as emblematic of the studio's entanglement with modernist aesthetics; instrumentalising technological otherness, as the realtime augmentation and transformation of human sonic and corporeal realities (whether vocal or instrumental) in search for a renewed formalism and avant-garde musical autonomy.

2.2 Halaphone: Spatialisation

Today, while *Mantra* is a relatively canonical modernist work in the context of Stockhausen's œuvre,[23] by contrast, the second work produced by the studio, and the first since its official founding, Cristóbal Halffter's *Planto por las Víctimas de la Violencia* (1971) for ensemble and live electronics, remains somewhat obscure and marginalised. Nonetheless, this work is equally significant in how it progressed the Experimentalstudio's technical paradigm to the point as virtually fully formed as Nono would first encounter it almost a decade later, particularly with regard to the use of spatialisation. As Haller concluded, the development phase and performance of *Planto* proved 'a symbiosis of electronics technician and musician' at the core the studio's practice.[24]

For this new work, Haller developed yet more electronic devices with Lawo for the premiere at Donaueschinger Musiktage in autumn 1971. Like Stockhausen before, Halffter joined Haller in the studio during several visits in early 1971 to experiment with the various live electronic processes, and to tailor his piece for the different possible combinations and functions. Most consequentially with this

[22] For discussion to the sublime in contemporary culture see Philip Shaw (2017).

[23] Newton Armstrong (2011)

[24] Haller (1995, vol. 2), 40.

project, a new instrument was introduced, the Halaphone: a spatialisation device that creates the illusion of a moving sound across an array of loudspeakers in pre-defined cyclical or reciprocating routes, and at variable speeds. In the years before the foundation of the Experimentalstudio, Haller experimented in his home studio and attempted to build a multichannel audio router based on a rotating axle design that would slowly pan a mono audio source between four channels.[25] While he reported that his engineering skills were inadequate to refine the prototype into a working model, the principle of his design, a device that pans a sound between several loudspeakers with a rotational movement of a controllable frequency, was fully realised in the Halaphone model which he later created with Lawo.

The first generation Halaphone, shown in fig. 3, could spatialise a mono audio source between four loudspeakers. Fig. 4 shows the second generation Halaphone from 1972, which added pin-board matrices that enabled easier routing changes, and fig. 5 shows the third generation Halaphone from 1985, which saw the digitisation of the system, including a computer monitor screen, and number keypad to recall different settings. In *Planto por las Víctimas de la Violencia*, Haller and Halffter used two Halaphones with several different configurations so that a total of eight loudspeakers expanded the spatial scale of the work, surrounding the audience. The spatialisation of the electronics was paralleled by the spatial placement of the ensemble around the performance venue. Fig. 6 shows the layout from the score for the premiere in the Donauhalle for Donaueschinger Musiktage. Throughout the different sections of the work, the two Halaphones employ a variety of spatial movements, usually slow cyclical motions between loudspeakers 1-4 or a linear motion across the length of the hall between loudspeakers 5-8 at speeds of 0.2 to 1 Hz. In addition to the Halaphone's wandering sounds, Haller also set locations for certain fixed sounds, routing them to either a single loudspeaker for maximum locational specificity, or to opposing pairs to create an antiphonal effect, e.g. loudspeakers 3-4 and 6-7.

[25] Haller (1995, vol. 1), 78-91.

Figure 3: 1st Generation Halaphone[26]

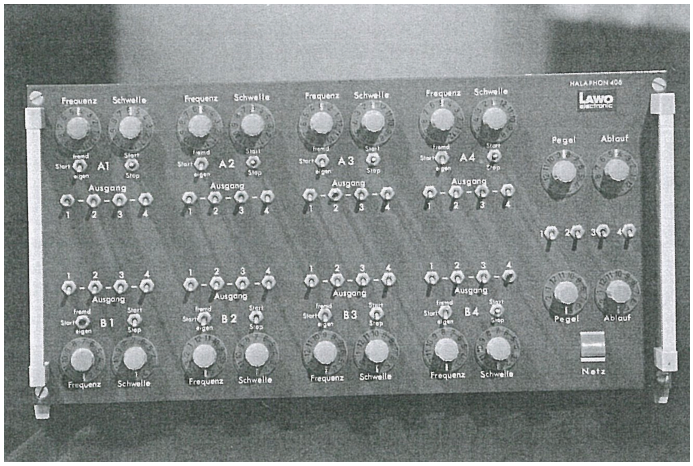
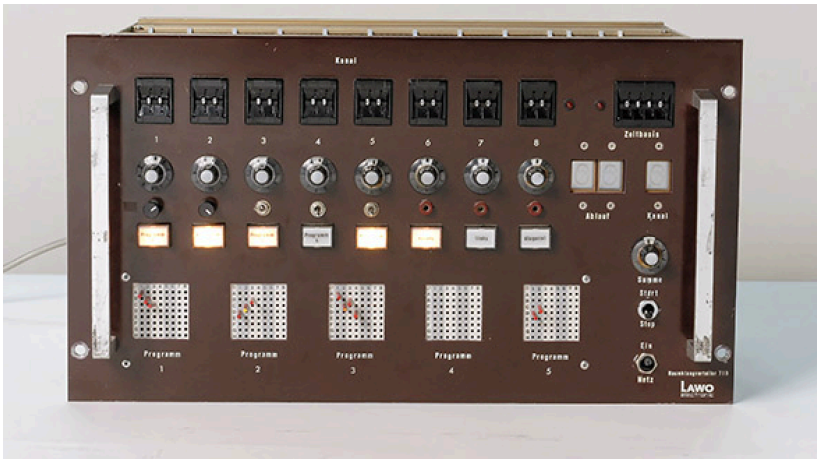


Figure 4: 2nd Generation Halaphone[27]



[26] Haller (1995, vol. 2), 36.

[27] SWR Experimentalstudio online Virtual Studio Tour.

Figure 5: 3rd Generation Halaphone[28]

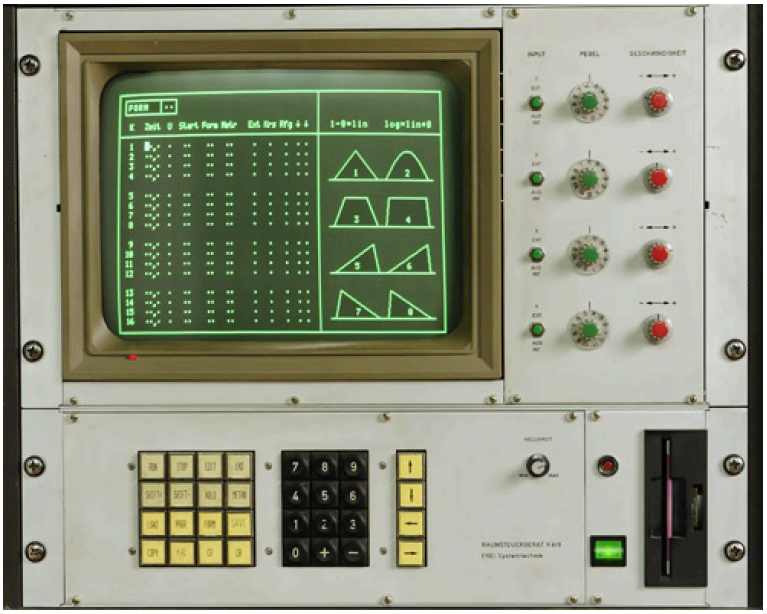


Figure 6: Performance Layout Plan for 'Planto por las Víctimas de la Violencia'[29]

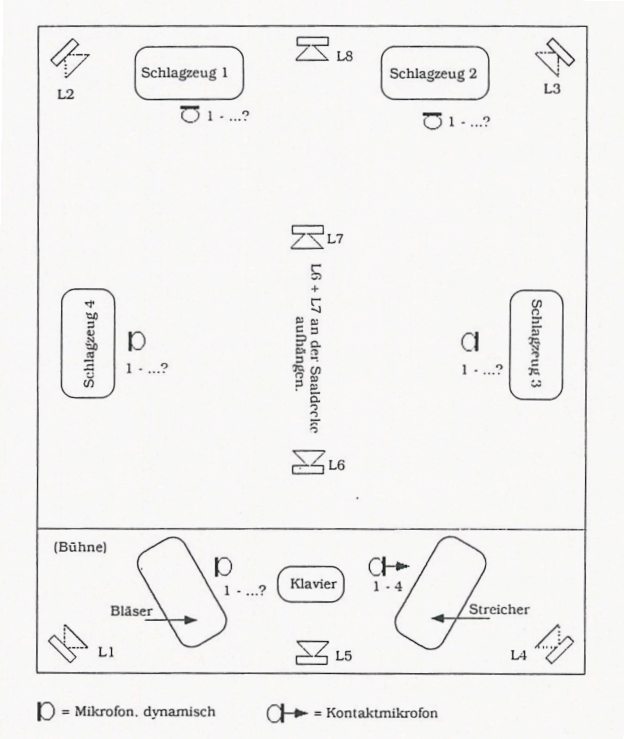


Table 1 reproduces the live electronic performance plan from archival sources at Experimentalstudio analysed by the author.[30] It is significant in the context of the evolution of the studio's practice because

[28] SWR Experimentalstudio online Virtual Studio Tour.

[29] Haller (1995, vol. 2), 34.

[30] Notes to the electronics for Halffter's *Planto por las Víctimas de la Violencia* in the archive of the Experimentalstudio Freiburg. Uncatalogued and un-dated but suspected to be original by the author and the studio's current director, Joachim Haas.

this is the first example of an electronic programme scheme that incorporates the studio's multi-instrument formation, and which details all the combinations of live electronics and spatialisation routines, as well as where to enact the programme changes according to the score. By the time of Nono's arrival in 1980, such plans had become a commonplace part of the studio's workflow, and are reflected today in the explanatory diagrams in the critical editions of Nono's scores by Ricordi Milano. Thus, the diagrams and table evidence how technology afforded new forms of documentation and media which would complement the conventional musical score, and in some case, particularly Nono's late works after *Prometeo*, supplant it.

Returning to the technology and the inner workings of the Halaphone, fig. 7 shows an explanatory diagram for the Halaphone from Haller's website, illustrating how a sound is spatialised around the audience via a quadrophonic speaker system, starting at the front-left speaker and moving clockwise. At the top of the schematic are four oscillators which sequentially output the four individual gain envelopes according to four possible waveforms (sine, triangle, sawtooth 1, sawtooth 2). The envelope shapes represent the automated gain control applied via *gates* (voltage controlled amplifiers) to the source signal across the four loudspeaker channels, i.e. the input source channel is routed directly to all four loudspeaker channels, but only heard in this demonstration one at a time from an individual loudspeaker according to the intended rotating spatialisation programme. In the schematic of table 1 the spatialisation result is a clockwise rotational movement from loudspeaker 1 to loudspeaker 2, 3, 4, and starting again from loudspeaker 1.

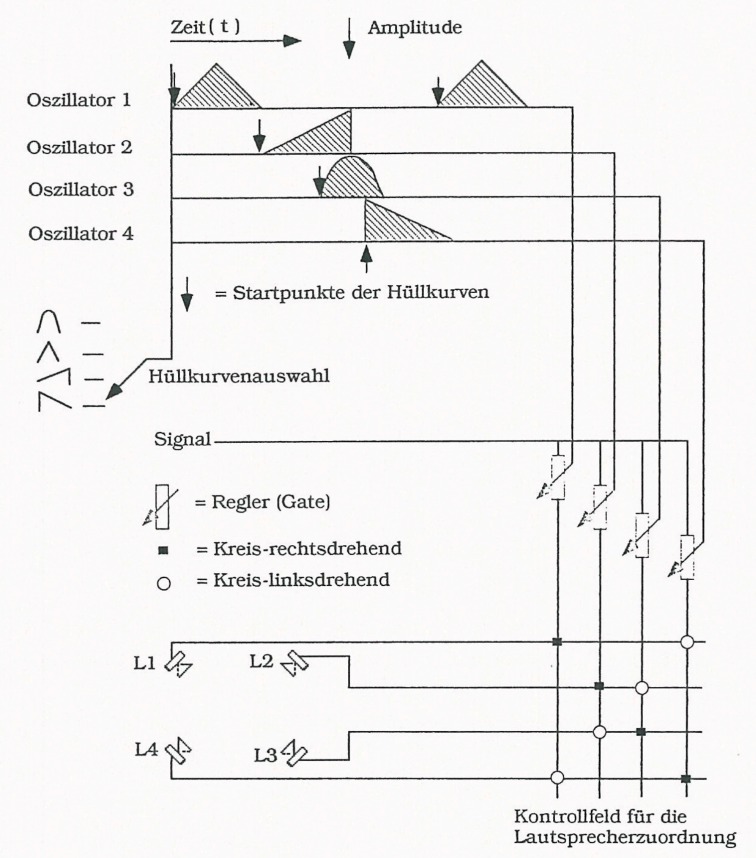
Table 1: Electronics Programme Plan for 'Planto por las *Víctimas* de la Violencia'[31]

Entry	**Instruments**	**Live electronics**	**Diffusion / Spatialisation**
1: pp. 1-6	String quartet	Ring modulation by 494 hz sine wave	L2
2: pp. 7-12	Woodwinds	Ring modulation moving gradually from 2093 to 174 hz sine wave	L3
	Percussion 1-4	Gate 1	L3
	String quartet	9 Bandpass filters gradually sweeping	L2
3: p. 13	Piano and percussion	Unprocessed, Halaphone 1,	Slow anticlockwise rotation L1-4
	Woodwinds	Unprocessed, Halaphone 2,	Slow clockwise rotation L5-8
4: pp. 14-20	Percussion 1-2	Bandpass filters gradually sweeping, to gates 1-2	L1+L2
	Percussion 3	Gate 3, to modulation, to Halaphone 2	Medium anticlockwise rotation L5-8
	Piano and percussion 4	Gate 4, to modulation, to Halaphon	
	Strings	Contact microphones to gates 1-4	
5: pp. 21-24	Tutti	Bandpass filters, sweeping, Halaphone 1 + 2	H.1 = variable clockwise rotation L1-4, 0.1-0.5 Hz H.2 = variable diagonal L5-8, 0.1-0.8 Hz
6: pp. 25-26	Percussion 1-4	Ring modulation with variable 590-660hz sin wave	L2
7: pp. 27-32	Tape part	Unprocessed, fixed stereo	L6-7
	Piano	Reverb, 2-3 second decay	L8
	Woodwinds	Unprocessed, alternating speaker diffusion	L1-3
	Percussion 1-4	Sweeping bandpass filters	Perc. 1-2 = L4 Perc. 3-4 = L1
8: pp. 33-35	Woodwinds	Static bandpass filters, to gate 1	L3
	Percussion 2	To gate 1	L3
	Strings	Ring modulation, slow sweep 988-220 hz sine tone, to gate 3	L2
	Percussion 4	To gate 3	L2
	Piano	Unprocessed fixed amplfiication	L7
9: p. 36	Percussion 1-4	Unprocessed, Halaphone 1	Horizontal alternation, 0.2-0.3hz, L1-4
10: p. 37	Strings	Ring modulation (247 hz sine), to Halaphone 2	Horizontal alternation, 0.2-0.3hz, L1-4
	Piano	Unprocessed fixed amplfiication	L6-8
	Woodwinds	10 sweeping quintal bandpass filters, 60-3417 hz	L6 + L8

[31] Transcription from Haller (1995, vol. 2), 38-39.

The spatialisation motion outlined here, assuming the input sound was constant, would not be perceived as entirely smooth and continuous because the envelopes for each loudspeaker are different shapes and overlap by different amounts, i.e. one would not necessarily perceive a co-articulated movement between loudspeaker 1 and 2 as the sound fades to silence between the two envelopes, however (acoustics notwithstanding) one should expect to hear some kind of smooth and connected motion between loudspeakers 2, 3, and 4 because of the overlapping envelopes.

Figure 7: Explanatory Diagram of the Halaphone[32]



In this early phase of live spatialisation technology, Haller recognised the contingency and limitations of such systems in spite of the theoretical expectations i.e. the limits of precise spatialisation and perceived localisation. He underlined how the devices sounded differently depending on the acoustic of the performance venue, and, foreshadowing psychoacoustic principles of localisation that would be developed years later, depending on the timbre of the sound itself, where rich or noisier signals are

[32] Haller (1995, vol.1), 78.

easier to locate in a space compared to purer waveforms (e.g. sine-tone), because the performance space colours and affects the sound as it reverberates in an acoustic before reaching our ears:[33]

> The later performance in Donaueschingen proved to us that contingencies still occurred with this first electronic surround sound control device. A randomness in the sound movement will always remain and with it part of the liveliness of the electronic sound transformation: the room acoustics, which cannot be precisely calculated in advance […] This information can only be relative; it has to be heard anew from concert room to concert room and modified accordingly.[34]

Despite the centrality of the Halaphone throughout the Experimentalstudio's first two decades, and in Nono's late works in particular, it is notable that discussions of preexisting spatialisation systems, spatial music and aesthetics, and composers working with space remain scant in Haller's book and other documents. As a composer and technician active in the West German avant-garde music scene in his capacity as an SWF employee, it is highly unlikely that Haller was unaware of other systems and repertoire from the 1950s. For example, in Europe alone there are numerous examples in the post-war period leading up to the studio's formation: the potentiomètre d'espace of the GRM in Paris during the early 1950s[35]; the Philips Pavilion at the 1958 Brussels' World Fair by Le Corbusier and Iannis Xenakis, including two tape works, Varèse's *Poème électronique*, and Xenakis' concrete PH[36]; and the WDR Studio's various multichannel speaker systems in the early 1950s, eventually used by Stockhausen for works using surround sound and tape including *Gesang der Jünglinge* (1955-6), and *Kontakte* (1958).[37] Beyond Europe, important moments in spatial music leading to the 1970s include the multichannel Fantasound system developed by RCA and Disney in the USA for the *Fantasia* film from 1938-42 (cited in Garrity & Jones: 1944), and the eight-channel experiments by John Cage and Earle Brown for their respective works *Williams Mix* and *Octet 1* in 1953 at the University of Illinois (Nattiez, 1995: 134-142). While it is impossible to determine the extent to which Haller was aware of such references in the available sources due to their apparent absence until Nono's arrival, we should nonetheless examine

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[33] Jens Blauert (1984).

[34] Haller (1995, vol. 2) 36.

[35] Teruggi (2007), Manning (2013, ch. 2).

[36] cf. Lombardo et al. (2009), Trieb (1996), Felciano (1996).

[37] cf. Beal (2003), Lindlar (1954), and Prieberg (1960).

how the early instance of the Halaphone fits within the context and history of spatial music and spatialisation technology in order to discern its distinctiveness, and to reveal heretofore hidden affinities with other examples in the field.

In his article sketching the history of stereophony and spatialisation in the mid-twentieth century, Patrick Valiquet makes a compelling case that undermines the narrative of technical and aesthetic primacy of the above-described western avant-garde lineage of spatial music, as often told in histories of electroacoustic music. Instead, Valiquet brings into light a wider field of contemporaneous participants from commercial, broadcasting, and film sectors, whom he shows to be equally important in the history of multichannel music technology.[38] Comparing the origins, usage, and polemics of the terms *stereophony* with *spatialisation* after the war, Valiquet reveals how composers and technicians affiliated with the avant-garde generated a discourse of exclusion and isolationism, separating their modernist musical practices of *spatialisation* from the broadcasting and recording fields of 'ordinary' *stereophony* (Schaffer's denigration),[39] in parallel with a wider though diffused effort to define and legitimise the postwar modernist genre:

> In order to capture and consolidate new institutional ground, aesthetic boundaries needed to be erected on two fronts, against mass cultural banality on the one hand, and against bourgeois a tradition on the other … composers and theorists were able to rationalise their appropriation of the technical apparatus of multichannel stereophony from the telecommunications and entertainment industries while simultaneously constructing an aesthetic of spatialisation which delegitimised commercial music and sound design.[40]

Valiquet points to the example of Harvey Fletcher at Bell Labs, who developed stereophonic technology in the 1930s,[41] and who chose conductor Leopold Stokowski over Varèse as a collaborator in developing and demonstrating their first experiments with stereophony in the 1930s, reportedly because Stokowski brought a more accessible and marketable type of orchestral music to their public

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[38] Valiquet: (2009), 407.

[39] Schaeffer (1952), 109.

[40] Valiquet (2009), 406.

[41] cf. Sterne (2003); and Ouzounian (2021).

demonstrations instead of Varèse's unproven and challenging modernist style (Varèse: 1972). Stokowski continued his support for technological innovation in the development of the Fantasound system by Walt Disney Studios and RCA for the film Fantasia from 1938, which in several versions of the system that toured theatres throughout the US until 1942, was the first public multichannel audiovisual work until its abandonment in 1942 due to excessive cost. The irony, Valiquet illuminates, is that Varèse's writings and *Poème électronique* are often cited as among the *firsts* in histories of electronic music and spatialisation, even though figures working in the broadcasting and commercial sector such as Fletcher and Stokowski had already engaged more seriously with the technology and its potential from the 1930s, almost two decades before Varèse even gained access to a electronic music studio for the Philips Pavilion project in the mid 1950s.

The Fantasia project is ignored in histories of spatialisation and early electronic music by authors including Harley (1994), Manning (2013), Nauck (1997), and Solomon (2007), even though Stokowski provided perhaps one of the earliest proposals (Francis Bacon's Soundhouse aside) for new multichannel listening and performance formats: 'recreation centres' where audiences can freely stroll between several diffusions of different concert broadcasts occurring simultaneously around the country.[42] The absence of references to the experiments in stereophony among the film and recording industries in both the contemporaneous discourses and later histories of the period is proof, in Valiquet's view, of the success of the Avant-garde's polemics in severing themselves from commercial and popular culture settings, while simultaneously positioning themselves as technically and aesthetically superior.

Providing an even broader view on the history of space in music, Georgina Born offers a productive threefold analysis of the discourses, uses, and concepts of space in composition, musicology, and sound art (Born: 2013). Firstly, Born describes a 'pitch-space formalism' predominant in western score-based music that prioritises space as an abstract container for harmonic, temporal, and structural units such

[42] Stokowski (1943), 258.

as pitch and rhythmic intervals. This paradigm, Born argues, is the most prominent in western scholarship on music, for example in Schenkerian analysis, but also in composition itself, where she highlights Boulez as a typical pitch-space thinker. Secondly, the paradigm of spatialisation and concepts of space abound in electroacoustic or acousmatic music that developed since the 1950s, as seen in the writings of Pierre Schaeffer, John Chowning, Trevor Wishart, and Denis Smalley. This lineage encompasses more phenomenologically-orientated approaches to spatiality, though still with the goal of creating bounded forms of musical autonomy. Born's third paradigm is 'post-formalist' and looser in terms of genre, incorporating artists across soundscape composition, experimental music, and sound art. What unites them is an underlying concern with 'subjective and embodied, physical and social locations' that 'transcend Euclidean forms' that are otherwise rife in the other two lineages,[43] as well as commonly featuring aspects of participation, interactivity, collaboration or community that render audiences less passive. Born points to Cage's *4'33"* as an important early work in this lineages alongside later work by R. Murray Shafer, Alvin Lucier, and Fluxus artists, and many others.

In considering the Experimentalstudio's foundational work prior to Nono's joining, we can appreciate both with regards to Valiquet and Born's historiographies that the origins of the Halaphone lie firmly in the aesthetics of modernism; the placement and motion of electronic sound in an abstracted, geometrical, or Euclidean space, where space becomes yet another musical dimension to quantify within a post-serialist compositional idiolect. Haller's lack of references to other systems from either avant-garde or commercial applications from the 1950s to 1960s suggests that he and Lawo sought to create their own *sui generis* technical platform, as explained in the schematic of fig. 7. It was not until Nono's arrival at the studio that a more fully-fledged aesthetics of space, beyond Euclidian and pitch formalisms, would emerge, detailed in chapter four.

Against this historical backdrop, what makes the Halaphone unique in the history of spatialisation technology up to the 1970s is its inherent *liveness* and relative *modularity*. While earlier systems such as

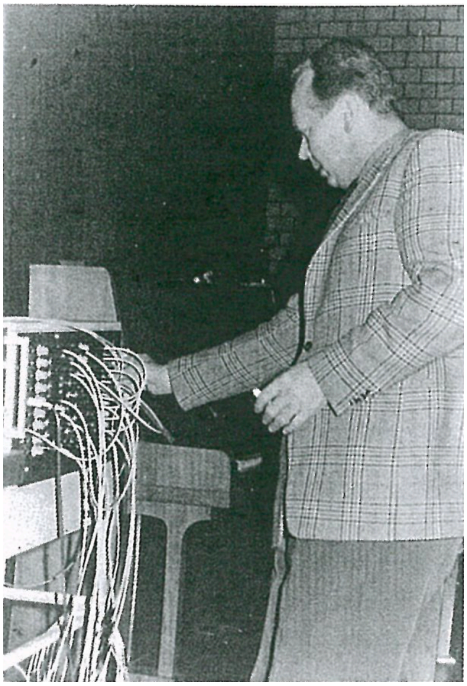
[43] Born (2013), 17.

the Fantasound or GRM's potentiomètre d'espace operated in realtime, where the operator would move a controller within the interface as an analogue of the sound moving between the loudspeakers, the Halaphone is perhaps one of the first analogue devices that created automated rotational trajectories that could be altered in realtime via the frequency control dials. Furthermore, as was the case with *Planto*, these trajectories could be re-routed during a pause in the performance, so that the Halaphone was not fixed to one type of pre-programmed spatialisation, as was the case with other avant-garde works using fixed multichannel tape or fixed infrastructure, e.g. the Philips Pavilion. Compared to the roomful of telephone exchange equipment used in the Philips Pavilion, the relatively compact size of the Halaphone, about the size of a big toaster, meant it could be easily assimilated within the multi-device collection of the burgeoning studio instrumentation. Moreover, as in *Planto*, two could be used in tandem to create multiple superimposed spatialisations and/or alternating between one another so that while one plays, the other could be re-programmed.

In addition to the Halaphone, *Planto* saw the first deployment of another new device, the HTK 4 (*Hallers tolle Kiste*), which combined a ring modulator with more filters. As with the *Mantra* ring modulator, both HTK 4 and Halaphone featured interfaces designed principally for the practicalities of performance, enabling Haller to switch between certain configurations of predetermined compositional intention. Nonetheless, as an analogue electronic device, the connections and operation of the devices require manual cable patching, and in performance, this meant Haller had to manually re-patch the devices according to the intended functionality as shown above in fig. 6. An impression of the jumbled and messy reality of early live electronics can be glimpsed in fig. 8, showing Haller with the HTK 4.[44]

[44] Haller (1995, vol. 1), 20.

Figure 8: Hans Peters Haller with the HTK 4[45]



2.3 Koppelfeld: Matrices and Modularity

During the premiere of *Planto*, the conductor had to make regular pauses to give Haller, Lawo, and Halffter enough time to re-patch the devices, and even then, Haller reported that they could not manage to patch all the connections that they had planned.[46] Such technical limitations spurred Haller's commissioning of Lawo in the following spring of 1972 for a new system for automatically reconfiguring connections between different devices, the Koppelfeld: a programmable multi-matrix controller, shown in figs. 9-10.

The Koppelfeld consisted of four pinboard matrices, each of which could connect 10 inputs to 10 outputs. In performance, one could switch between the four possible matrices that were pre-programmed, and which, when not in use during performance, could be re-programmed. This meant that Haller could switch almost instantaneously between four different programmes, but even more importantly, and assuming the piece allowed time for it, he or an assistant could reconfigure the three

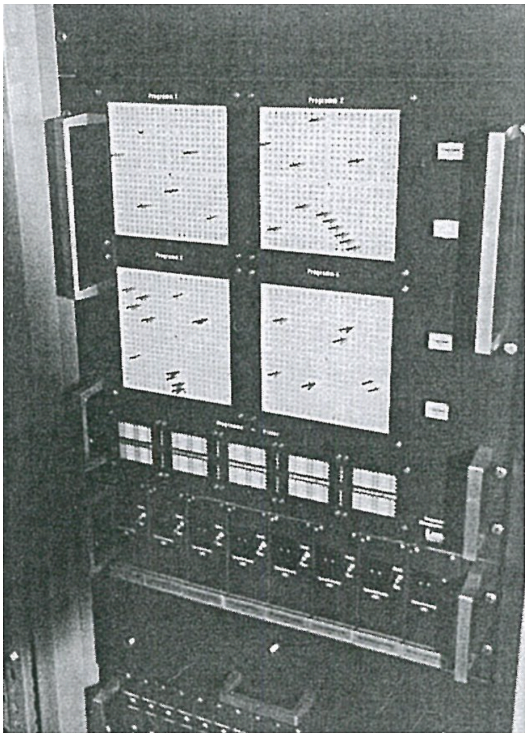
[45] Haller (1995), vol. 1), 20.

[46] Haller (1995, vol. 2), 41-42.

matrices not in use in a given moment, meaning that a work could utilise more than the four initial settings. Furthermore, in addition to the four programmed matrices, the Koppelfeld included five secondary matrices used to control the settings of the filter devices, seen in fig. 9 below the main programme boards.

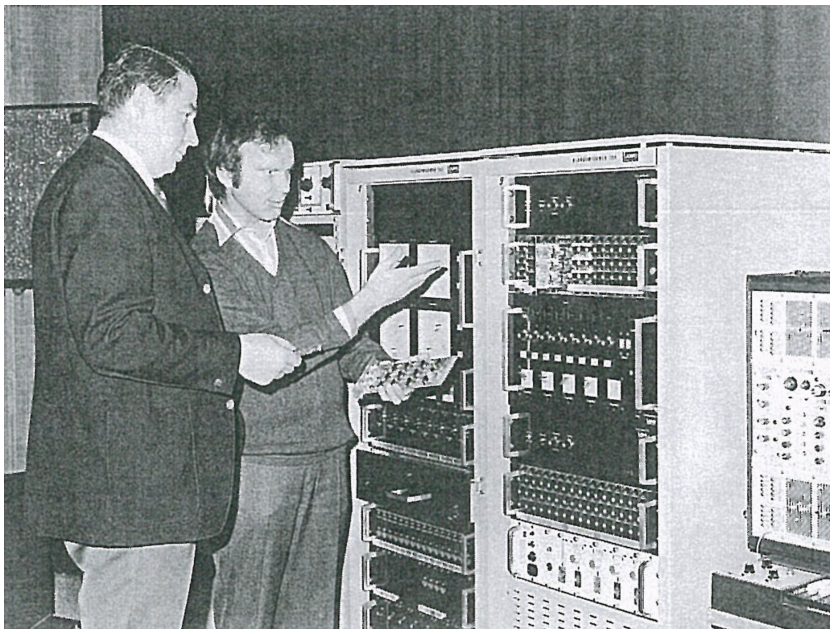
The Koppelfeld enabled Haller to expand the studio's instrumentational possibilities further, since he could now re-patch devices without having to tediously replug cables between them, and instead, work with the greater visual clarity and consolidated design of the pin board matrices. With the new possibilities afforded by the Koppefeld in the 1972, the first so-called *Ausbaustufe* (expansion stage) of the studio emerged, including among its instrumentation: Koppelfeld, HTK 4, Halaphone (second generation), Tape delay, and ARP synthesiser. Fig. 10 shows a photo of Peter Lawo and studio technician Rudolf Strauß next to the new cabinet housing of the devices. The righthand cabinet is fitted from top to bottom with ring modulators, gates, Halaphone and filter bank. The Halaphone is also equipped its own programmable array of matrices, with the five pin-boards seen in the third rack unit from the top.

Figure 9: Koppelfeld[47]



[47] Haller (1995, vol. 2), 52-53.

Figure 10: Peter Lawo and Rudolf Strauß inspecting rack-mounted devices[48]



The Koppelfeld acted like the central nervous system of the Experimentalstudio, connecting and controlling virtually every subsystem other than haptic interfaces which were performed live, such as the mixing desk faders. With the exception of modular synthesisers, which processed synthesised rather than live acoustic signals, this study found no other historical examples of such programmable analogue multi-matrix devices used as instruments for live electronics outside of recording studio contexts in the 1970s. It was not until the 1980s, such as with the digital systems of IRCAM's 4X computer, that other comparable platforms would emerge. Moreover, in the specific case of the 4X, it is this study's view that the Experimentalstudio's technology influenced aspects of the design of the 4X system, because of the early performances it collaborated in of Boulez's …*explosante fixe...* and the premiere of *Répons* at Donaueschingen in 1981.[49] This aspect of the studio's early support of IRCAM's activities is overlooked in existing accounts of IRCAM and Boulez's work, such as Born (1994) and Goldman (2014), and points to the strong self-promotional power of IRCAM (as documented by Born), that has erased the credit of the Experimentalstudio's vital role in the creation of one of its crown jewel, Boulez's *Répons*.[50] As such,

[48] Haller (1995, vol. 2), 52-53.

[49] Once IRCAM developed the 4X, all subsequent performances of *Répons* have been IRCAM productions.

[50] Also evident today, albeit anecdotally, on the Wikipedia page of *Répons*, which lacks any reference to the Experimentalstudio: https://en.wikipedia.org/wiki/R%C3%A9pons accessed 30.08.23.

the Koppelfeld stands as a historically significant device in the history of electronic music, especially in light of how commonplace matrices and modular systems are today in a diverse array of contemporary electronic music and digital arts, prime examples being post-glitch and algorithmic artists using systems built using Max such as Autechre, Mark Fell, or Ryoji Ikeda, to name a few, for whom presets are vital instrumental features.

Overall, Halffter's project, expanding on the initial methods of *Mantra*, created the foundations and distinguishing aspects that would remaining consistent for the next few decades of the Experimentalstudio's performance practice and compositional methodology. These can be generalised as a six-fold process:

1. Initial meetings and workshops with technician and composer, demonstrating the technology
2. Further workshops with musicians, testing live electronics
3. Composition of a scored work and the creation of programme schemes for the live electronics
4. Rehearsals
5. Performance
6. Possible revisions to the score and live electronics

This methodology reflects the studio's allegiance to the strong work concept that was prevalent among postwar European modernist composers and the fora that supported them, such as major festivals like Donaueschingen and Darmstadt. Tellingly, the power of these institutions and the projection of their aesthetic proclivities can been seen in the case of the ultimate deprioritising of the studio's early forays into Free improvisation and Jazz.

Haller performed the studio's live electronics alongside the Manfred Schoof Group in Donuaeschingen in November 1976,[51] using delays on the ensemble musicians so they could improvise to echoes of

[51] Not the festival, but another concert series organised by the Gesellschaft der Musikfreunde Donaueschingen.

themselves, which Haller would also manipulate live to enact a form of mutual improvised interplay. He also played pink noise, spatialised and mixed as dynamic waves in the beginning section as a way for the performers to emerge from the noise without their timbral identities being immediately obvious.[52] Like the ring modulator, the example of Haller's instrumentalisation of pink noise and delays is another example of the studio's use of live electronics to augment and denature acoustic instruments and natural sounds, although in this example, within the contrasting aesthetic domain of improvised music rather than postserial modernism. Another Free Jazz project took place between the studio and Karl Otto Bäder's Jazz-Nova-Ensemble in Lahr in September 1978. The fact that Haller only documents these projects in a rather brief postface-like chapter in his chronology of the studio entitled merely *Weitere Aktivitäten des Experimentalstudio*, and that Free Jazz and improvisation were not pursued as directions of development for the studio in subsequent years, both prove the primacy of the studio's modernist orientation and aesthetic agenda. Nonetheless, as discussed in chapter four, Haller's earlier curiosity with improvisation was perhaps cause for the success between him and Nono, since Nono's work, while challenging modernist compositional methodologies and the strong work paradigm, provided a degree of creative freedom for Haller, and crucially, without undermining the studio's aesthetic and socio-cultural integration with, and reliance on, postwar modernism.

Haller recalled that the *Planto* project proved their practice as 'an absolute integration of the live electronic 'instruments' into a compositional process - a symbiosis of electronics technician and musician.[53] This *symbiosis* equates technician and musicians, and chapter four will explore both how this fold of creative agency can be extended to include the instruments themselves, as well as how this generates new perspectives on authorship and agency in live electronic music more generally.

[52] Haller (1995, vol. 2), 75 & 215.

[53] *Ibid.*, 40.

2.4 Gates: Interactivity

The next most significant part in the chronology of the studio is its project with Pierre Boulez and his first work with live electronics: *...explosante-fixe...* . Boulez visited the studio in the summer of 1972 and then organised an invitation from the Chamber Music Society of Lincoln Center, New York City, for two concerts in January 1973 with the Experimentalstudio featuring a new version of his *...explosante-fixe...*, for eight instruments and electronics. By contemporary standards we might note this astonishingly short lead time for a transatlantic project involving complex and expensive equipment, musicians, and personnel; a reflection of Boulez's power at the time. Yet more remarkable is the anomalous approach Boulez took in his collaboration with the Experimentalstudio compared to their as then established practice. According to Haller's account, after Boulez's initial visit to the studio and demonstrations of the various instruments and their possibilities, the studio team then developed the live electronics without Boulez experimenting further in the studio with live musicians and equipment, and instead, by planning *a priori* 18 programmes for the work during a short trip that Haller made to Boulez in London from 26-28 December 1972.[54] Given that this was Boulez's first work with live electronics, and furthermore, his first work with any electronic component since his withdrawn 1955/58 orchestra and tape work *Poésie pour pouvoir*, we should scrutinise the significance of such a comparatively curtailed interaction with the studio. Firstly, however an account of the work and the performance for context must be outlined.

After the 480 kilograms of studio equipment arrived partially damaged for the concert at New York's Lincoln Center, Haller and his team narrowly saved the performance from cancellation in a matter of hours by re-soldering and repairing the faulty gear. The rehearsals continued successfully, and the concert received critical praise in the New York Times, whose reviewer applauded the historical import of the devices, comparing the innovation of the Halaphone to the advent of stereo recordings, and

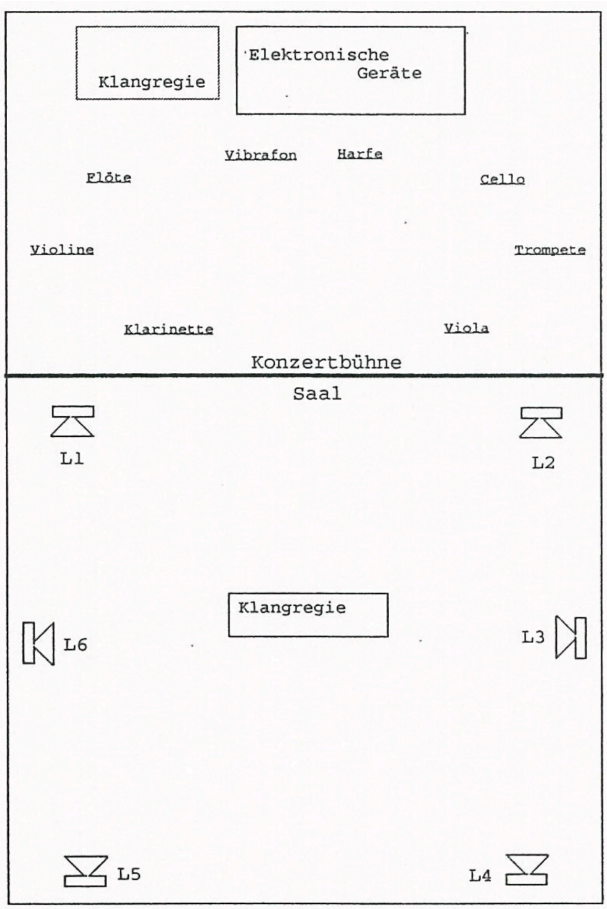
[54] Haller (1995, vol. 2), 56.

realising the potential of live electronics as a new domain for musical exploration over works with tape, although, ceding most credit to Boulez rather than Haller and his team:

> In this work the medium rather than the message is the thing. Now that electronic music has broken away from abstract noises, composers more and more are beginning to utilize it as merely another instrument in the ensemble. That is what Mr. Boulez has done. If, as a composer, he represents a period that already is largely closed, he also, in this work, is pointing to one element of the electronic future.[55]

Fig. 11 shows the performance layout of the ensemble and loudspeakers from the score. For the premiere of this second version of *...explosante-fixe...* Boulez incorporated most of the electronic instruments available as part of Experimentalstudio's first A*usbaustufe*: ring modulators, filters, gates, reverberation, and the Halaphone.

Figure 11: Performance Layout Plan for '…explosante-fixe…' (1973 version)[56]



[55] New York Times, 7 January 1973, Harold C. Schonberg, 'Music: Now We Have the Halaphone ', 65; also New York Times, 5 January 1973, Donal Henahan, 'Boulez Tunes Up for Electronic Debut', 14.

[56] Haller (1995, vol. 2), 57.

Boulez was primarily interested in using live electronics as a means to interweave the disparate layers of instrumental materials in this second version of *explosante-fixe*. The gate devices, created by Haller and Lawo as a subcomponent of the Halaphone, were used in this context as the means to fulfil Boulez's technical and compositional goals. In the Halaphone, the gates were used to control the output of loudspeakers using *low frequency oscillators* (LFOs) as a control signal, where the LFOs determined the rotation speed through a predetermine loudspeaker path. In *explosante-fixe*, the live instruments were used as the control signal, meaning that one live signal could control the amplitude of another output signal, with either positive or negative correlation. The control signal was smoothed out by an averaging function to avoid any spikiness and unevenness caused by strong attack transients and other nosies. In contemporary parlance, Haller's gates are a combination of *envelope followers*, a now common and essential part of DSP, whether in pop or experimental electronic contexts, and *voltage controlled amplifiers* (VCAs), integral components of analogue synthesisers.

In Boulez's work, the gates were used in two ways: first, where the dynamics of an instrument could be positively or negatively correlated to the dynamics of either its own electronic processing level output, or another instruments' electronic processing level output; second, an instruments' performed dynamics could be used to control the speed of the Halaphone motions, i.e. the louder one plays, the faster a spatialised sound travels around or across the performance space. Furthermore, as in Stockhausen's *Mantra*, Boulez assimilated the harmonic and timbral potential of the ring modulators as part of his work's harmonic and timbral structure, using one instrument as input, and another as modulating signal, further interweaving the otherwise disparate instrumental layers through electronics. Thus, the Koppelfeld, was integral to the instrumentality of the Experimentalstudio's instruments in this case, weaving electronic and acoustic instruments together in changeable configurations.

The inherent paradigmatic combinatoriality afforded by the Koppelfeld gave Boulez the means to work with live electronics while adhering to his existing compositional method of abstraction and

parameterisation, thereby conforming with his long-standing post-serialist compositional idiolect. As proof of Boulez's apparent disjunction with the studio's founding ideals of hands-on, in-person, and practice-led experimentation, we can see in an interview from 1985 how he had imagined the live electronics from the start of the project as a solution to a question of abstract combinatorialism:

> The live electronics came in later because as I progressed with the composition of the piece, I realised that the instruments were isolated, and I wanted to have some kind of mutual reaction; but it should be a kind of aleatoric reaction, despite a certain commitment. I said to myself: the instruments are all fixed in their area; how can they influence each other, and not just in terms of their dynamics, that's not enough for me. but also from the pitch? And that's where the live electronics came to my aid, because here they react to one another not only in terms of space and dynamics, but also in terms of sound. For example, if two instruments are modulated together, then the pitch is a resultant and not just the original pitch. ... And then there was also the change in timbre. I have often noticed that an instrument that is being transformed by electronics begins to seem completely anonymous. And I wanted to create a kind of gradation between the individuality of the instrument, which is practically not transformed or only very little transformed, and the total anonymity at the end, where sometimes you cannot distinguish any instrument from the others.[57]

For Boulez then, the material and aesthetic levels of the work consisted of disparate compositional parameters, the 'pitch-space' formalism as described by Born: discrete dynamic, pitch, rhythmic, timbral, and (geometric) spatial metrics. The live electronics merely augmented, reified, and ultimately valorised the score-notated materials and their potential interrelationships rather than reveal immanent features of the musicians — their instruments' individualities or own bodily subjectivities — or performance space characteristics, as would become the core of Nono's late practice. This is to say, for Boulez, electronics offered another means to refract the material contained in score, rather than act as a creative force for methodological renewal, disrupting and progressing the very idea of notation and the work concept, which, again, would be the case with Nono's late works.

In the case of *...explosante-fixe...* as explained in the above quotation, the Koppelfeld enabled the instruments to modulate one another via ring modulation, and to thereby generate additional emergent layers of harmonic and timbral structures. The point is that for Boulez, it is structure rather than

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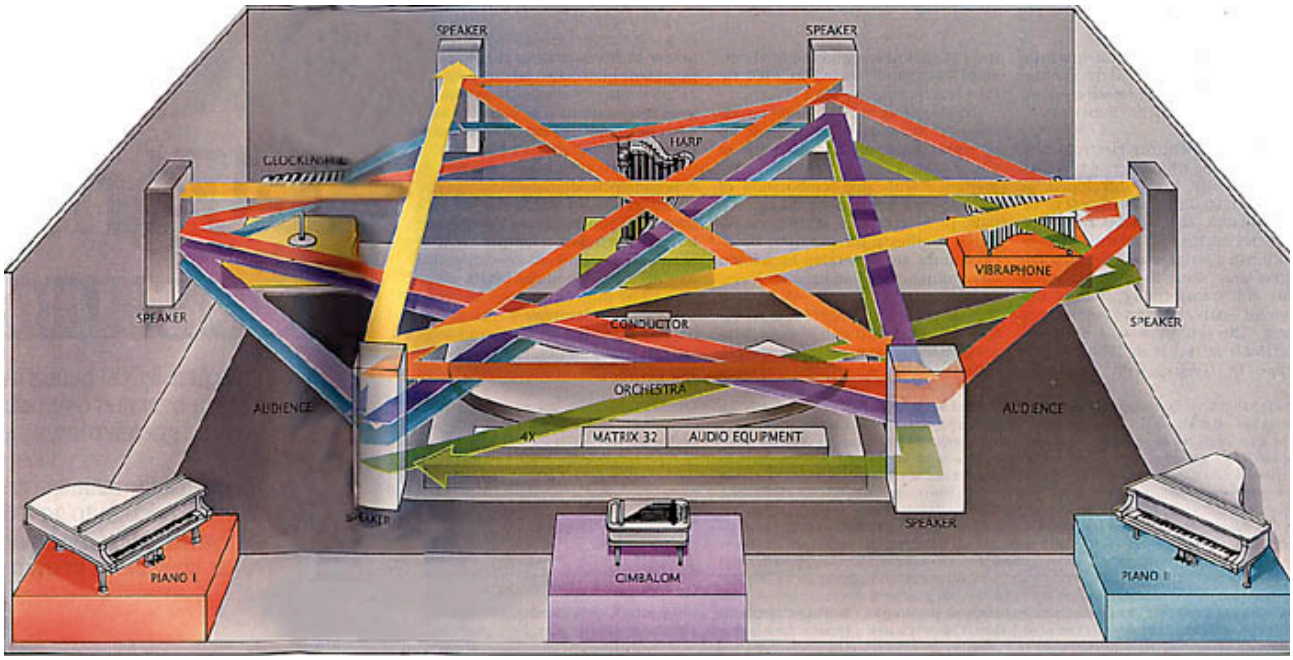
[57] Pierre Boulez and Josef Häusler (1985), 'Pierre Boulez: Über *Répons* — ein Interview mit Josef Hausler', *Teilton 4, Schriftenreihe der Heinrich-Strobel-Stiftung des Sudwestfunks* (Kassel: Bärenreiter Verlag), 7-14.

phenomenology or practice which sits at the core his aesthetic, and its allegiance to the strong work concept. The aleatoricism Boulez speaks of is arguably secondary to the fundamentally fixed structures of the work; a kind of dressing, a weak form of indeterminism. Other than the timbral modulation, there is no hint from Boulez that the live electronics offer their own entirely distinct or novel affective or compositional category, whether narrative, theatrical, or phenomenological; material and performative contingency is rejected in favour for a yet more intense and total control, mediated through notation and electronic programmes.

While Boulez describes using electronics to engender a 'mutual reaction' among the musicians, whom, through electronic sound, 'influence each other', such interactions are nonetheless neither known nor palpable in any way by the musicians themselves; they *merely* perform and reify the score rather than truly react to one another or to the electronics. There is no responsive, generative, or improvisatory aspect to the work in performance that grants the performers agency to explore their new means of interdependence and instrumentality, rather, the 'mutual reactions' remain purely at a level removed from the performers, only available fully to the listeners to hear, or in Boulez's mind. Paraphrasing Lachenmann's critique of Boulez, in *...explosante-fixe...*, and later works like *Répons*, live electronics are used somewhat reductively as a means of 'structure for the sake of structure'.[58] Further emphasising the architectural primacy of electronics for Boulez, Fig. 12 shows a drawing that illustrates the spatialisation paths of sound in *Répons*, the ensemble work that followed *...explosante fixe...,* As the different colour paths show, for Boulez, spatialisation became yet another controllable parameter in his hierarchical construction.

[58] Helmut Lachenmann (1996), 276.

Figure 12: Illustration of Spatialisation in Boulez's 'Répons'[59]



Pulling back from Boulez' specific compositional and aesthetic position to reflect on the technology itself, while envelope followers and VCAs were already common place since the 1960s in popular music and industrial broadcast applications in the form of compressors and other hardware dynamic processing devices,[60] this study failed to find an earlier use of the devices and techniques in a live electronic context with live acoustic instruments, and this fact potentially bestows the Experimentalstudio with a unique historical place in the history of electronic music. The next closest and most historically-reliable report of early interactivity via envelope following in live electronic music with acoustic instruments is Morton Subotnick's 'Ghost Score' works, using the so-called 'Ghost Box', a multi-effects unit including pitch and dynamic envelope followers that he used in his mixed media works *Four Butterflies* (1973) and *Before the Butterfly* (1975).[61] There is no evidence to suggest that Haller and Subotnik had any encounters and influence on each other throughout the 1970s. Therefore, the parallel emergence of the Halaphone and Subotnik's technology can be viewed as an example of

[59] Pierre Boulez and Andrew Gerzso (1988), 'Computers in Music', Scientific American, vol. 258, 4, archived by IRCAM: http://articles.ircam.fr/textes/Boulez88c/

[60] Harold Bode (1961), 37.

[61] Harold W. Whipple (1983), 'Beasts and Butterflies: Morton Subotnick's Ghost Scores', in *The Musical Quarterly*, Vol. 69, No. 3, 425-441.

multiple discovery or parallel invention, a surprisingly common phenomena in the field of science and technology

In further triangulating the distinctive history of the Experimentalstudio, another major counter-example in posing this 'firstism' of interactivity is evident in the earlier 1960s works involving circuit bending and cybernetic aesthetics by American experimental musicians Reed Ghazala, David Tudor, and Gordon Mumma.[62] Responding to the overly stable and predictable sounds and behaviour of early Moog and Buchla synthesisers, as well as the recent scientific discourses that advanced the new fields of cybernetics and artificial intelligence, Mumma's Cybersonics developed circuits of modular electronic instruments that could influence each other through feedback networks. Mumma recognised the radical new potential for this technology, and, drawing on contemporaneous ideas in science, advocated a cybernetic aesthetic that embraced machines and circuits as co-performers, while also foregrounding the contingency and indeterminacy that such systems entailed as the central features of a new performative practice:

> We may treat the artificial intelligence not as a slave, but as a collaborative equal in a democratic musical society. […] My personal interest is with matters of influence rather than control. In my live/electronic work I explore the influences and interactions among myself and other people and the electro-acoustic circuitry that is our "instrument."[63]

David Tudor's composition *Mesa for Cybersonic Bandoneon* (1966) is a paradigmatic example, where Mumma's modules of electronics transformed the sound of Tudor's bandoneon while being modulated by the live sound of the bandoneon itself, as shown in Fig. 13. However, in Tudor and Mumma's systems and performances, interactivity is located *within* and *between* the instrument and performer; even if the instrument is itself a meta-instrument of bandoneon and modular electronics, overall, they form a unity. In the case of the Experimentalstudio, however, Haller's matrix paradigm enabled interaction between *multiple* instruments and performers through the use of the Koppelfeld; a plural instrumentality.

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[62] Ghazala (2005)

[63] Mumma (1970)

It is ironic, especially in the light of Tudor and Mumma's instrumentalisation and aestheticisation of interaction and expanded technological agency, that while the Experimentalstudio developed and realised the technology for such multi-agent live electronic interactivity as in the case of Boulez's *explosante fixe*, the aesthetic potential of these systems was curtailed and muted within the parametricism of Boulez's musical language. As shown in chapter four, Nono's works of the 1980s would come to more fully realise the musical, technical, and aesthetic affordances that such technology generated, as well as the mutualistic practice of collaboration among human, machine, and architectural participants, and, furthermore, with an entirely idiosyncratic discourse separate to the various scienticisms of Boulez and Mumma.

Figure 13: David Tudor working on his 'Cybersonic Bandoneon'[64]

[64] Nakai (2021), 230-231; Photo: Franny Breer, Klüver/Martin Archive.

3. Nono - Crisis - Renewal

In the years leading to Nono's arrival at the Experimentalstudio, Nono suffered a protracted creative impasse; a crisis of confidence in music and politics amid the events of the 1970s, as well as personal turmoil: the death of both his parents within three months of one another, and the death of his mentor, Luigi Dallapiccola, in February 1975. Between his opera *Al gran sole carico d'amore* in 1975 and *Das atmende Klarsein* in Freiburg in 1981, Nono managed to compose only four works.[65] These were, nonetheless, crucial stepping stones and artistic challenges that would lead to the fertile period of the 1980s. This was not Nono's first crisis; creative hurdles and crises of political belief were not uncommon in the decades preceding his more protracted 1970s block. Moreover, Lachenmann later commented that crises were in fact not just momentary flairs for Nono:

> not a one-off moment of violent insecurity, a shock followed by inspiration, but rather a constant potential presence [which] frees you from all false security and confronts you with your own rough, inner landscape, leading you into realms where the socialisation of the ego is no longer adequate and where crisis and greatness determine each other and art, as their messenger, brings both light and depth, clarity and mystery. […] Nono remained untiring and self-consuming in his search for the ultimate secret of an art based on awareness.[66]

Nono's 'awareness' was driven by his political activism. As a lifelong member of the Partito Comunista Italiano (PCI) since joining in 1952, Nono was both deeply committed and active both on an artistic and personal level, but this had consequences, as Nono would frequently struggle to reconcile a meaningful musical response to the brutality and suffering that he saw throughout the globe amid the height of cold war geopolitics, and he would later suffer, though at times also benefit, from his identification as a communist party member. Collaboration and interdisciplinarity were core characteristics of Nono's work since *Il Canto Sospeso* in the mid 1950s, and part of his more general approach to political life, in which he made great efforts to travel and meet people in both communal/

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[65] The incidental music work 'I Turcs tal Friúl' ' is not discussed here as it is less consequential.

[66] Lachenmann (1999), 27-28.

local and intellectual/global circles. As he rose to prominence during the post-war Darmstadt years alongside the like of Boulez, Cage, and Stockhausen, Nono enjoyed deep friendships and creative partnerships with composers and conductors, including Dallapiccola, Herman Scherchen (his teacher), Bruno Maderna, and his student Lachenmann (despite a substantial falling out), as well as the painter Emilio Vedova. He studied concepts from theatre, including those of Meyerhold, Piscator, Peter Weiss, and Josef Svoboda, as well as the political thought of Sartre and Gramsci, and the poetry of Eluard, García Lorca, Neruda, Pavese, and Ungaretti, and developed acquaintances with many of them from the mid 1950s, and throughout the 1960s.

Nono also frequently identified Schoenberg as a vital influence, not only materially in terms of assimilating twelve-tone technique, but more fundamentally, philosophically in terms of how to 'think musically'.[67] His musical references extended far back in time before the twentieth century thanks to his formative studies at the Venice Conservatoire, and with his later teachers like Scherchen: from Beethoven to Bach, and the Polychoral music — *cori spezzati* — of the Venetian School. Therefore, already from the early Darmstadt years, Nono's preoccupation with a more historically materialist view on artistic enterprise rendered him somewhat anomalous among his peers whom were otherwise predominantly concerned with the autonomy of postwar modernist music. This difference would become a source of division in subsequent years between him and his fellow Darmstadt composers.

Nono's style continued to evolve at the turn of the 1960s, though he became increasingly marginalised from the western avant-garde, partly due to his denouncement by others composers and commentators connected to the Darmstadt Summer Courses, claiming that Nono's music lacked compositional innovation in its 'stagnant' twelve-tone technique, while also tiring of his ceaselessly antagonistic political stance. Nono also directly provoked the scene, particularly in his lecture 'Geschichte und Gegenwart in der Musik von Heute' at the 1959 Darmstadt Summer Course, and in the following year the lecture 'Text – Musik – Gesang'. Both criticised the two fashions pervasive in the Darmstadt; the

[67] Nono (1980); Nono also married Schoenberg's daughter, Nuria, in 1955. She continues to champion his work and oversee the Archivio Luigi Nono today.

increasing formalism of musical autonomy post-Boulez and Stockhausen, and the chance-based anti-formalism post-Cage composers:

> Today there is a prevalent tendency, in both the creative and critical-analytical fields, not to want to integrate an artistic–cultural phenomenon in its historical context, that is, not to want to consider it in relation to its origins and the elements that formed it, not in relation to its place in present reality and its effect on that reality, nor in relation to its capacity to project into the future, but exclusively in and of itself, as an end in itself, and only in relation to that precise instant in which it is realised.[68]

In this period, Nono's thinly veiled criticisms of composers riled the otherwise collegiate atmosphere of Darmstadt, for example, Nono accused Stockhausen and his admirers of seeking 'abstract refuge in a scientific principle or mathematical relationship.'[69] Cage and his followers whom Nono claimed to emulate and misunderstand Cage also came under fire, with Nono comparing Cage's chance method to imperialist China's denial of historical progression:

> The youth of Europe are being offered 'the resigned apathy of "it's all the same anyway" in the complacent form of "I am space, I am time". [. . .] This is capitulation in the face of time, the flight from responsibility. […]
>
> The rhetorical use of concepts of liberty and non-liberty in an artistic-creative process is nothing other than an umpteenth propaganda trick, and a very cheap one, to attempt to influence the future.' [70]

By the end of the 1950s, Nono had thus estranged himself from the European musical circles in which he had risen to success during the preceding decade. By 1960, Nono's thoroughly historical materialist concept of composition had become polemically fully fledged:

> Music will always remain a historical present, a testimony of those who consciously confront the process of history, and who in every instant of that process make decisions in the full clarity of their intuition and reason, and act to uncover new possibilities in the vital need for new structures.[71]

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[68] Nono (1960), LN(1), 46

[69] *Ibid.*, 49

[70] *Ibid.*, 52-53

[71] *Loc cit.*

Thus, guided on the one-hand by a more formalised political agenda, and on the other, a less formal though modernist compositional technique, porous to a range of sonic and cultural materials, the 1960s would see the technical evolution of Nono's *cris de coeur*, both in his continued use of text as equally sonic, socio-political, and poetic medium, but also in his use of electronics. This is most evident his opera *Intolleranza 1960*, a major work which directly confronted racism, fascism, class struggle, and Cold War geopolitics, and which provoked protest during its premiere in Venice in 1961, though it ultimately received high critical praise. Nono's concept of *azione scenica* emerges through the course of this project as a new guiding framework, towards a music theatre which is socially, culturally, and politically engaged.

Despite the critical success of *Intolleranza*, the sheer complications of the production and working with an orchestra lead Nono to electronics, and specifically tape, working at the RAI Studio di Fonologia in Milan, where throughout the 1960s he created a series of highly political and unconventional works: including *La fabbrica illuminata* (1964) for soprano and tape; *Ricorda cosa ti hanno fatto in Auschwitz* (1966) for tape, and *A floresta è jovem e cheja de vida* (1966) for voices, clarinet, tape, and percussion. All of these works included sounds of real places and happenings, denoting certain socio-political contexts, or even reportage from radio and televisions broadcasts, for example the Vietnam War protests in *A floresta*, or factory workers in *La fabbrica illuminata*. Thus, while Nono's concept of *azione scenica* arose in the context of theatre, it was nonetheless implemented across a wide range of smaller scale works, aided by technology and recorded sound. Reflecting on this period in an interview in the 1980s, Nono recognised the potency of technology in renewing his compositional practice, as well as the potential of recorded sound to figure as a material of a wholly new category, removed from the parameterisation of dodecaphony:

> When I began to compose with electronics I was afraid of using them inappropriately, and to get over this fear I decided to give myself over to my musical intuition rather than let myself be guided by rationality.[72]

[72] Baroni and Dalmonte (1985), 83-84.

This theme of intuition will be examined in more detail with regard to the later works. As a representative of the PCI, which he often had to turn to for support in making his projects happen in the 1960s, Nono travelled extensively throughout the 1960s, across Europe, Latin America, Asia, and the Soviet Union, and amid the 1968 protests. His collection of texts used in this period offer a collage of socialist culture from the time: from Fidel Castro, to Che Guevara, Rosa Luxemburg Marx, Brecht, and Malcolm X. Despite the abundance of external references to extra-musical materials and cultures during his works of the 1960s, at the root of Nono's compositional thought was the impulse to situate music as a site for empathy, exchange, solidarity, and in Lachenmann's words 'awareness', which all underly a universalist belief in socialism's promise. As Borio explains, the act of listening itself was always at the heart of Nono's music, for 'to listen is to know; sensitivity to the circumstances of suppression and abuse that determine human suffering is a prerequisite to their overcoming.'[73] The role of listening in Nono's work and the context of listening in the second half of the twentieth century is discussed further in later sections.

Since *Intolleranza*, the medium of theatre proved itself to Nono as one of the most potent forms of artistic production and socio-political enterprise, capable of bringing together larger audiences, fostering public debate, and communing artists and workers from a wide range of disciplines, plus, concepts and materials from a panoply of society and the arts. From 1971, Nono began working on his next opera, *Al gran sole carico d'amore* (In the bright sunshine heavy with love), with Claudio Abbado and Maurizio Pollini, whom he had worked with previously for his work *Como una ola de fuerza e luz*. During this project, which was sparked by the centenary of the 1871 Paris Commune, Nono further developed his *azione scenica* framework to more directly foreground collaboration between him, director Yuri Lyubimov, designer David Borovsky and others; it would be 'a collective work from the outset. That is, a work that grows together between us.'[74] Nono initially assembled an array of texts and subjects which his collaborators would then help shape into a theatrical concept: texts from Che

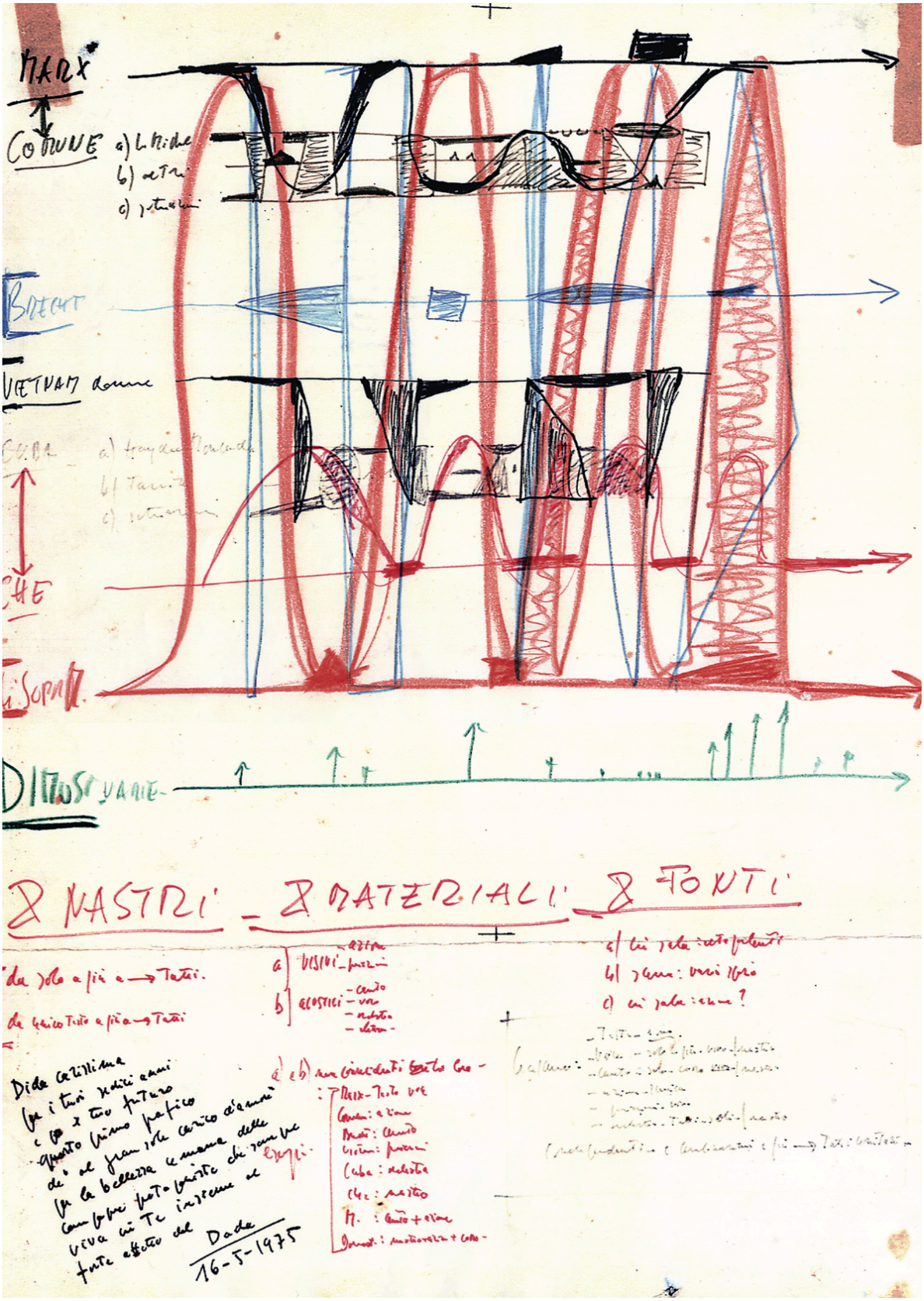
[73] Borio (2001)

[74] Quoted in Trudu (2008),195.

Guevara, Brecht, Gorky, Lenin, Luxemburg, Marx, Pavese, Rimbaud, and reference to the Commune, Vietnam, Cuba, other protests and resistance songs of the recent years, as well as the *Internationale*.

Fig. 14 shows an early sketch which reveals the inherently spatial dimension of Nono's thinking, in his schematisation of the various references: 8 tapes, 8 materials, 8 sources. The prominent feature of the wave which represents the musical flow between the disparate elements would become an increasingly important metaphor in the following years, and lead to Prometeo's underlying concept of *suono mobile*. Mobility of sound, of relationships, and of perspective was thus fundamental to Nono's musical thinking, and reflective of his process-led practice. Nono's goal in both forming the experience and production of his work was to manifest a polyphony of dynamic and diverse interdependence: audiences were free to discover their own paths through the dense yet fragmented references in *Al gran sole*, as were Nono's collaborators free, in theory, to bring their own subjectivities to the work, as long as they did not destabilise the ideal of the 'collective'.

Figure 14: Sketch for Nono's 'Al gran sole carico d'amore' (Archivio Luigi Nono)[75]



[75] ALN 40.06/01. © The heirs of Luigi Nono. Reproduced by kind permission.

3.1 ..... sofferte onde serene ...

By 1975, Nono was exhausted by his experience with the opera house during the production of *Al gran sole*, as La Scala had suffered much political upheaval and funding cuts amid a cultural backlash, during which Nono also became a target of public criticism. Throughout the opera, Nono had long planned to return to a more intimate collaboration, which finally came to fruition with Pollini in the piano and tape work *..... sofferte onde serene ...* from September 1975 to its premiere in 1977. Nono's work at the Studio di Fonologia in Milan with Pollini and studio engineer Marino Zuccheri started from a less formalised and materially-elaborate place than Nono's previous studio and theatrical projects. He was less interested in the piano's sound as an abstract generator of timbres or political symbology, and more in Pollini's ways of playing, as well as the intimate mechanical sounds that are usually only heard by the pianist, such as pedal sounds and their effects on resonance. The title (serene waves suffered), points to the soundworld of Venice, which Nono explains in his note about the piece:

> In my home, on Giudecca in Venice, sounds arrive continuously from different bells, with different reverberations, different meanings, day and night, through the fog or the sun.
>
> There are the signals of life on the lagoon, on the sea.
>
> Calls to work, to meditation, warnings.
>
> And life continues in the suffering and serene necessity of 'the equilibrium of the profound interior', as Kafka says.[76]

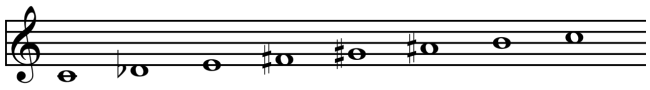
Thus, *sofferte* embarks on a double journey: on the the micro-level of musical material, it searches the interiors of Pollini's musicianship mediated through the mechanics and resonances of the piano; and, on the macro-level, the wave metaphor and multifaceted Venetian acoustic world as ramified throughout the structure of the work, whether in the wave-like arch form of the work itself, or the principle of multiple superimposed wave sounds and ripple spaces: bells heard across the water, through the alleys, waves lapping and crashing on the embankments, the rumbles of boat engines, and cries of sea birds. *sofferte* also holds a pivotal place in Nono's output, as it was his first in over a decade not to use any kind of reportage material that denotes specific political or social contexts; 'The source is

[76] '..... sofferte onde serene ...'. LN(1), 482. Author's translation.

his work and friendship with Pollini, as Impett explains.[77] These investigatory workshop sessions would prove pivotal in later defining Nono's practice with the Experimentalstudio. Impett continues to describe Nono's process from *sofferte* as being akin to a folding rather than of fragmentation: 'Material is produced linearly then folded, reconstituted and folded again such that new simultaneities and figures emerge, to themselves become subject to the same process.'[78]

Beneath the folds of constructed material, *sofferte* also contains materials of particular personal significance to Nono: Verdi's 'scala enigmatica' forms part of the pitch material, originating in Verdi's *Ave Maria* of his *Quattro Pezzi Sacri* from 1889; referencing Nono's late mother, Maria, and also reflecting a parallel long caesura that Verdi endured before completing the piece, like Nono. The scala enigmatica, shown in fig. 15 will remain one of the most important harmonic objects for the rest of Nono's œuvre, and a core component of *Prometeo*.

Figure 15: Scala Enigmatica



Nono's folding of pitch-space materials also extends to both the electronic and acoustical sounds in performance. By placing an additional loudspeaker under the piano, the recorded sounds of piano resonances and mechanisms are re-mediated by the same instrument through the resonant sound board. The piano becomes a prism that modulates sounds both within and without; a microscope of the piano itself and Pollini's musicianship, as well as a kind of *camera obscura*; a portal that projects the teeming soundworld of Venice. Nono's sublimation of *place* and *site* in this work, as well as its principles of multi-perspectivalism, superimposition, intermodulation, and sonic-corporeal intimacy would all prove vital in his later concept of *suono mobile* that epitomise his work at the Experimentalstudio. The

[77] Impett (2019) 343

[78] *Loc cit*.

premiere was received with high praise, with critic Massimo Mila understanding the modest (14 minute) work's significance in relation to Nono's broader musical journey:

> For the first time Nono presented himself not as a man certain of the truth but as a man searching for truth, and above all who lives instead of fighting, who allows himself to live, with all that it brings, with plural visions of things and the world, with different perspectives, and thus with inner enriching and maturing.[79]

3.2 Con Luigi Dallapiccola

Despite the critical and compositional success of *sofferte*, Nono remained in the grip of a protracted crisis for a few more years. In this uncertain period, nonetheless, *Prometeo* emerged as new work concept between Nono and philosopher Massimo Cacciari. By 1979, Nono was composing again, and was commissioned by La Scala for a work for six percussionists and live electronics. *Con Luigi Dallapiccola* is Nono's homage to Dallapiccola following his death in 1975. The composer meant a great deal to Nono, especially in his early life, as the figure who introduced him to serialism, and who lead a similarly politically engaged artistic life of resistance and antifascism, though not without earlier flirtations with Fascism. Moreover, making a note in the working draft score, Nono described *Con Luigi* as a 'new study of a specific language […] and a new beginning for Prometeo'.[80]

Con Luigi is Nono's first work since the mid 1960s to abandon the use of tape. While no workshop studio recordings were made in the same process as *sofferte*, Nono continued a more investigatory approach to the percussion instruments and the musicians, making copious notes about different timbral possibilities through different mallet choices and contact points.[81] Nono revives an idea he abandoned with *sofferte,* ring modulation, and uses three devices and three microphones placed on the large bass bell plates. Nono's use of ring modulation predominantly features sub-audio frequencies, resulting in an intense tremolo effect on the very long resonances of the metal sustaining instruments,

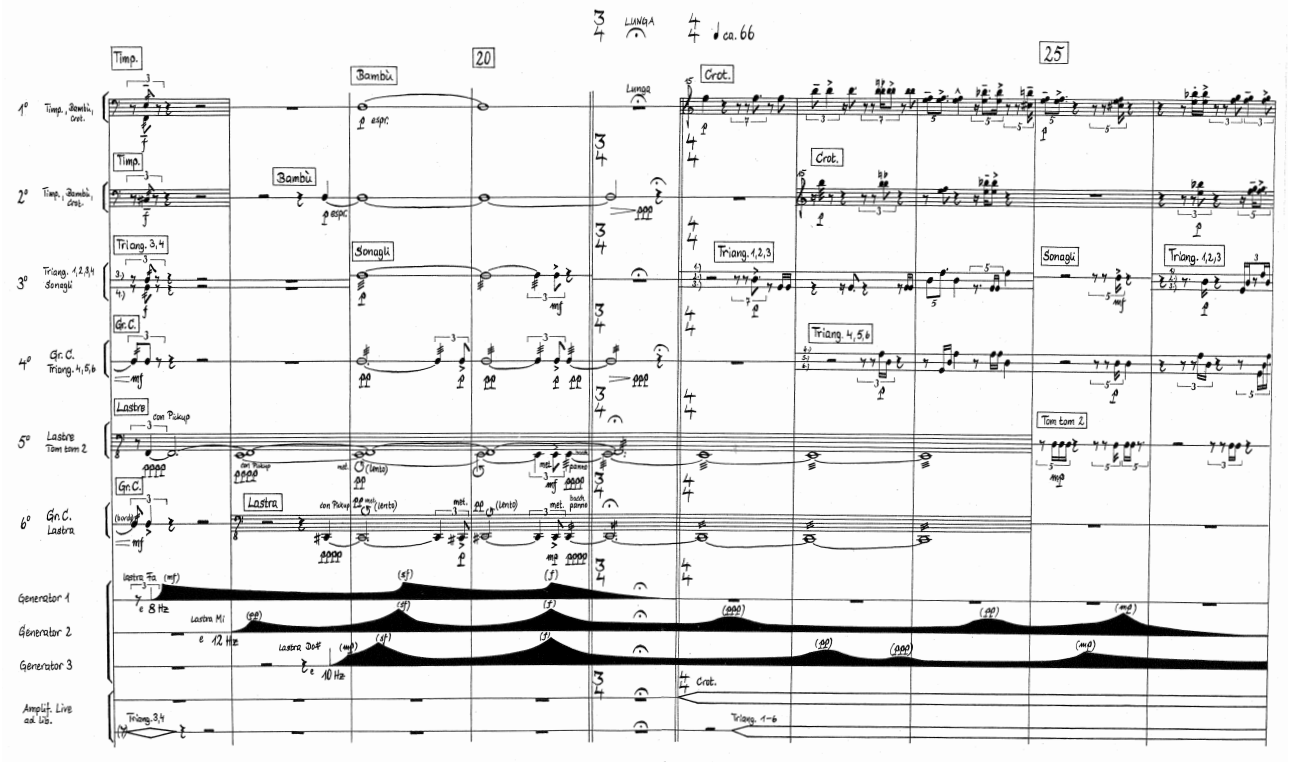
[79] Mila (2010), 303

[80] Draft score, ALN 43.07.01/01.

[81] Sketches, ALN 43.01.

as shown in the score excerpt in fig. 16, replete once again with ever more important wave form. In the second half of the work, he uses modulation signals in the upper registers, from 1200-9000hz, resulting in more synthetic bell-like timbres as in Stockhausen's *Mantra*.

Figure 16: Score excerpt from 'Con Luigi Dallapiccola' (© Ricordi Milano)



Thus, the concept of intermodulation as it emerged in *sofferte* finds a new and more direct sonic manifestation in *Con Luigi* in the form of ring modulation. As Impett has detailed, the underlying compositional structure of the work is rigorous, and incorporates various musical and personal ciphers in the pitch and rhythmic dimensions (Impett 2019, 345-349). These include the 'fratello' motif from Dallapiccola's *Il Prigonero*. Nono himself described the piece as a study:

> of the simultaneity of waves, of surfaces in which every now and then there occurs not a counterpoint between lines but emerging relationships between waves which arise and others that disappear.[82]

Another emerging feature in both *sofferte* and *Con Luigi* is Nono's use of silence and pauses. In both works, they figure as a structural embodiment of the ebbs of the metaphorical waves. Moreover, it is

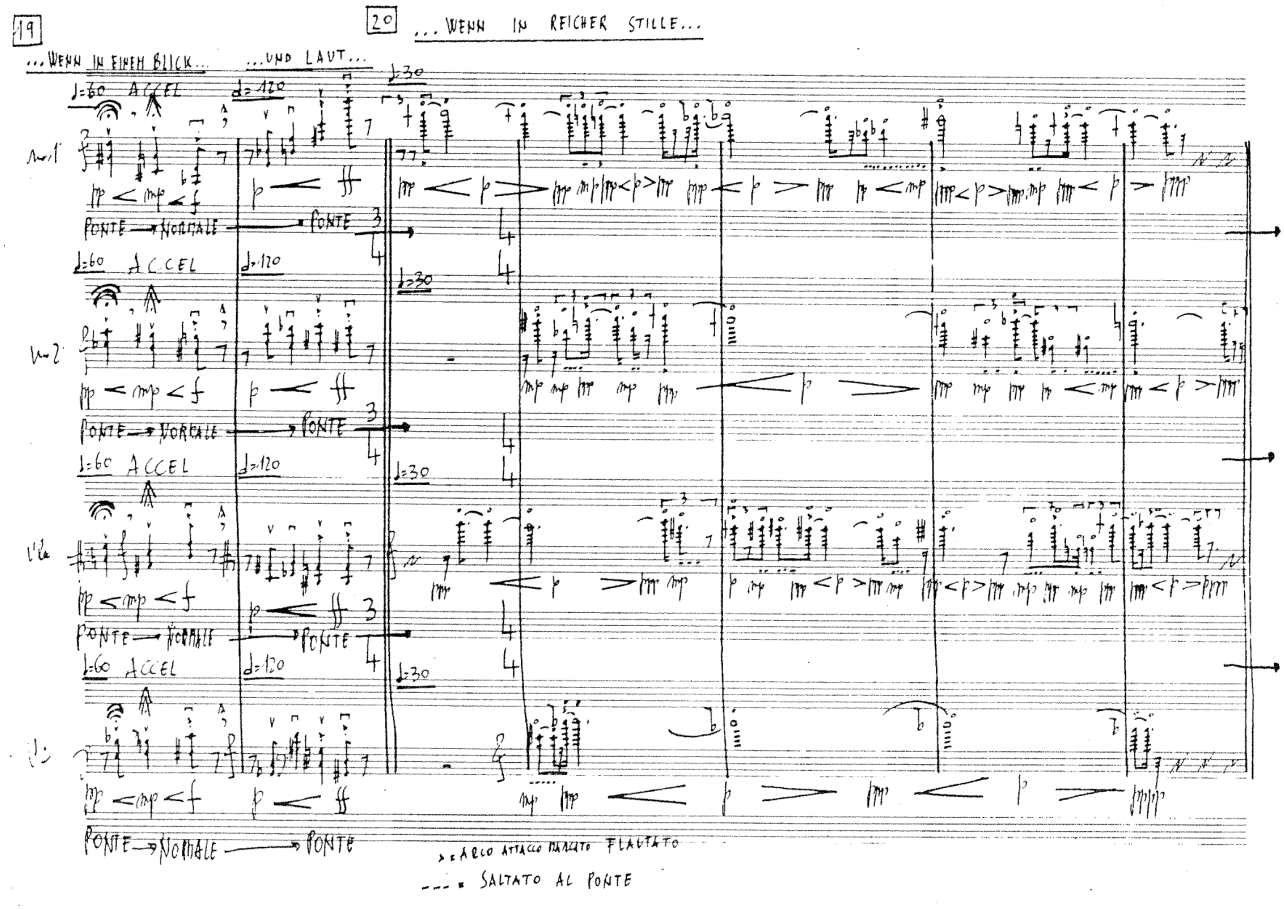
[82] Interview with Renato Garavaglia, 1979–80. LN(2), 241.

clear that Nono also viewed silences on more phenomenological and aesthetic levels, bringing the listener's focus back to the performance space, and thereby to the very act of public listening, but also to temporality, disrupting any sense of continuous flow or traditional formal momentum by fragmenting time. Nono would take this idea much further in his next work, the last that he composed before beginning his partnership with the Experimentalstudio, his string quartet: *Fragmente-Stille, an Diotima.*

3.3 Fragmente-Stille, an Diotima

Commissioned by the 30th Beethoven Festival in Bonn, Nono composed *Fragmente-Stille* for the LaSalle Quartet over the summer and autumn of 1979. It was premiered in Bad Godesberg on 2 June 1980. As with the preceding two works, the more intimate qualities of the musicians' sounds became a principal concern for Nono, although he decided not to use amplification and electronics in this case, which would prove significant in shaping the work's more radical features. Over its circa 35 minute scale, the quartet proceeds in a highly fragmentary form: shards of material briefly flicker into life before dissolving into silence or very quiet — almost inaudible — sustained sound. No sense of progression or telos takes hold, and instead, listeners are left with a series of furtive moments or elusive skittering sounds and sustained hushed timbres. The 'an Diotima' of the title refers to the Hölderlin extracts that Nono included as annotations throughout the final score, as shown in the excerpt in fig. 17 (…when in a glance…; …and loud…; …when in rich silence…).

Figure 17: Score excerpt from 'Fragmente-Stille, an Diotima' (© Ricordi Milano)



Nono explained, the text is:

> never to be spoken aloud during performance
> under no circumstances to be taken as programmatic performance indications but many other moments, thoughts, silences 'songs'
> of other spaces, other skies
> to otherwise rediscover the possible, do not 'say farewell to hope'
> The players should 'sing' them inwardly, in their autonomy
> In the autonomy of sounds striving for a 'delicate harmony of the inner life[83]

Nono was drawn to Hölderlin's work, not only encouraged by Cacciari's shared interest in its poetics, but also in its inherent approach to the multiplicity of thought and inner voices, which must have appealed to Nono as such a text-centric thinker. Nono writes of Hölderlin:

> he really wanted to fix in space the simultaneity of thought we have within us. I think this is a general problem today. When I hear something, I hear something else at the same time, sounds

[83] Performance instructions in the score of *Fragmente-Stille, an Diotima*.

> of a different nature which do not belong to the others. It is also a problem of different planes of sound.[84]

Foreshadowing the island forms of *Prometeo*, Nono also explains the relevance of fragmentation in terms of a phenomenological approach to temporality and musical form, while referring to Nietzsche's figure of The Wanderer:

> [there are] fragments that don't conclude and that don't reveal themselves in some later moment of synthesis, but that rather show particular moments of potential, of life, and which develop further, also conflictually, where no dialectical movement is possible, just an emerging of various different possibilities, potentials, forces or such moments […] which together offer a great multiplicity of thought, of life, of existence. Rather when through a dialectical moment there comes a synthesis, a goal, a revealing – it is more important for me to develop these contradictions, dissents, conflicts further. There is this need of the Wanderer – Benjamin, Nietzsche – for whom there is no fixed moment but just a constant searching.[85]

Elzenheimer also described Nono's use of pauses in *Fragmente* as forming a 'Dramaturgy of silence,'[86] although Nono's drama is neither narrative nor telos driven, and rather more concerned with the physical act of listening. The work tends towards very fragile sounds contrasted by violent outburst, exploring their relationships to space and acoustics, and to the physical and instrumental bodies of both the musicians and their instruments. The human voice and diverse uses of text were essential in Nono's earlier works, and while they are sonically absent from *Fragmente*, there is nonetheless a silent voice present in the form of the Hölderlin annotations. As such, Impett sees *Fragmente* as Nono's response to the concept of The Unsayable as it appears in the writings of Wittgenstein, Nietzsche, Cacciari, and Hölderlin, describing the work as 'transformational, not utopian', and drawing in listeners 'to become fellow Wanderers, constructors of meaning,' as a 'song suspended in webs of presence and absence, listening, making sound and making meaning.[87] Lachenmann also recognised Nono's quartet's phenomenological and temporal aspects that render listeners more active participants:

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[84] Comporre oggi'. Interview with Wilfried Gruhn, 1984. LN(2), 323.

[85] Nono (1980)

[86] Elzenheimer (2008), 140-149.

[87] Impett (2019), 361.

> it is the perception of its reflection in our inner selves, across the space of silence and also remembrance, reflection, self-discovery as opened up by the fermata which he piles up in constantly changing, almost artless configurations.[88]

Nonetheless, during its premiere, it confounded some observers who were used to Nono's more politically explicit tact. In the introduction to the first radio broadcast, the presenter Max Nyffeler asked: 'Has the composer turned away from revolution and social development in his string quartet […] an ideological retreat accompanied by an aesthetic regression?'[89] Responding to this and later criticism that his late works were politically regressive, mystical, and escapist, Nono clarified the significance and potential of his renewed style towards silence and quietude:

> I have in no way changed; the soft, the private also have their collective, political side. Thus, my string quartet is not the expression of some new retrospective line, but my current experimental condition: I want to say the largest, most agitating things with the smallest means.[90]

[88] Lachenmann (1999), 24.

[89] Quoted in Metzger (1981), 112.

[90] *Ibid*., 93

4. Das atmende Klarsein

In 1978 Nono embarked on a new collaborative project with flautist Roberto Fabbriciani, whom he had met at La Scala at a production of Camillo Togni's *Blaubart*, and in which Fabbriciani had a major role as a soloist.[91] Fabbriciani visited Nono in Venice and they worked together on new materials for the flute,[92] and in particular the bass flute, which would form the basis of their creative relationship for the remainder of Nono's life. Throughout this period, and together with Cacciari, *Prometeo* was beginning to take form as a large-scale work concept, centred around the myth of Prometheus, and the image of Nietzsche's Wanderer, among other references.

After a few workshops at each other's houses in Venice and Florence, on 1-2 December 1980, uplifted and motivated by his recent successes with *Con Luigi Dallapiccola* and *Fragmente-Stille, an Diotima*, Nono went with Fabbriciani to the Studio di Fonologia in Milan to begin exploring the flute's potential for electronic transformation. Despite the support of studio engineer Mario Zuccheri, the studio was at the tail-end of a protracted period of decline. They recorded several tapes of flute material, but had no viable options for live electronics After two days of frustration with the limitations at the Milan studio, Nono and Fabbriciani left and drove straight to Freiburg, to the Experimentalstudio, where Nono had been invited by Haller. Haller recalls Nono's arrival and response after giving him a tour of the studio and demonstrations of various devices, during which time he remained mostly silent while making copious notes:

> After about two and a half hours Nono wandered pensively, silently around the studio and sat on the piano stool with his head in his hands, concentrating. After a little while he suddenly stood up, continued his walking around, came up to me timidly and said "my friends call me GIGI!"[93]

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[91] Author's interview with Roberto Fabbriciani (2021).

[92] Zattra et al (2011), 419.

[93] Haller (1995, vol. 2), 116.

Thus began the creative partnership between Nono and the Experimentalstudio. Following Nono's crises of the 1970s, the Experimentalstudio and the potential of its technologies provided a pathway to overcome many of the problems with conventional musical western performance, composition, and institutions, which Nono had felt with increasing frustration though without an apparent satisfactory response. Moreover, the technological and methodological practices already established by the studio in its first decade of operations, as detailed in chapter two, mapped directly onto the emerging ideals of Nono's renewed musical thought, as Impett similarly notes, the Experimentalstudio 'afforded mobility of sound on the very axes of manipulation of musical ideas that supported his compositional practice, but on the finest of levels, with control, responsiveness and – above all – in real time; in performance.[94]

Nono stayed at the Hotel Halde, nestled further up in the Black Forest, away from the city and the studio, which was based in the small hamlet of Günterstal. The Halde became Nono's home away from home during his long stints at the studio, and the surrounding serene forest areas would prove an important source of sonic-spatial inspiration as a counterpoint to the bustling soundscape of Venice. The two contrasting environments would prove an important material dialectic, as Fabbriciani recalls:

> Emission is breath, *anemos*, source of life and it is the generating force of *Das atmende Klarsein*. The vitality of this piece is set in the freedom of an intoxicating breath. I remember the walks with Gigi along the paths of the Black Forest near Freiburg: he breathed deeply inviting me to do the same, as if taking on a new life[95]

Following their first visit in December 1980, Nono and Fabbriciani returned to the Experimentalstudio in January 1981 to continue their now revamped project. At the same time, the Maggio Musicale festival commissioned Nono for a new work, which he saw as a first step towards *Prometeo*, and moreover, as an actual part of the final opera itself (though this would not work out in the end). Cacciari had previously suggested parts of Rilke's *Duino Elegies* for *Prometeo*, and with the new commission, he proposed to Nono a hybrid text that folded fragments of the Rilke with Orphic poems for the dead, which Nono further worked into a constellation of fragments connected by symbolic and

[94] Impett (2019), 369.

[95] Fabbriciani (1999), 11.

phonetic resonances. Nono originally considered a larger instrumentation — flute, trombone, percussion, choir, live electronics, and a tape recording of the bells of Freiburg Cathedral — but decided to concentrate the ensemble as solo bass flute, chamber choir, and live electronics. The eventual work would be an expression of breath and of a revitalised artistic life, symbolic of the fertile period that would follow. There is a striking clarity and sparseness to many of the textures compared to the somewhat more obscure sound worlds of the preceding 1970s works, as if reflecting the illuminating clarity that the work holds in the progression of Nono's oeuvre. The next section gives an overview of the completed work to contextualise the subsequent analyses in subchapters 4.2-4.5.

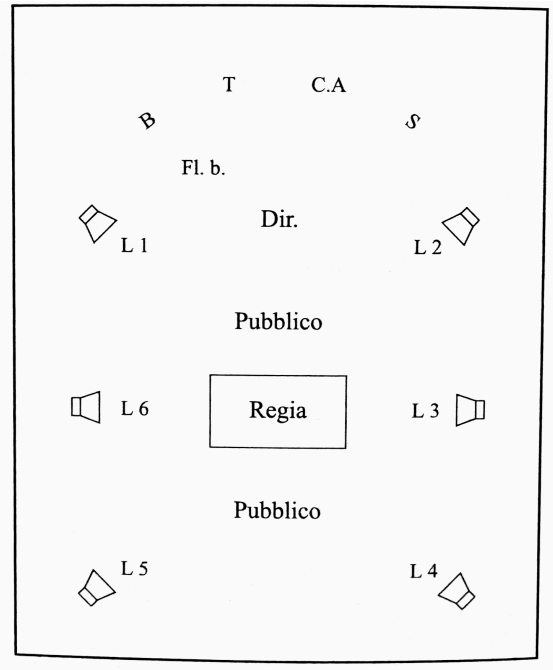
4.1 Overview

The final version of *Das atmende Klarsein* as presented in the critical edition Ricordi Milano score edited by Mazzolini and Richard reveals a work of bifurcated design. The bass flute soloist and chamber choir never perform together, but instead alternate with one another in their own separate movements, with very slight overlaps so that the movements follow attacca with one another. The work comprises eight movements, structured as shown below.[96] The performance layout is shown in fig. 18: the choir is on stage at the front, with solo bass flautist and conductor. The sound director is in the centre of the space, and there are six loudspeakers that surround the audience.

1. Choir (spatialised amplification): 1'30"
2. Bass flute (spatialised amplification): 5'40"
3. Choir: 8'06"
4. Bass flute (delays): 3'46"
5. Choir: 6'36"
6. Bass Flute (microtonal harmoniser): 2'34"
7. Choir : 4'05"
8. Bass Flute (improvisation to pre-recorded bass flute): 6'08"

[96] Durations are taken from the 2001 Col Legno album performed by the Experimentalstudio, Solistenchor Freiburg, Roberto Fabbriciani, and André Richard (conductor).

Figure 18: Performance Layout Plan for 'Das atmende Klarsein'[97]



Fabbriciani explains the reason for the separation: 'the choir and the flute never encounter each other because one is nostalgia for the past and the other nostalgia for the future.'[98] *Nostalgia for the future* became Nono's motto in his late period, embodying the forward-looking promise of new technologies and their musical forms, with an aesthetics rooted in cultural memory, historical materialism, and political acts of resistance, following his earlier years of confrontational works.[99] The opening lyric of *Das atmende Klarsein* in the short introductory choir movement can thus be read as autobiographically significant: *nach spätem Gewitter das atmende Klarsein* (after a late storm, the deep-breathing freshness). The work speaks of the new life breathed into Nono's musical world by his new network of collaborators, instruments, places, and practices.

In addition to their structural segregation, Nono characterises the choir and bass flute with different material types, reflecting their contrasting future and past-facing symbolisms: the choir movements are very similar, and consist of slow arcing phrases of text fragments, often beginning and ending on a single pitch or bare perfect fifth interval. Each slow phrase unravels in a wave-form, starting on 1 or 2

[97] From the score of *Das atmende Klarsein*

[98] Cescon (2002), 100.

[99] Nono (1986/2018), 392.

pitches, and peaking at denser chords of 6-8 pitches, punctuated by silences of several seconds. The choir must sing without vibrato, and often at very quiet dynamics (*pppppp* to *p*), which presents a challenge to most vocal groups, not only with the control of dynamics, but intonation too. The fragility and pure tone of the voices symbolised for Nono a certain timelessness or ancientness, reinforced further by the use of the Orphic fragments as sung text. As in Nono's earlier music, his text-setting is not concerned with comprehensibility or word-painting, but rather, with the phonetic sound of the words themselves, and the type of engaged listening that their fragmented setting might provoke for listeners.

> It is not the contents of the texts that are reproduced musically but paths. The work does not give form to images or words but to the way in which they are combined, to what they suggest, and to what disturbs them.[100]

While the choir movements unfurl as waves of self-similar slow-motion phrases, exploring the material's fine-level detail and combinations, the bass flute movements form a sequence of four individually distinctive tableau with unique materials and live electronics. As the flute part forms the focal point of this study, the following analysis examines each flute movement in detail.

4.2 Movement 2

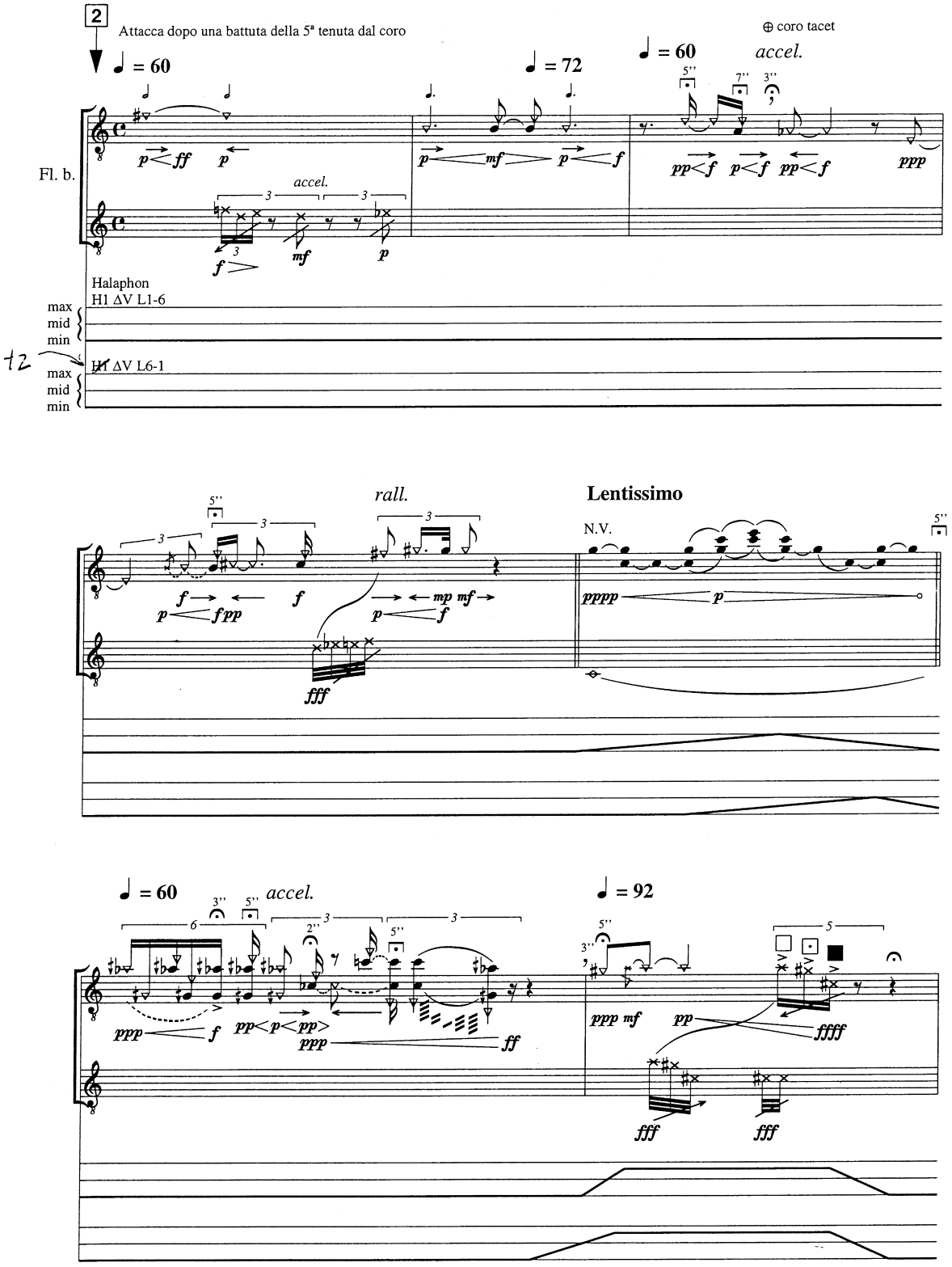
The second movement presents breath-like sounds flecked with trembles and percussive scurries, which the electronics spatialise without additional processes. The score clarifies that the quieter breath sounds should move very slowly, whereas the faster percussive sounds can move much more quickly. To achieve this, the electronics part in the score includes two envelope or fader level diagrams, which the sound director must perform to control the speed of the Halaphones in conjunction with the notated bass flute part. Fig. 19 shows the first page from the final score.

[100] Stenzl (2003), 92.

This opening movement presents the bass flute, Nono's herald of the future, as though some kind of elemental wind spirit. It emphasises the breathing quality of the flute, directly with inhalation and exhalation gestures, overtones arpeggios, diaphanous multiphonics, and aggressive explosions of almost white noise. The spatialisation suggests an organic analogue or biomorphic design, due to the positive correlation between the loudness of the flute, and the speed of the sound movement; a relationship one might experience in a number of environments when either animals or vehicles pass by you quickly or quietly. In this case though, the Black Forest is the specific subtext, even if Nono does not make the connection explicit.

The flute chromatically tinges the breath sounds of the flautist, just as the trees and their leaves in a forest render audible the wind in subtly different shades of rustling noise. The various key clicks of the flute also provide mimetic suggestions of trees, branches, and twigs clattering and sweeping one another in the wind, or perhaps also suggest distant footsteps in the undergrowth. In this first solo flute movement, the corporeality of the bass flute suggests not just a singular body, a creature in a forest, but rather, paraphrasing Fabbriciani, as the 'generating life force' which permeates the entire forest. This movement reveals the strong agency of both Fabbriciani and the bass flute itself in guiding the course of the composition. As shown in chapter five, Fabbriciani had already collected these wind-like materials from the beginning of his workshops with Nono, even before their recording sessions in Milan and Freiburg.

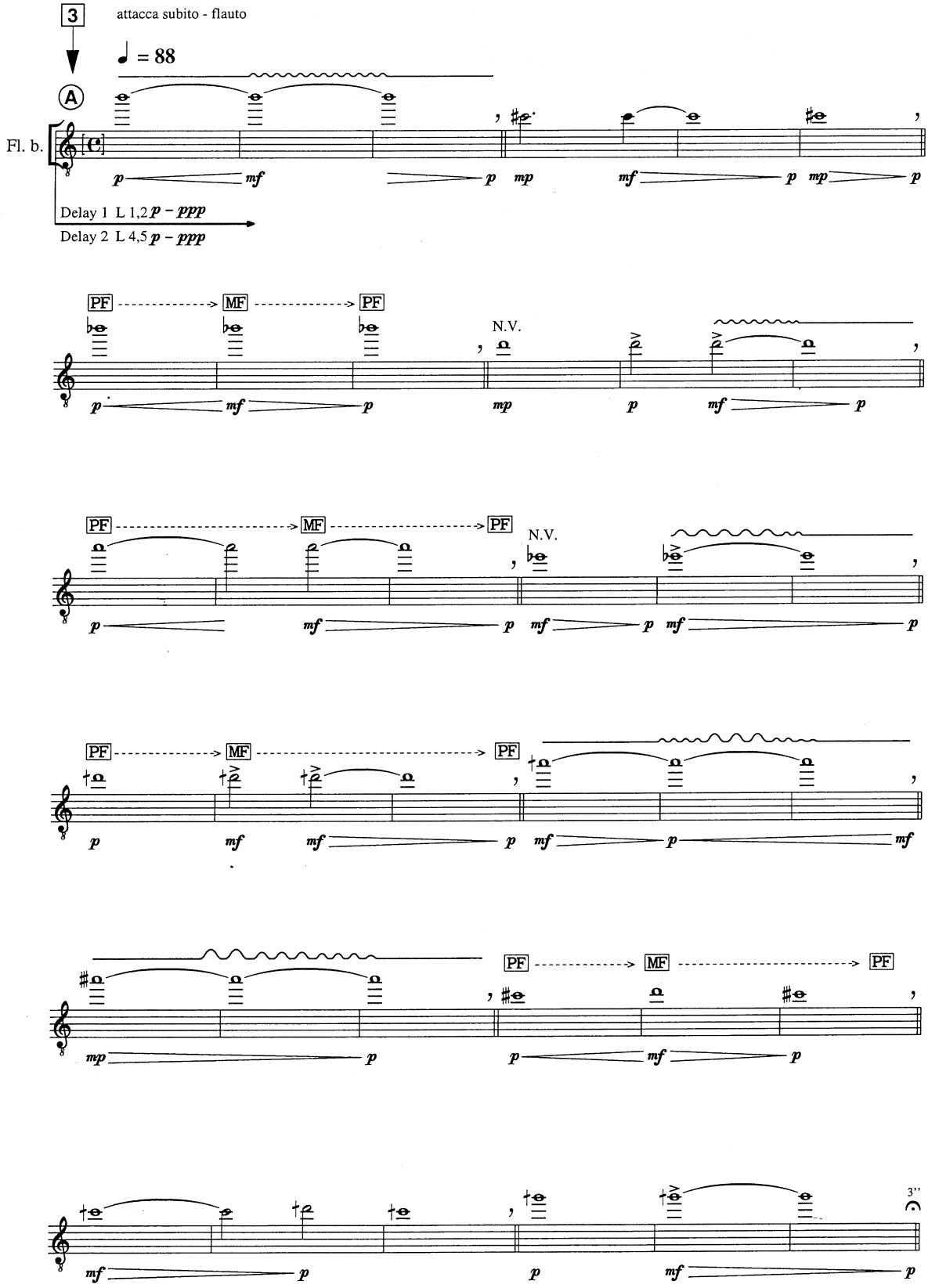
Figure 19: Score excerpt of 'Das atmende Klarsein', mvt.2 (© Ricordi Milano)



4.3 Movement 4

The fourth movement sees the bass flute weave a chorale-like texture with the assistance of two delay units in the electronics. A slow melody in the upper register of the bass flute mirrors itself as the delay units multiply the original input to form a canon of the flute at two different echo speeds: 3 seconds and 3.5 seconds. Fig. 20 shows the first page of the movement from the score. Lying at the centre of the work, the electronics in this movement enable the flute to resemble the choir that it never plays together with. The choice of high register further emphasise both the breath-like quality of the flute sound, as well as the greater tonal clarity or brightness of timbre. The use of delay extends the principle of blurring live performer and electronic from the spatial domain, as heard in the second movement, to that of the temporal. As the movement unfurls, the echoed version of the flautist accumulate to the point where it is essentially impossible for the audience to distinguish the performer from their electronic reflections, a distinguishing musical feature of Nono's later *suono mobile* idea as it would evolve around *Prometeo.*

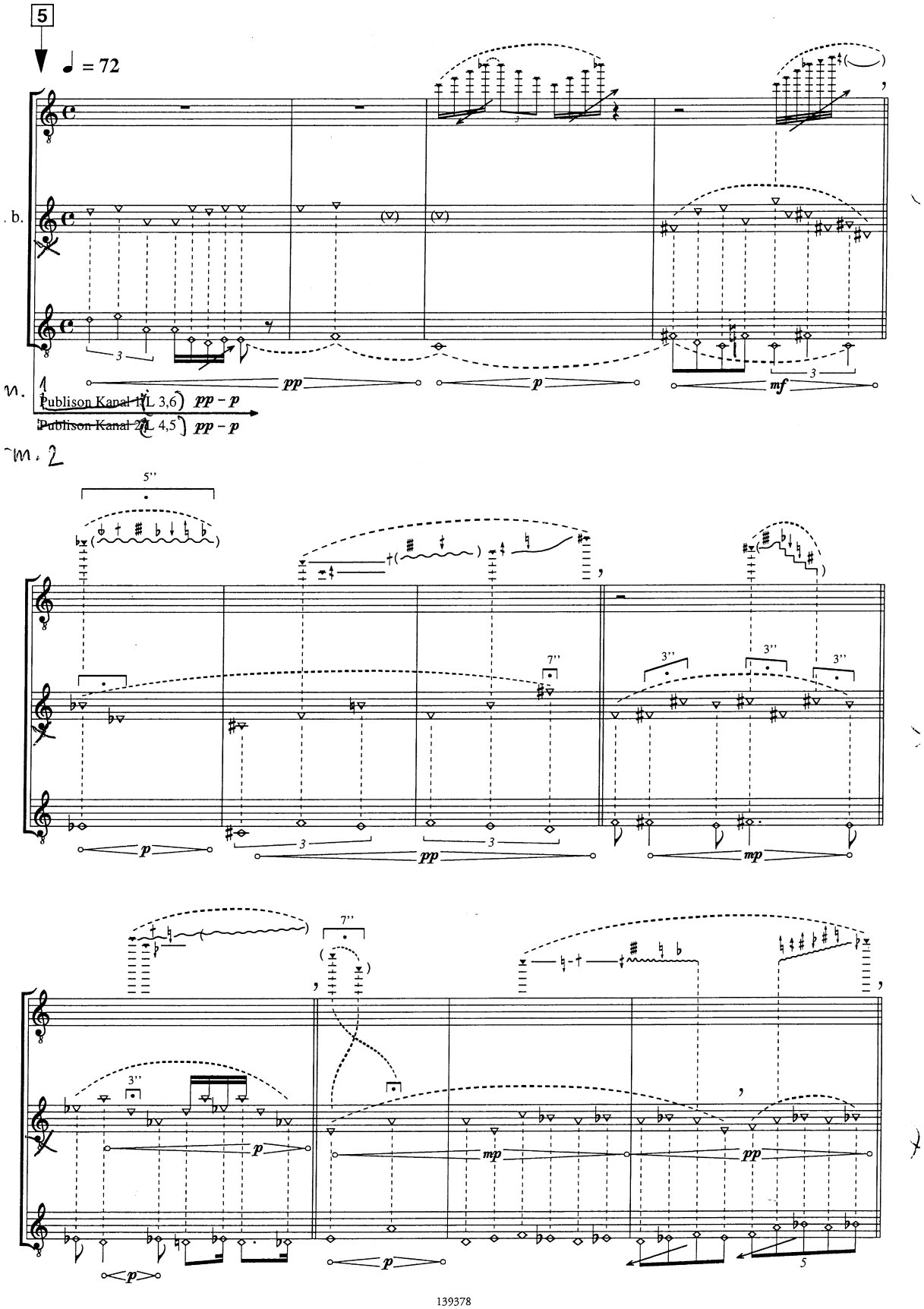
Figure 20: Score excerpt of 'Das atmende Klarsein', mvt.4 (© Ricordi Milano)



4.4 Movement 6

The sixth movement uses two harmonisers in conjunction with the raw bass flute signal. The harmonisers are set to -71 cents and +34 cents, where the effect, when blended with the original sound, sounds as three microtonally-related transpositions that lie within the space of 105 cents, or almost a semitone. The result is akin to a kind of chorus effect, with a shimmering and iridescent quality. The bass flute explores the extremes of the instrument's softest dynamic, using whistle tones (very faint and unstable harmonic tones that speak when the main fundamental tone is too soft to sound normally), 'aeolian' harmonics (isolating individual harmonics within the spectrum of a 'normal' flute tone, usually the second up to the eighth overtone), and very soft low tones focusing on the fundamental tone, and with minimal overtones or brightness. As is visually self-evident in the arpeggios of the score, shown in fig. 21, this movement provides yet another mimetically-charged evocation of the winds rustling through the Block Forest trees, or the wind-rippled surface of the Giudecca's waters, and is remarkable for its sense of darkness, intimacy, and foreignness, achieved with the destabilising sound of the harmonisers. Yet again, as with the spatial and temporal augmentations as witnessed in movement two and four, the very blurring of the harmonic grid in movement six further speaks to the specific aesthetic vision of *Das atmende Klarsein*, wherein electronics denature the human and material world, if only to encourage the audience to listen closer, not in search of a hidden absolute architecture, which for Nono would be hegemonic, but rather, to more finely sense an essentially inscrutable musical world, and to be more present and aware in the world, in the moment of listening in public.

Figure 21: Score excerpt of 'Das atmende Klarsein', mvt.6 (© Ricordi Milano)



4.5 Movement 8

The final eighth movement requires yet more detailed explanation, because it leads to points of controversy that ultimately prove illuminating for this study. In the final movement, the flautist improvises to a pre-recorded tape, which itself is an improvisation by Fabbriciani, guided and approved by Nono. The sound director also improvises the live electronics part, responding to the flautist, but mainly with reference to the tape part, which can be rehearsed. Very little is explained in the final score as to the possible musical relationships that the flautist and sound director can realise in this improvisation. Should the flautist mirror the tape, or contrast with it? While the score does specify that the electronics can run either with or against 'the rhythmical development of the spatialised action', flautists today face a challenge in creating a meaningful interpretation of the work. The score states:

> The flautist chooses fragments of the first section and performs them in free sequence, superimposing them on and mixing them with the sound of the magnetic tape with tempi and durations *ad libitum*.

Helen Bledsoe (2017), flautist of Ensemble MusikFabrik, documents the problematic aspects of *Das atmende* Klarsein, from ambiguous notation to the inherent variability of multiphonics, and offers several practical solutions based on personal experiences of performing the piece, as well as a broader philosophical framework to discover and interpret the 'intentio' of the work, drawing on Walter Benjamin's ideas of translation and Stanislawski's acting methods. Zattra et al (2011) take such unresolvable problems as proof of Nono's flouting of Nattiez's 'neutral' level of analysis; The Work *per se* is inherently entangled with and dependent on its interpretation by musicians, and they in turn are dependent on the extant materials that mediate such an interpretation, from score, to recording, and other documents of their performance practice.[101] The following section presents a new view on this aspect of Nono's work, revealing such ambiguity to be in part the byproduct of an intensely

[101] Zattra et al (2011), 415

collaborative process, and one that relied on oral and personal performance practices, which the scores do not fully communicate.

5. Workshop Sessions: ‘do what you want and always say what you do’

One of the most exciting parts of the materials preserved by the Archive Luigi Nono (ALN) is the numerous tape recordings of workshop sessions with Nono and his collaborators. Table 2 shows a list of tapes relevant to the late period works, including catalogue number and descriptions, translated from Italian.

Table 2: list of archived tape recordings related to Nono’s late work

ALN NM 98	Rehearsal with Ciro Scarponi?
ALN NM 157	M. Cacciari reads texts for *Das atmende Klarsein*: from Rilke's *Duino Elegies* and from the Orphic *Laminae* (reading from the Greek and then translation)
ALN NM 158	Preparatory material for the tape [of *Das atmende Klarsein* final movement]: various effects produced with the flute by Roberto Fabbriciani
ALN NM 159	Final tape of *Das atmende Klarsein* [final movement]?
ALN NM 160	Base Tape for *Das atmende Klarsein*
ALN NM 164	Workshop with Nono Luigi - Ciro Scarponi - Carlo Denti
ALN NM 165	Workshop for *Guai ai gelidi mostri* with Giancarlo Schiaffini, trombone
ALN NM 166	Workshop for *Guai ai gelidi mostri* con Carlo Denti, viola da gamba
ALN NM 167	Workshop for *Guai ai gelidi mostri* con Carlo Denti, viola da gamba, probably discarded
ALN NM 168	Workshop for the cello part of *Guai ai gelidi mostri]*
ALN NM 169	Workshop for the cello part of *Quando stanno morendo* and *Diario polacco n. 2*
ALN NM 171	Workshop for *Guai ai gelidi mostri* with tuba, strings, electronics, tape, 3 February 1983.
ALN NM 172	Workshop for *Das atmende Klarsein* with R. Fabbriciani, Freiburg 19-12-1980
ALN NM 175	Workshop with R. Fabbriciani, C. Scarponi e S. Otto, C. Theus, H.P. Haller for *Guai ai gelidi mostri,* Freiburg, 13 April 1983
ALN NM 176	Workshop with R. Fabbriciani, C. Scarponi e S. Otto, per *Guai ai gelidi mostri*, Freiburg 13 April 1983
ALN NM 179	Material for the final bass flute tape part, Tuesday 1.12.1980, Studio di Fonologia di Milano; R. Fabbriciani
ALN NM 180	Studio session for bass flute part, Tuesday 1.12.1980, Studio di Fonologia di Milano; R. Fabbriciani
ALN NM 181	Workshop with Roberto Fabbriciani on Piccolo, 2 December 1980
ALN NM 182	Workshop with Giancarlo Schiaffini, December 1980?
ALN NM 191	Workshop Luigi Nono: The composer and musicians explain his work - *Quando stanno morendo. Diario polacco n. 2*, Funkhaus Köln, Grosser Sendesaal, Saturday 23 October 1983, 11:30am, Tape 3
ALN NM 204-207	[Preparatory materials for the tape of *La lontananza nostalgica utopica futura*. Madrigals for "caminantes" with Gidon Kremer: rehearsals and dialogues with Kremer, Tapes 1-4

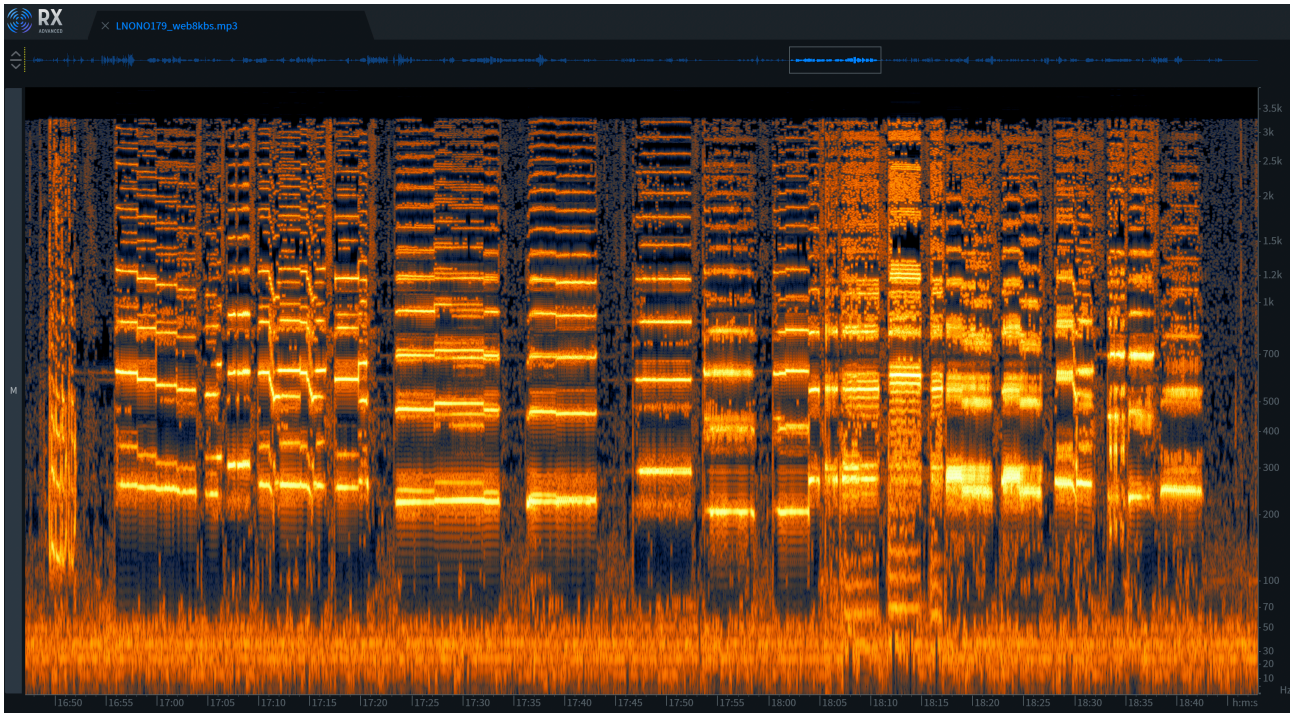
At the time of writing, no other study has presented analyses of the tapes, although some writers such as Impett (2019) make several references to them. Nevertheless, the recordings provide a vital insight into the reality of the workshop sessions, from the minutiae of interpersonal interactions, to the development of musical material from early stage to score. This chapter will focus on the tapes related to *Das atmende Klarsein* as shown in the catalogue numbers in bold in the above table: 158, 172, 179, 180, 181. Insights from other tapes concerning later works are brought into focus when relevant.

The catalogue numbers are not chronological, and some tapes are not dated. As such, the following presents the tapes in a suggested chronological order, focusing on the development of the bass flute part. The tapes are available to listen to on the ALN's online catalogue as low-quality mp3 files. The following analyses of the tapes uses higher quality aif files provided by ALN, and which are the original results of archive's digitisation project. The analyses dissect each recording, identifying, where possible, the ultimate manifestation of the material in the final score, and adding contextual notes e.g. if material seems to have been rejected.

ALN NM 179

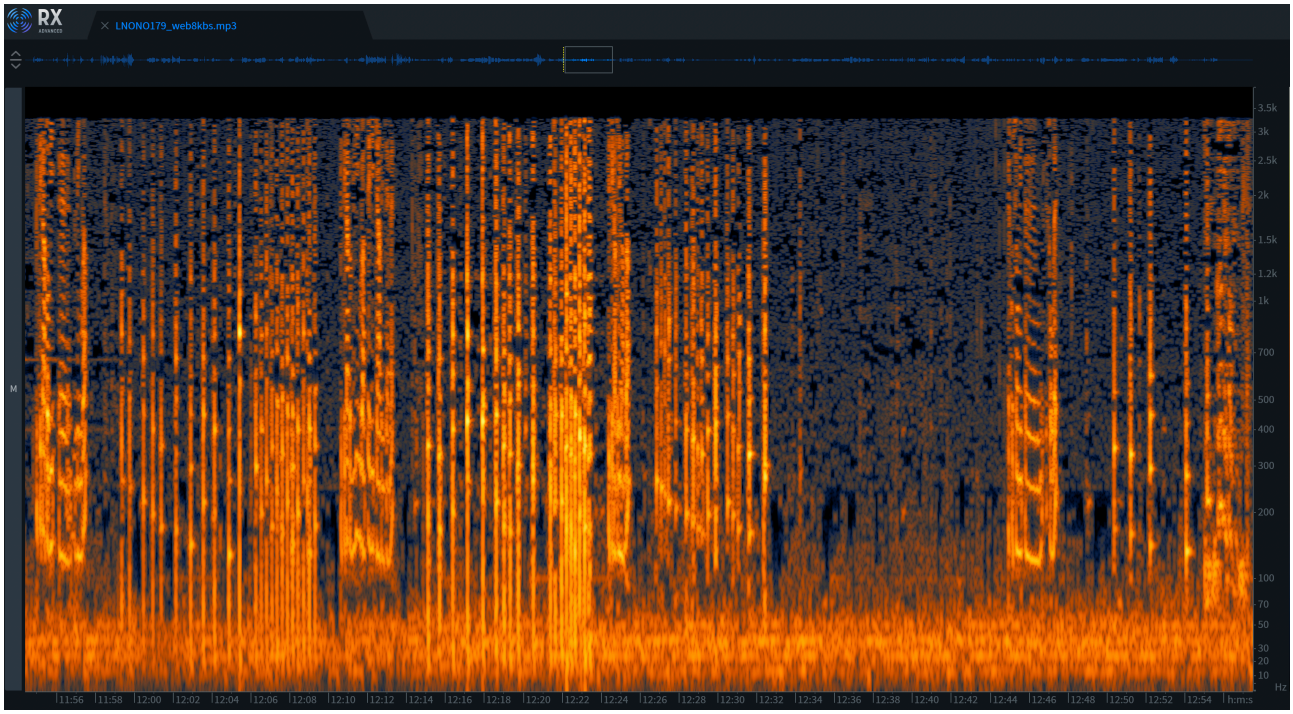
This tape is the first documented recording of bass flute material for *Das atmende Klarsein* with Roberto Fabbriciani. Recorded on 1 December 1980 at the Studio di Fonologia in Milan with studio engineer Marino Zuccheri. ALN NM 179 consists of three tracks on a single stereo tape reel. The appendix (chapter 6.1), includes analytical tables for ALN 179.1, 179.2, and 179.3. The spoken statements by Fabbriciani and Nono were transcribed by the ALN, and translated to English by the author. The mp3 recording used in this analysis combines the three tracks into a single sound file, and so, the timings of the tables refer to this consolidated digital version. The tables index each distinct event (dialogue, different sounds) by number to enable easier navigation and comparison. Figs. 22.1.-5 show the sonograms for ALN 179.2 in two-minute chunks, as generated in the programme iZotope RX, and which I further annotate with the event numbers. T.R. stands for tongue rams.

Figure 22.1: annotated spectrogram of ALN 179



1: multiphonics

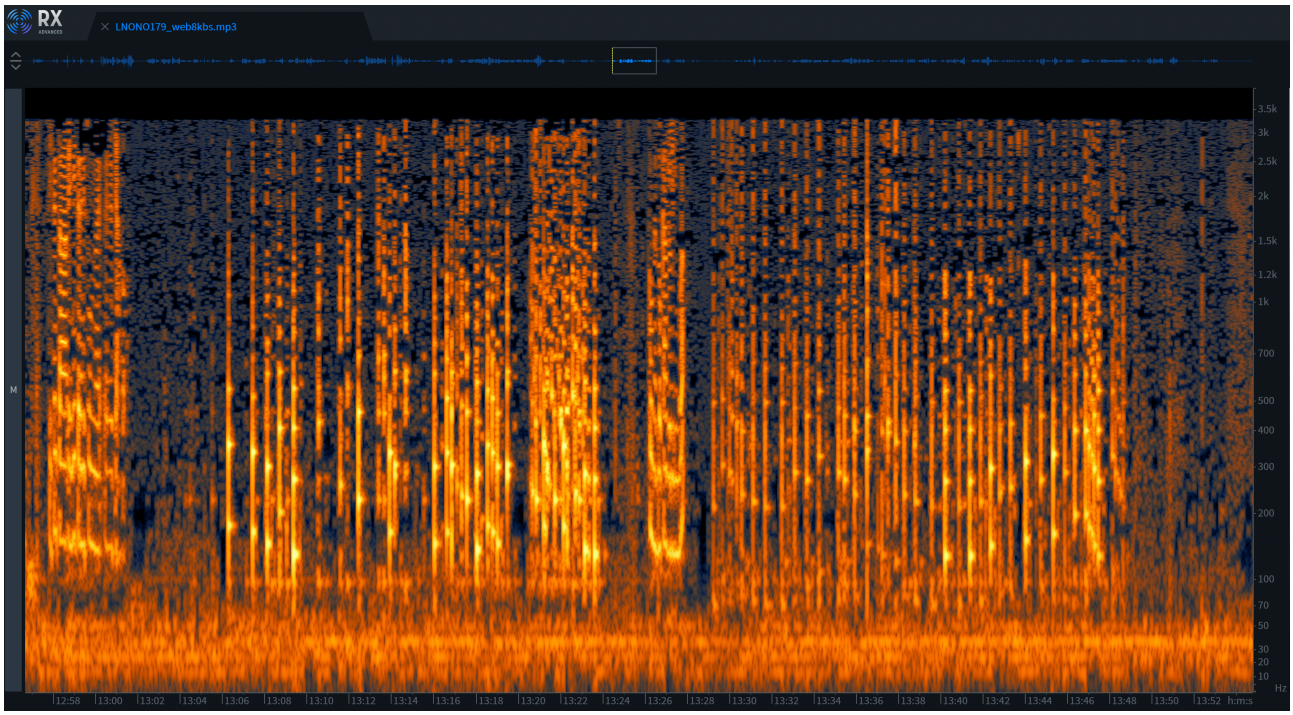
Figure 22.2: annotated spectrogram of ALN 179



2: speech 4. speech 6: speech 8: speech

3: tongue pizz. 5: tongue + key pizz. 7: T.R. 9: T.R.

Figure 22.3: annotated spectrogram of ALN 179



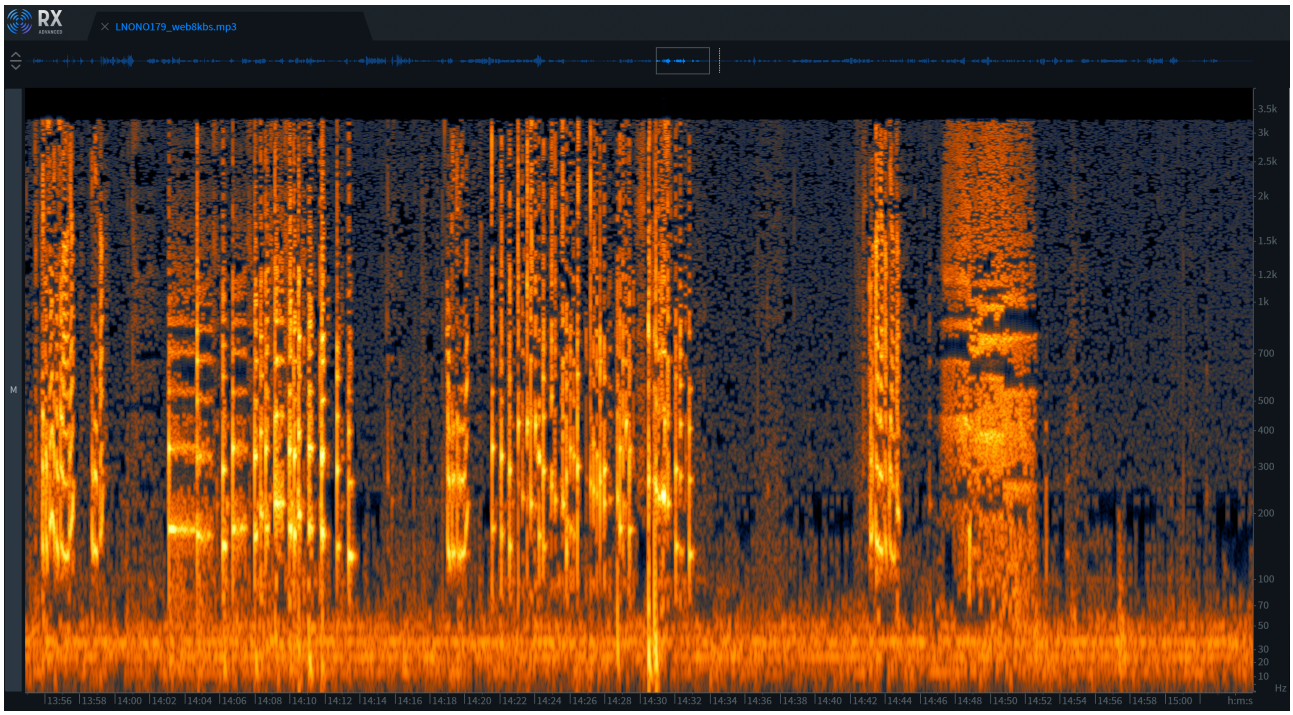
8: speech

9: T.R. open

10: speech

11: T.R. blocked

Figure 22.4: annotated spectrogram of ALN 179



12: speech

13: airy lip pizz.

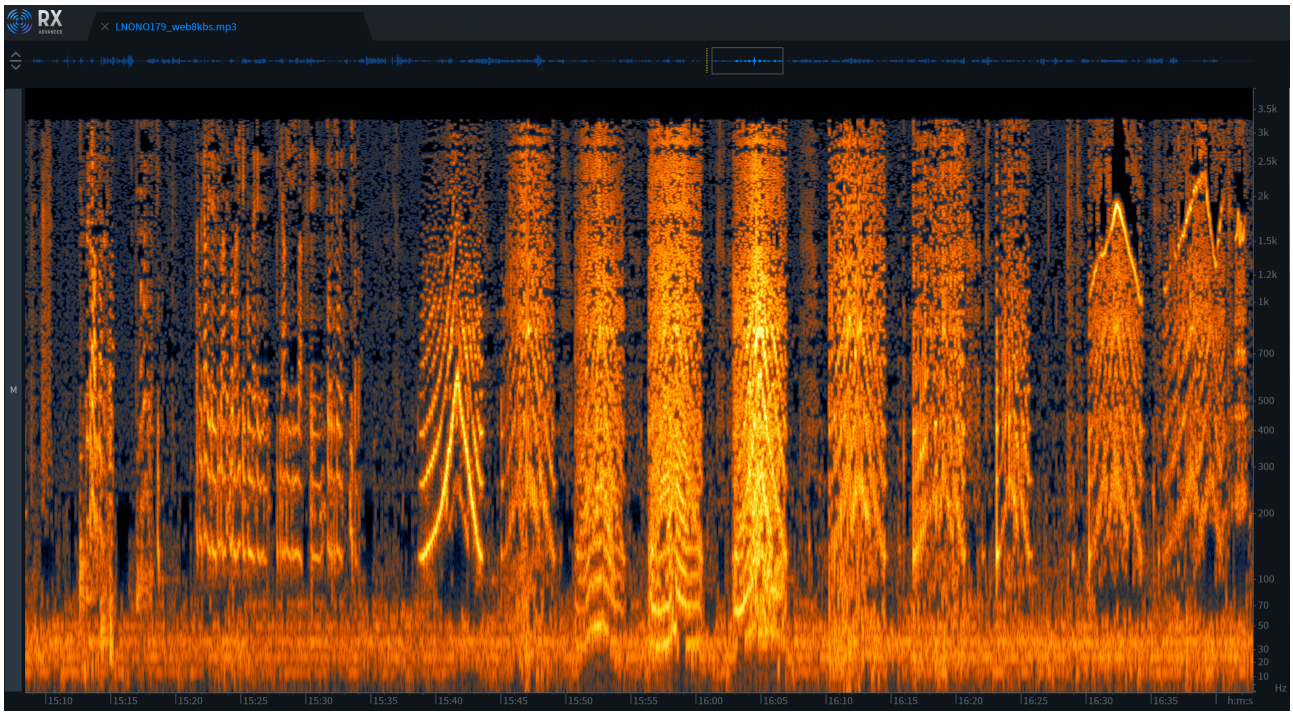
14: speech

15: tongue clicks

16: speech

17: slow airy melody

Figure 22.5: annotated spectrogram of ALN 179



In analysing this tape a few things become clear about both the working practice of Nono and Fabbriciani, and the development of the work in question. Firstly, and most importantly, Nono invites Fabbriciani to freely explore different sounds, techniques, and gestures on the bass flute. The statement 'fa tu quello che vuoi e di' sempre quello che fai' (do what you want and always say what you do) in ALN NM 179.1 event 10, makes obvious that Fabbriciani held a high degree of agency in setting the course of the collaboration in his initial choices of material to offer. In all of the tapes, Nono only occasional interjects, and usually to clarify exactly how Fabbriciani is making a particular sound. He does not micromanage or direct Fabbriciani on low-level details. The working process is that Nono collects the material explored by Fabbriciani, and later goes through the recording to select and develop the material he prefers.

What is striking in listening to these tapes, especially when considering that the Milan tapes precede the first Freiburg visit, is that there is already a substantial amount of material from the final published piece present throughout the early recording sessions. Fig. 23 shows a page from Fabbriciani's original

performance part, in Nono's handwriting, annotated with the dates and places of numerous performances until 1995. The extract in fig. 23 corresponds to the end of the second movement, the first statement from the bass flute. Fig. 24 shows the critical edition score of the same passage.

There are several remarkable observations to note in comparing these two sources, as well as the tape recordings of the early sessions. Firstly, all fingerings for the multiphonics have been removed from the final score. This is not fully explained in the score, but the assumption, which Bledsoe also makes, is that flautists must work out the fingerings for themselves to find the best sound, despite this being an intensely challenging task due to the individual nature of multiphonics and how they vary from instrument to instrument. Even if the argument could be made that the same fingerings produce different sounds on different instruments, in the author's own research on multiphonics,[102] it is clear in practice that both professional and student flautists benefit from a starting point i.e. from sharing a fingering to work with. From an initial given fingering, flautists can modify the fingering key by key to get the best result on their instrument. Without any prompt, the task to prepare the solo part becomes gargantuan, and this could be read as an effort on Fabbriciani's part, not denied in the author's interviews with Richard and Haas, that he wanted to retain a degree of exclusivity as the work's primary performer.

The next key insight in this analysis shows how parts of the final score contain elements from Nono and Fabbriciani's very first recording sessions together in Milan. In both figs. 23-24 we see a series of diaphanous multiphonics that morph between unpatched air and pitched tone sounds, with the occasional interruption from short bursts of loud tongue pizzicato without tone. This exact material at the same pitch level can be found in ALN NM 179.2.

[102] Nicholas Moroz & Taylor MacLennan (2020) Bass Flute Multiphonic Guide, https://explore-ensemble.com/bass-flute-multiphonics

Figure 23: Fabbriciani's part to 'Das atmende Klarsein' (ALN 45.19.05.3)

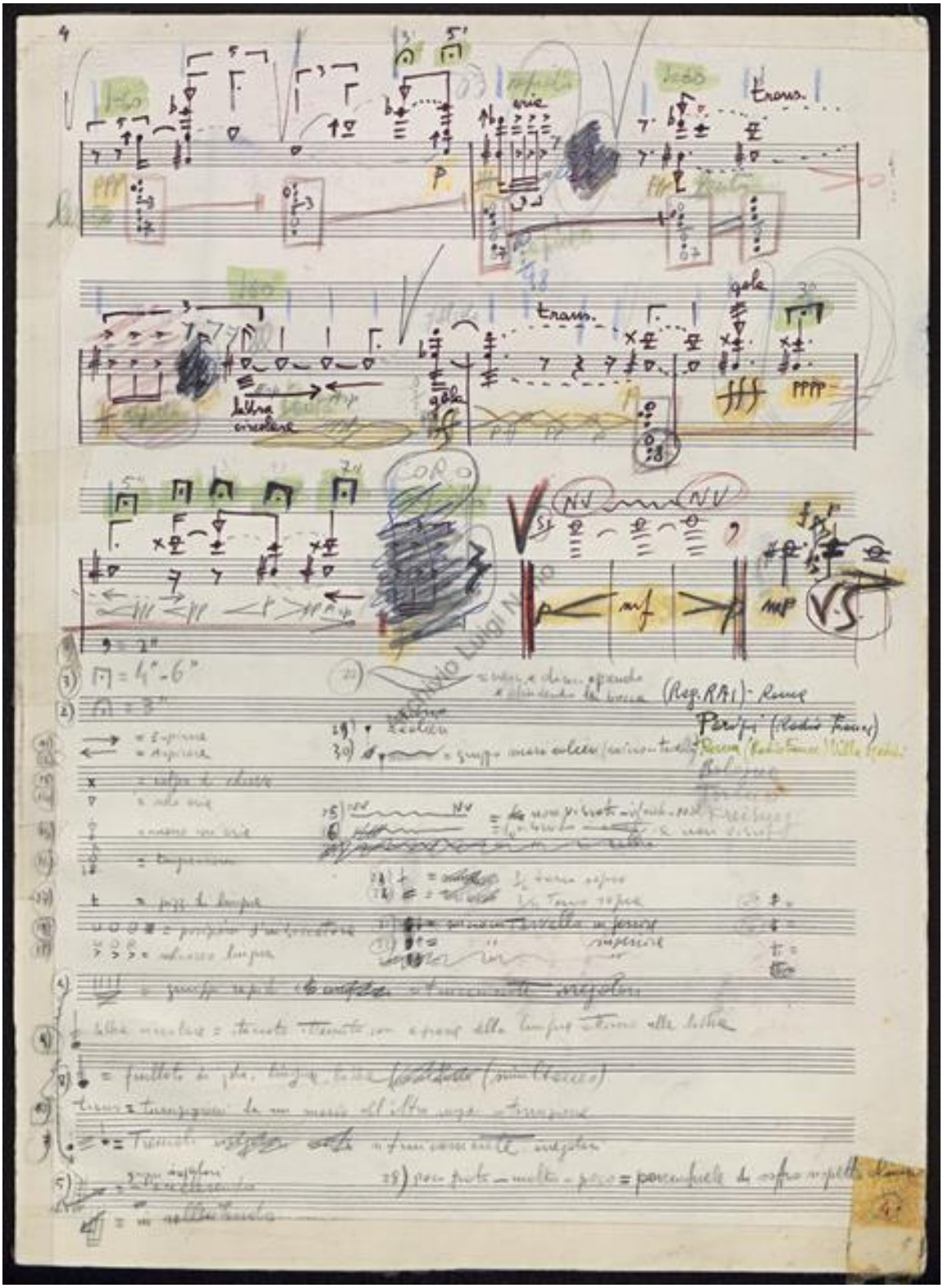
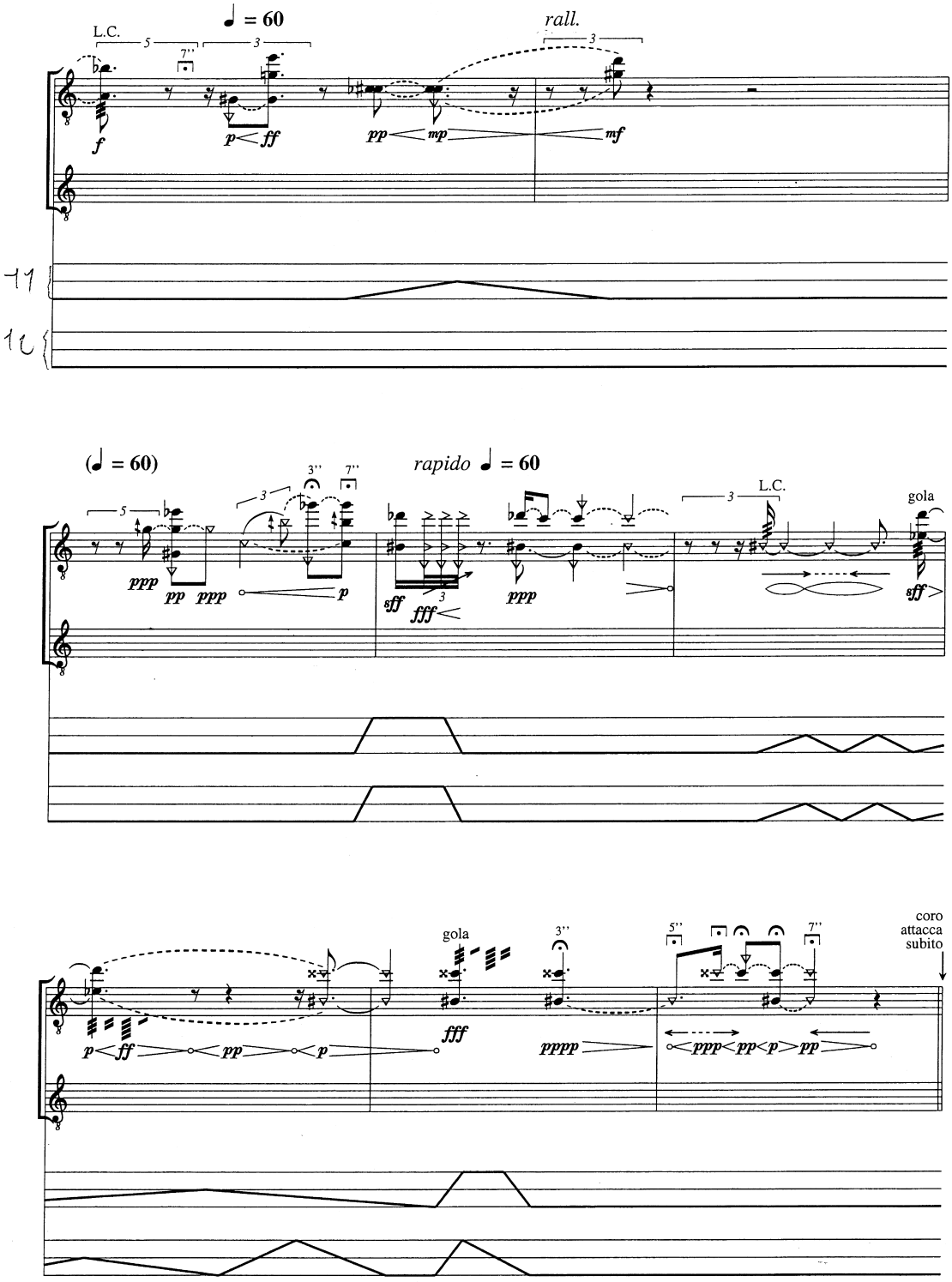


Figure 24: Score excerpt of 'Das atmende Klarsein' mvt.2 (© Ricordi Milano)



The comparative analysis of the workshop tapes, sketches, and score, provide the heretofore missing yet crucial material evidence that proves the nature of the actual interactions between Nono and his collaborators. Returning to Haller's notion of Nono's collaborators as being mere constructors of raw materials as discussed in chapter one, the analysis in this chapter shows a more complex situation at play: were it not for Fabbriciani's initial offerings of various bass flute materials, it is entirely plausible that Nono would not have composed *Das atmende Klarsein* in the manner in which we know it today. The manner in which Nono collected and then sorted through the vast array of recorded workshop material is much alike his process of working with field recordings and reportage used in his earlier tape works. The vital difference here is that the workshop tapes of Fabbriciani are artefacts of a living process of collaboration, and therefore not merely found objects of fixed meanings, but rather, a multiplicity of human and non-human actors: a musician with his own history of instrumental proclivities, and a flute with its own musical capabilities and character. The discussion of the improvised eighth movement in chapter four shows how the collaboration that brought the work to life was a continuous process right up to and including its performance. Does this mean that Fabbriciani is a co-composer or co-author? Examples from contemporary music can help shed light on how this question itself might be moot, since it is couched in the language of institutionalised role playing i.e. either the composer or the performer.

Collaboration in contemporary music has become a norm, particularly in the more experimental and electronic fields. This is also a byproduct of these genre's less strict division of labour between composer and performer, and between composition and improvisation. To just pick a few examples from 2023 in electronic and experimental music, we might consider Mark Fell & Will Gutherie's *Infoldings / Diffractions* 2023 release, pitting live generative electronic against drums and percussion improvisation; *Does Spring Hide Its Joy* by Kali Malone, Stephen O'Malley, and Lucy Railton, melding organ, electric guitar, and cello in an expansive drone world, and; Jennifer Walshe's and Jon Leidecker's ensemble and electronics work *MILLIONS OF EXPERIENCES (HUGE IF TRUE)*. In these cases, the composers *are* the performers, and the performance *is* the composition. While improvisation features

heavily in such works, we cannot treat improvisation as a reductive and catch-all term to supplant composition. As other have shown such as George Lewis and Benjamin Piekut, practices of improvisation cover a diverse range of practices and methodologies.[103] Furthermore, in the world of more score-centric composition, collaborations are becoming increasingly common, for example as with Cassandra Miller and Michael Finnissy's collection of piano pieces *Sinner, don't let this Harvest pass* (2014), Enno Poppe and Rebecca Saunders' 'joint composition' for violin and piano *Taste* (2022), and Mauro Lanza and Andrea Valle's huge cycle for ensemble and computer-controlled noise objects *Systema Naturæ* (2013-2017).

As this study's analysis of Nono and Fabbriciani's collaboration, the prevalence of improvised materials from Fabbriciani, a mutual interaction between both, as well as the powerful mediators of the live electronic instruments in further augmenting the sense of instrumentality, all point to a *decentering* of the composer, and a form of distributed creativity among both human and non-human subjects.[104] Writing of such interactions in relation to contemporary music for the Shakuhachi, Joseph Browning states that 'Composition creates composers, just as much as the other way around.'[105] Taking this idea further, we might say that instruments create compositions; the bass flute and live electronics have innate sounds and modes of playing that self-organise into certain musical materials and stylistic motifs. However, to take instruments seriously in this context, we require yet another framework by which to consider the topic of instrumentality in relation to Nono's work and the Experimentalstudio, and so the following chapter turns to this question by addressing the studio and its instruments' immanent capacities for certain aesthetic and sonic forms.

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[103] G.E. Lewis and B. Piekut (eds.), (2016). *The Oxford Handbook of Critical Improvisation Studies*

[104] E.F. Clarke and M. Doffman (eds.) (2016). *Distributed Creativity: Collaboration and Improvisation in Contemporary Music*

[105] J. Browning (2017). 'Mimesis stories: composing new nature music for the shakuhachi' , *Ethnomusicology Forum,* vol. 26:2

5. Instrumentality: Studio as Methodology

In examining the history of the evolution of the Experimentalstudio's distinctive technologies and musical practice prior to Nono's engagement, the concepts of liveness, interactivity, modularity, and spatialisation have helped to situate the Experimentalstudio within a range of contrasting strands of post-war modernism and experimental music, from the more familiar comparators of Stockhausen and Boulez, to new perspectives via cross-examinations with figures including Ghazala, Mumma, Tudor, Subotnik, and the GRM composers. In developing this chapter's historical, organological, and aesthetic survey of the studio, the concept of instrumentality as recently presented in critical organological studies provides a productive framework by which to consolidate many of the concepts and features discussed above, and to further identify unique aspects of the studio and its practice.

Writing for the New Instruments for Musical Expression (NiME) conference series, Hardjowirogo (2017) interrogates several historical definitions of instruments, from Hornbostel and Sachs (1914) and their organological definition of instruments as *sound generators*, while contrasting this with contemporary accounts of digital instruments, such as Malloch et al (2006), which conceptualise instruments according to a tripartite system comprising a *sound generator*, *control interface*, and *mapping*. Enders (1987) proposed a four-part system, adding to the above a subsystem for storing, recalling, and controlling sound, automation data, and presets. Looking more recently, beyond Hardjowirogo's survey, Snape & Born (2022) advance a more current account of the complex material and agential aspects of digital instruments through the example of the software platform Max. Their study reveals a need for yet another dimension to a putative definition of an instrument, because the machine systems (algorithmic or generative) of Max blur the boundaries between instrument and performer, and which provokes the question, to what extent is a Max patch performing or playing itself as an instrument? We might speculate how this additional fifth degree of the embedded *nonhuman agency* of a software instrument could be extended in the future to include AI systems, although this provokes yet further

questions in observing the boundaries between an algorithmic instrument (a Max patch) and a digital performer-agent or machine consciousness (Artificial General Intelligence), which go beyond the scope of this study.

Returning to the realm of existing technology, Hardjowirogo concludes that there is still no single satisfactory definition of a musical instrument, especially in the domain of contemporary digital systems. The usage, materiality, and socio-aesthetic affordances of different instruments will inevitably lead to mutable and dynamic definitions. Cann (2013) reflects this sentiment, emphasising that the potential actions and meanings embedded within objects define their instrumentality more so than any intended design: 'it appears that "instrument" does not actually refer to a device [...] but rather qualifies its interaction with users […].'[106] The concept of instrumentality, then, is a means to dissect and specify the complex and multifaceted dimension of an object's musical potential and its emergent features as distinct from its intended design, while also distinguishing it from other sound-producing objects such as a train, toaster, or toilet. Elaborating on the above five-fold list of instrumental qualities, Hardjowirogo outlines a 'provisional inventory' of the criteria of instrumentality:[107]

1) Sound production
2) Intention / Purpose
3) Learnability / Virtuosity
4) Playability / Control / Immediacy / Agency / Interaction
5) Expressivity /Effort / Corporeality
6) Immaterial features / Cultural Embeddedness
7) Audience Perception / Liveness

The following section unfolds the Experimentalstudio in its first Ausbaustufe according to the above criteria, and with the addition of an eighth: *non-human agency.*

[106] Cann (2013), 297.

[107] Hardjowirogo (2017) 17-21.

Sound Production

As the above analyses have shown, the studio produced sounds with a range of devices, however, the central feature of live electronics is its interdependence on live acoustic instruments or the human voice as an initial sound generator; the studio in Nono's practice used no synthesisers or other electronic sound generators which operated independently of an external acoustic input.[108] As such, this necessitates a definition of the studio as a multi or meta-instrument, since it both relies on the input of another instrument to produce sound, while consisting of multiple modules of electronic instruments which can be rerouted into innumerable combinations and signal chains. Furthermore, the studio relies on a particular performance space to shape the final sound of the performance. This aspect would be fully realised with Nono's late works, where speakers, reverb times, and spatialisation processes were tweaked in response to particular acoustics, in order to create the best version of the intended spatial effect (depth, movement, clarity/dryness, saturation/wetness). As Nono stated 'The music I'm looking for is written with the space: it is never the same in every space, but instead works with it'.[109]

We can further delineate the studio's organological modes of sound production reread as sound transformation (*Klangumformung*) as follows: timbral, temporal, and spatial. The ring modulator, HTK 4, filter banks (and later, vocoders and harmonisers) all transformed the timbre of an input signal in realtime. The delays, and perhaps to a lesser extent the Halaphone, transformed the temporal dimension of an input sound and/or treatments by other timbral modification devices. The Halaphone transformed the spatial dimension of an input sound and/or other treatments. The crux of the Experimentalstudio's sound production as an ensemble of electronic instruments is this three-fold dimensionality of acoustic and electronic sound manipulation, with the loudspeakers being the final

[108] The studio did have an ARP synthesiser, but Nono never used it.

[109] Nono (1983/2018), 368.

instruments responsible for rendering, colouring, and diffusing the mixture of treated and untreated acoustic and electronic sounds. Furthermore, the studio's modularity, afforded by the Koppelfeld, enabled the dynamic interplay of these three different dimensions depending on the variable programming of combinations between inputs, processes, and spatialisation routines.

The multifaceted experience of sound transformation through live electronics is specifically what enabled musicians, composers, technicians, and audiences to register the studio's instruments as cohering together to form technical ensembles (Simondon 2017). Nonetheless, As the studio's worked progressed, live electronics were not simply a case of demonstrably showcasing obvious processes or sound modules, for example as it was more so initially with *Mantra* and ring modulation, but rather, it evolved its own aesthetic and compositional practice that blends, superimposes, and confuses both acoustic and processed sounds, as exemplified with Nono's concept of *suono mobile*, which emerged in the creation of *Prometeo*. Unlike synthesisers, drum machines, or samplers, the live electronic instruments of the studio and the connected musical affordances from the sonic and agential fusions of musician, technology, and performance space, destabilise what Simondon identifies as the 'three types of reality: the world, the subject and the object, which is an intermediary between the world and the subject, the primary form of which is the technical object.'[110]

Intention / Purpose

It is self-evident that the studio's foundation is the result of specific socio-cultural conditions, namely, its embedding within a state institution of the SWF, and its entanglements in a wider cultural milieu of postwar European modernism. To this end, the studio's instruments were created initially as solutions to pre-existing plans determined by people and institutions either part of or related to the SWF, such as Strobel and the Donaueschingen Festival, as with Stockhausen's *Mantra*. The elaboration of the studio's instruments continued as an example of highly intentional instrument design that responded to specific

[110] Simondon (2017), 417.

compositional propositions. With the formation of the first Ausbaustufe, the instrumentation of the studio was somewhat fixed, though capable of a multitude of combinations and artistic purposes. A shift occurred between the initial practice of in the early 1970s, from developing entirely new devices, to refining existing ones, such as the Halaphone, with its three generations shown in figs. 3, 4, & 5. This shift in the technocultural practice of the studio from inventing to refining also saw the addition of commercially available instruments and devices to its formation, for example, the Publison DHM 89 B2 shown in fig. 26, as realtime digital harmoniser, which would prove important in Nono's works of the 1980s.[111]

Figure 26: Publison DHM 89 B2

The studio's instruments are, therefore, highly 'scripted' (Akrich 1992) or have 'locked in' (Lanier 2010) musical intentions and functions, as this chapter has elucidated. This aspect of deliberate engineering at the core of the studio further allies it to more institutionalised forms of modernism such as the WDR Studio, GRM, and later IRCAM, and in contrast to less formalised and more DIY practices of artists including Mumma's cybersonics, or a number of sound art focused composers and artists such as Alvin Lucier or Maryanne Amacher from the periods of the 1970s and 1980s (Ghazala 2005; Collins 2009; Rodgers 2010: 147–48; Pinch 2016).

[111] Archival photo from Experimentalstudio's Virtual Studio Tour.

Despite the *intentional design* of the studio's instruments, as Nono makes clear, accidents, errors, and even a sense of play were still a major part of working at the studio, and a vital part, in his view, behind their deep historical significance in the development of music:

> It is not quite true that whatever you choose is the one and only correct option; perhaps what you did not choose is more correct. In the work in the studio, in electronic music, this is what happens. There are many unforeseen events, issues, errors—errors that are of great importance, as Wittgenstein has theorised.
>
> Because error is what happens and breaks the rules.
> Transgression.
> What goes against the established institution.
> […]
> Diversity of musical thought.
> Not musical formulas, rules, or games.
> A musical thought which transforms the thinking of musicians,
> rather than providing them with a new skill that allows them to make the so-called music of today, a skill that can be applied like formulas.[112]

This ludic yet critical embrace of material contingency — stuff not working and doing something unexpected — is an index of the studio's defining feature of liveness, as well as a reflection of Nono's constant search for renewal, and new ways to connect with audiences and musicians.

Learnability / Virtuosity

A core part of the studio's methodology was the interaction between the composer, technician (or Klangregisseur), and musician in the introduction and workshopping of the studio's instruments. The studio's novel technology and performance practice had to be introduced and demonstrated to the composer by a technician; a composer couldn't 'pick up and play' any of the studio's instruments like a synth or drum machine. In this sense, the Experimentalstudio quickly created its own forms of institutional knowledge and practice embedded in the technology, retained among its staff by memory,

[112] Nono (1983/2018), 368.

transmitted orally, and through the new forms of documentation as in the programme schemes and performance layout diagrams.

In the Experimentalstudio's concerts, audiences were supposed to watch the musicians on stage or simply to listen, and not watch the technicians at the sound desk. As such, a conventional notion of virtuosity might seem inappropriate for the studio's instruments, since they and their operators are not meant to be viewed, nor are the operators exerting much physical effort. In performance, the Klangreggiseur and technicians would principally occupy themselves with three tasks: mixing, reprogramming, and score-following. The studio continues this tripartite setup of performance roles to this day, as witnessed by the author in a number of performance. The number of people at the sound desk can vary between one and five or more depending on the complexity of the production. Digital technology has enabled these three roles to be reconciled into one person in less complex and demanding cases.[113]

The virtuosity of the Experimentalstudio in performance is, then, more akin to Cohen's notion of a virtuosity that exhibits 'something difficult done without apparent effort.'[114] Despite appearances, the haptic control of faders, programme controllers, even turning of the score pages, combined with the auditory skill of listening to the global live picture of raw and processed sound, and the continuous adaptation of these layers and their interplay, are all highly specialised roles that require many hours of training and real world performance experience, just like other conventional acoustic instruments.

Playability / Control / Immediacy / Agency / Interaction

The actual playability of the studio is described above in relation to virtuosity and learnability. We can further identify a distinguishing and somewhat ironic feature of the studio, that despite their focus on

[113] Concert with Explore Ensemble, Lotte Betts-Dean, and Experimentalstudio Freiburg on 8 December 2023 at ZKM Karlsruhe.

[114] Cohen (2008), 58.

liveness, and therefore, a notion of immediacy and interaction in performance, the reality of their practice and methodology was rather slow, incremental, and highly distributed in time, across instruments (acoustic and electronic), and between people. The materiality and playability of the studio's instrument could not be easily grasped by a single person like a violin or piano. While the studio lacks the immediacy of playability compared to, for example, a Jimi Hendrix style setup of electric guitar, distortion pedal, amp, and wah-wah pedal, the studio enjoys other features that distinguishes its unique musical capabilities, notably, it is inherently *collaborative* and *distributed* between human and non-human actors.

Expressivity / Effort / Corporeality

In some senses, the emphasis of both haptic and auditory control (listening, responding, fading, playing) is somewhat conventional in terms of existing repertoires of kinaesthetics and behaviours one would expect from an orchestral musician or expert operator of a machine. Less conventional and more unique are the inconspicuous physical and mental efforts of the sound technicians, and the lack of corporeality or direct interaction with the electronic instruments, when, in concert, they are not touched live, but rather, controlled remotely via the Koppelfeld and mixing desk. The exception being the mixing desk and matrix programme controller.

Taking this point of overt vs. covert skills further, we can observe a recurring trope in the projects of the Experimentalstudio: the confusion of acoustic and electronic sound. In Boulez's early version of *explosante-fixe*, and later in the case of Nono's *Das atmende Klarsein*, composers commonly pursued the effect of blurring the distinction between acoustic and electronic sound with the Experimentalstudio's instruments. Before the performance of *A Pierre*, Fabbriciani reports that Nono gave him the direction 'non si deve capire niente!' (You shouldn't understand anything!), reflecting the fact the he made the

acoustic instrumentalists hold their instruments to their mouths throughout the piece, even when they were not playing, to confuse the audience's ability to distinguish raw from processed sound.[115]

How can a notion such as musical expression figure in such a system where the very distinctions between instruments and human are undermined? It is precisely in the entanglement of the many layers of distributed human and nonhuman components in the studio's practice that make it a strikingly original example of early live electronic music. As is shown in the case study of *Das atmende Klarsein*, the technology of the studio augmented and in some cases subverted conventional notions of instrumental expressivity to the point of an entirely new mode of expression, revealing the historical importance of this *sui generis* phenomenology of live electronic music. This new mode of expression in the Experimentalstudio's work is arguably best represented in Nono's late works, and in his concept of *suono mobile*, a conceptualisation of sound as continuously fluctuating multidimensional field of sonic and affective possibilities which engulfs the audience both literally and figuratively.

An under-examined aspect of Nono's late music and the Experimentalstudio's work is the type of corporeality that they emphasise. It is clear that their music can be experienced simultaneously at many different spatial scales, from the tiny quivering reed of a contrabass clarinet or micro movements of a violin bow, to the entire instrument body, the tendril-like microphones that ensnare it, the body of the performer and those of the sound directors, the electronic instruments, and the architecture of the performing space. As such, a performance with the Experimentalstudio renders the various implicated bodies as sites in and of themselves, while also fusing them into a multi-site or multi-body entity that still maintains the material autonomies of each contributing component e.g. the unique visual and acoustic aspects of a performance venue. In this confusion and reconfiguration of such different spatial scales and corporeal entities — human and non-human — a useful comparison arises in light of cyborg aesthetics.

[115] Zattra et al (2011), 433.

Donnarumma (2017) argues that we must move beyond the concept *bodily extension*, and instead focus on a notion of *bodily incorporation*. Referring to 'technological bodies' after Haraway (1985) and Schilling (2005), he outlines a critical aesthetics of amalgamated bodies that hybridise organic and technological matter while challenging normative socio-cultural definitions of cyborgism as inherently 'monstrous' and 'unnatural'. It seems entirely plausible and illuminating to extend his description of *inhabiting technological bodies* to the work of the Experimentalstudio. However, where Donnarumma literally embodies techno-organic hybrids in his work, with the work of the studio, the boundaries between bodies are always maintained on a physical level. Nonetheless, on an aesthetic and performative level, we can argue that the performers indeed contribute to the embodiment of a multi-articulated sonic body that the audience and performance co-inhabit, and one which is constituted by acoustic and electronic sound which act in co-dependence. This reading of the studio via cyborg aesthetics helps to re-contextualise or de-essentialise the received historical position of the studio, for in this case, we view their work as belonging to a broader continuum of artists working with post-industrial technology that extend from live electronics to cyborg performance artists, and not only to post-war musical modernism.

Immaterial features / Cultural Embeddedness

The above section on 'Intention / Purpose' emphasises the Experimentalstudio's position within a specific socio-cultural milieu and historical lineage of postwar European modernism. Of most significance to Nono, and what has arguably been overlooked in previous scholarship, is the point that the entanglement of technology of aesthetics which formed the studio's first decade led to the emergence of a micro-sociality in the studio; a practice of collaboration and open-ended experimentation, driven by reflexive exchanges between new instrument design and compositional forms. As detailed in chapters 3, 4, and 5.1, Nono embraced an intensely collaborative practice in his work since the turn of the 1960s and his turn towards theatre and politics, bolstered by his use of electronics and tape. Nonetheless, it was not simply Nono who brought this collaborative practice to

the studio upon his arrival at the turn of the 1980s, rather, both he and the studio already possessed such features. Moreover, the unique practice of the studio as detailed in this chapter proved to be vitally transformative for Nono after a period of protracted crisis. Indeed, as chapter two has shown, the studio's work pre-empts many aspects of Nono's complicated aesthetics, especially spatiality, and this must be understood as a major contributing factor to the long-lasting success of their partnership.

Audience Perception / Liveness

The aspect of audience perception suffers substantial under-theorisation in existing studies on Nono and the Experimentalstudio, which reflects a broader trend in musicology that overlooks the place of audience perception in contemporary instrument design. Nonetheless, as this study has detailed, liveness sits as a core aesthetic ideal and technical methodology within the studio's practice. Emerson & Egerman (2017) demonstrate the importance of transparent mappings for an audience's comprehension of instrumentality in the context of digital music instruments. Nonetheless, as explained above, the mappings of physical movements to audible sound in the Experimentalstudio's practice, both by the acoustic and electronic instrumentalist, are not always self-evident, and are sometimes deliberately obscured.

We can extend the concept of mappings from the domain of physical movement and effort to harmony as in the case of the ring modulator in *Mantra*, where the harmonic outcomes of piano input signal and modulating signal, the former existing as both a tempered structure and natural/complex timbre, and the latter as a non-tempered and artificial/simple sine-wave timbre. Unless one plays piano notes which form consonant relationships with the modulating frequency, the results of ring modulation can produce highly dissonant and unpredictable harmonic sounds, including sub-bass tones, or shrill metallic high frequencies. Furthermore, and linking back to the notion of physical movement as originally discussed in Emerson & Egerman, ring modulation can distort melodic shapes of the input

piano signal. An ascending piano scale can produce a descending or randomised series of sidebands; the mapping between the register and melodic shape of the piano material is not mirrored.

Since Stockhausen employed an atonal pitch formula, and as the pianos' pitch material for the entire piece lack hierarchal tonal centres (in the broadest sense of the term) which might align with the modulating tone, we can say that Stockhausen's used mappings that deliberately emphasised the transformative power of ring modulation, augmenting the pianos' intrinsic temperedness with unpredictable electronic sidebands. The same type of utilisation of ring modulation holds true in Boulez's *explosante-fixe*; ring modulation electrically augmented the timbres of the acoustic instruments, but, due to the nature of the process, the audience's perception, ability to predict or map the instrumentality of the device with the performed sounds of the acoustic instruments was unattainable. This unpredictability and inscrutable dimension of ring modulation is, arguably, constitutive of its associations with sci-fi in popular culture, and to an aesthetics of technological otherness in postwar modernist music.

5. Conclusions

This study has developed a new critical framework to help disentangled the distinctive aesthetic, technical, and collaborative aspects of the work of Luigi Nono and the SWR Experimentalstudio at the turn of the 1980s. As a corrective to the now demonstrably problematic omissions of the Experimentalstudio in existing English-language musicology, chapter two's new historiographical account of the studio, critical organological analyses of its instruments, underlying concepts, and working methodologies clarifies the studio's historical significance in the context of twentieth century modernism and electronic music. Moreover, chapter two reveals how numerous facets of the studio's practice would later prove entirely concurrent and axiomatic with Nono's shifting thinking throughout the 1970s, as detailed in the survey of his crises and transitional works in chapter three. Thus, chapters two and three present the pre-histories of Nono and the studio as a means to explain the power of their collaboration through their compatibility.

Chapters four and five investigate this shared practice through an analysis of *Das atmende Klarsein*, the first work Nono composed with the Experimentalstudio. Chapter five offers a new analytical method through the critical comparative analysis of workshop recording tapes with sketches and the final score. This work has elaborated in material terms the dynamics of the shifting network of composer, musicians, technicians, architectural spaces, landscapes, poetry, and acoustic and electronic instruments, which all drove the development of Nono's late works. In the face of the tensions which surround the contributions of Nono's collaborators both historically and in some cases still in the present day, an ANT-tinged methodology enables us to ally issues of interpersonal discord and ego, by elevating both human and nonhuman actors as potential objects of study. Chapter four also forwards several novel aesthetic and historiographical interpretations of Nono and his concept of 'suono mobile' via comparisons with present day electronic music practitioners. Thus, chapter four puts forward a flexible and responsive framework that moves between temporal, spatial, technological, and cultural scales as a means to overcome the problem of disagreements among the original collaborators.

The principal aim of this study is one of illumination. Nono's late works and the creative practices with the Experimentalstudio are complex and dynamic, and for the same reason, the true richness of their shared work is difficult to grasp without a more holistic understanding of collaboration between people and instruments. In presenting the early history of the studio, and the first work Nono created there, this study provides the foundation for further research concerning the rest of Nono's late period. Further work could address the three distinctive phases in Nono's music following 1980s: the already described 'verso Prometeo' period from 1980-1984, Prometeo itself, a post Prometeo period from 1986-1988, and the works throughout the 1980s which turned away from the centrality of the score, towards improvisation, but which the committee for publishing Nono's works refused to release. As this study has shown, a 'new materialist' approach that embraces the agency of objects both physical and discursive, as well as human, can help to unpick the vast entanglements that constitute Nono's late works, and in doing so, help establish new perspectives on the historiographical, compositional, aesthetic, and instrumental dimensions of this elusive yet ever wandering, yearning, and utopian music.

In the present day, when new music technology and the wider ascendancy of AI in neoliberal socio-economic forms poses both a constant threat and opportunity to communities of creators, performerss, and listeners alike, this dissertation presents a modest toolbox to explore human and technological interactions. In their inseparability from contemporary neoliberalism and big tech capitalism, today's digital and AI technologies are undoubtably far more inscrutable than those of the Experimentalstudio at the turn of the 1980s, from Spotify or YouTube's recommendation algorithms, to the ethics of harvesting data in the training of generative models for text, music, and images, such as with OpenAI's ChatGPT or Uido's text-prompt to music generator. Leading voices in music today such as Holly Herndon, Marco Donnarumma, Jennifer Walshe, Mark Fell, and George Lewis, among others, all advocate in different ways for a critically-orientated and more hopeful approach to technology. Nonetheless, as this study has shown, the methodological ramifications of the complexity of comparatively simpler techno-musical practices, let alone the impact they have on their participants

and listeners, is an inherently intractable and ever changing knot. The discussions and solutions that Nono's music has provoked here point to new approaches that can help to untangle the powerful mediatory effects of technology, and stand as a reminder for the contemporary reader, in the spirit of Nono and his convoluted communist politics: a moral for why we should never underestimate the agency of instruments and the nonhuman in music and contemporary society, lest we risk forever being locked out of Silicon Valley's black boxes, and stuck in a regime of globalised capitalist techno-feudalism.

6. Appendix: Analyses of Archival Tapes

ALN 179.1

Event	Time	Content	
1	00:12	LN: [inaudible] RF: aria intonata un po' aerofona, e molto diffusa dallo strumento	LN: [inaudible] RF: tuned air a little aerophonic, and very diffused by the instrument
2	00:24	Fast descending scalic passages over ca. the lower octave, with very airy tone, sometimes with flutter tongue	
3	00:48	Very airy medium-paced melodic arcs of 5-6 notes in upper middle register, wave like dynamics, sometimes with a single loud percussive consonant attack at the peak dynamic. Flutter tongue towards the end.	
4	01:40	Loud percussive attacks followed by very soft air tones, played in fast succession over several low register notes. Use of loud key clicks in combination with tongue ram and percussive consonant attacks.	
5	02:32	LN: [inaudible]	
6	02:41	Several multiphonics played slowly in succession, occasional use of trill keys, flutter tongue, and voice	
7	04:01	RF: suono che diventa aria e ritorna suono	RF: sound that becomes air and returns to sound
8	04:07	As described by RF, playing notes in the lower register, individually, then slowly melodically, with varying degrees of vibrato	
9	04:47	Return to material in event 6	
10	05:22	LN: fa tu quello che vuoi e di' sempre quello che fai RF: Si, e suono con voce? LN: [inaudible] RF: come quando canto…	LN: **do what you want and always say what you do** RF: Yes, and do I play with my voice? LN: [inaudible] RF: like when I sing…
11	05:48	Numerous multiphonics with voice	
12	06:39	Low notes with airy tones plus whistling, some with percussive key click tremolo	
13	07:08	Growl sound: flutter tongue while covering the sound hole with the mouth over a descending chromatic scale, later with the voice	
14	07:31	Singing through the instrument while covering the sound hole with the mouth and making key clicks	
15	08:04	Jet whistle tones across fast chromatic scales;	
16	08:11	Breathy aggressive attacks over a rapid alternation between descending scales and multiphonics	
17	08:19	Like in event 14, covering the sound hole with the mouth, singing descending scale + flutter tongue + descending fingered scale	
18	08:31	RF: frullato di labbra	RF: fluttering of the lips
19	08:36	Blowing a raspberry' type fluttering of the lips over low register melodic fragments	
20	09:03	RF: di gola	RF: [fluttering] of the throat
21	09:06	Chromatic scales with throat growl	
21	09:15	RF: di gola lingua e labbra insieme	RF: [fluttering] throat tongue and lips together
22	9:19	As described, with a loud dynamic and some percussive attacks	

ALN 179.2

Event	Time	Content	
1	09:36	Individual and multiphonics played slowly and loudly, some with vibrato, some without, one with timbral trill	
2	11:54	RF: pizzicato di lingua	RF: tongue pizzicato
3	11:59	Fast succession of short chromatic notes with tongue pizzicato	
4	12:10	RF: pizzicato di lingua e di chiave insieme	RF: pizzicato of tongue and key together
5	12:14	Double note' effect combining attacks of the tongue and key click, together or slightly delayed	
6	12:24	RF: pizzicato di labbra … percussioni sole	RF: lip pizzicato … only the percussion
7	12:50	Tongue rams without blocking the sound hole	
8	12:58	LN: cosa vuol dire 'sole', scusa? RF: senza emettere nessun fiato	LN: sorry, what does 'solo' mean? RF: without using any air/breath
9	13:06	More tongue rams in medium and then quick succession	
10	13:26	RF: con bloccaggio di lingua	RF: with the tongue blocking [the sound hole]
11	13:29	More tongue rams with the sound hole blocked in quick succession, chromatically	
12	13:55	RF: percussioni con sola aria emessa	RF: percussion with only air emitted
13	14:03	Lip percussion attack with airy tone in low register	
14	14:19	RF: con clic di lingua	RF: with a tongue click
15	14:21	More percussive notes with tongue clicks	
16	14:42	RF: con aria aspirata	RF: with aspirated air
17	14:47	Slow middle-register melody with very airy tone	
18	15:12	LN: [inaudible, probably asking for more precise descriptions] RF: alcune scale semitonate, normali e con pizzicati di lingua... sola percussione... misto, insomma.	LN: [inaudible, probably asking for more precise descriptions] RF: some semitone scales, normal and with tongue pizzicatos... only percussion... mixed, in short.
19	15:38	Chromatic scale over two octaves, fast; then with short percussive attacks; then with flutter tongue, then with flutter tongue covering the sound hole, then while whistling with the lips	

ALN 179.3

Event	Time	Content	
1	16:49	RF: alcuni bicordi e accordi	RF: some dyads and multiphonics
2	16:55	Several multiphonics played in succession, later with trill keys and flutter tongue	
3	18:54	RF: pizzicati di chiave, ossia colpi di chiave	RF: RF: key click pizzicati, or key strokes
4	19:04	Short notes with key clicks	
5	19:25	LN: [inaudible] RF: no, solo chiave. Adesso, Io faccio con chiavi e colpo di lingua, senza suono	LN: [inaudible] RF: no, just [with the] key. Now, I do it with keys and tongue stroke, without sound
6	19:42	Double-attack type note with key click and percussive tongue attack	
7	19:54	RF: con clic di lingua	RF: with tongue click
8	19:58	Similar chromatic runs with tongue clicks	
9	20:13	RF: con aria	RF: with air
10	20:19	Similar short chromatic runs with percussive attacks and some airy tone	
11	20:25	RF: con suono	RF: with sound [breath tone]
12	20:27	Similar short chromatic runs with percussive attacks and a clearer normal tone	
13	20:33	RF: cercando di legare il più possibile tra loro	RF: [I'm] trying to tie them together as much as possible
14	20:36	Rising chromatic scale with percussive attacks and full tone, more legato, then with whistling	
15	21:38	RF: questa era la transizione tra suono-aria, con o senza fischio; anzi ne ripeto alcuni adesso…	RF: this was the transition between sound-air, with or without whistling; indeed, I'll repeat some of them now…
16	21:52	Sustained low tone shifting between full tone, air, and whistling	
17	22:18	RF: con vari tipi di vibrato	RF: with various types of vibrato
18	22:22	Sustained shifting tone with various vibrato speeds	
19	22:38	RF: con portamento	RF: with portamento
20	22:41	Sustained shifting tone with slow microtonal portamento inflection, later with multiphonics	
21	23:38	RF: micro toni	RF: microtones
22	22:42	Normal tone with irregular vibrato across microtonal notes, transitioning into timbral trills	
23	24:24	RF: cantato dentro lo strumento†	RF: singing into the instrument
24	24:32	Chromatic scale with sound hole covered by mouth, and with flutter tongue, low register	
25	24:46	Higher register singing into the flute with timbral trills	
26	25:07	LN: facevi frullato oppure veniva così? RF: no era una sillaba "trrrr" a mo' di trattore che si può cantare in varia estensione	LN: did you make it flutter or did it come out like this? RF: no it was a tractor-like syllable "grrr" that can be sung in various ranges
27	25:43	Quiet tongue rams, chromatic scale at various speeds	
28	26:09	RF: questo è un bloccaggio... praticamente un rumore di lingua: bloccaggio del foro	RF: This is a blockage... basically a tongue noise: blocking the hole

ALN 172

This tape contains several splice points containing different experiments with flute and live electronics, predominantly with ring modulation. While the flute explores materials relate to *Das atmende Klarsein*, the electronics explored here are not taken forward in the final work: ring modulation, harmoniser with feedback, voice modulating

Event	Time	Content
1	00:04	Bass flute with ring modulation: slow sustained tones and medium paced melodies
2	00:45	Bass flute with ring modulation: airy melodies, slow and fast
3	00:59	Bass flute with ring modulation: percussive sounds in rapid succession
4	1:14	Bass flute with ring modulation: erratic loud notes legato in quick succession, some with airy tone, some with voice
5	2:34	Bass flute with ring modulation: low and quiet tone, slow legato melodies, altering vibrato, flutter tongue, and airy tone later on
6	4:36	Bass flute with ring modulation: melody with voice, percussive attack
7	4:42	Bass flute with ring modulation: upper register melody
8	4:47	Bass flute with ring modulation: upper register short percussive attacks, later some flutter tongue
9	5:30	Bass flute with ring modulation: fast chromatic scale, low register, exhaling through covered sound hole
10	5:44	Bass flute with ring modulation: airy sustained sounds, then very short key clicks and lip sounds
11	7:22	Bass flute with ring modulation: slow melodic phrases, legato, moving from low to high register
12	8:00	Bass flute with ring modulation: aggressive airy tones and flutter tongues,
13	8:28	Bass flute with ring modulation: short stuttering notes in rapid succession - a second tape part possibly being played in background
14	8:50	Bass flute with ring modulation: loud aggressive notes with portamento, moving to high register
15	10:08	Bass flute with ring modulation: slow low melody, narrower bandpass filter on output

ALN 172.2

Event	Time	Content
1	00:04	Bass flute with ring modulation: slow sustained tones and medium paced melodies
2	00:45	Bass flute with ring modulation: airy melodies, slow and fast
3	00:59	Bass flute with ring modulation: percussive sounds in rapid succession
4	1:14	Bass flute with ring modulation: erratic loud notes legato in quick succession, some with airy tone, some with voice
5	2:34	Bass flute with ring modulation: low and quiet tone, slow legato melodies, altering vibrato, flutter tongue, and airy tone later on
6	4:36	Bass flute with ring modulation: melody with voice, percussive attack
7	4:42	Bass flute with ring modulation: upper register melody

8	4:47	Bass flute with ring modulation: upper register short percussive attacks, later some flutter tongue
9	5:30	Bass flute with ring modulation: fast chromatic scale, low register, exhaling through covered sound hole
10	5:44	Bass flute with ring modulation: airy sustained sounds, then very short key clicks and lip sounds
11	7:22	Bass flute with ring modulation: slow melodic phrases, legato, moving from low to high register
12	8:00	Bass flute with ring modulation: aggressive airy tones and flutter tongues,
13	8:28	Bass flute with ring modulation: short stuttering notes in rapid succession - a second tape part possibly being played in background
14	8:50	Bass flute with ring modulation: loud aggressive notes with portamento, moving to high register
15	10:08	Bass flute with ring modulation: slow low melody, narrower bandpass filter on output
16	13:12	Bass flute with harmoniser: slow meandering melody. Harmoniser feedback effect audible in successive rising major third echoes
17	13:59	Bass flute with harmoniser: slow melodic tones. Harmoniser feedback effect with falling major second echoes
18	14:30	Bass flute with harmoniser: short percussive notes with harmoniser feedback effect, rising minor third echoes
19	14:50	Bass flute with harmoniser: slow melodies, upper register, harmoniser feedback effect, rising major third echoes

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